BUREAU OF FISHERIES

REPORT

OF THE

UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1921

WITH

APPENDIXES

HUGH M. SMITH
Commissioner

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

CONTENTS.

ERRATA.

Appendix IV.—Page 6, 3d line from bottom: *33.9* should read *32.9*.
Page 8, 5th line under *Station 17: 56* should read *51*.

Appendix V.—Pages 151 and 152: Superior reference figures should be changed as follows—under *Washington*, *1* in first line of figures should read *2*, and *2* following *Canned sardines* should read *1;* in footnotes, *1* should read *2* and *2* should read *1*.

Appendix VI.—Page 93, 3d line from bottom: *3* should read *2*.

Appendix VIII.—Page 16, 9th line under *Pacific herring:* after *in* insert *January and February and off Baranoff Island in*.

REPORT OF THE
UNITED STATES COMMISSIONER OF FISHERIES
FOR THE FISCAL YEAR ENDED
JUNE 30, 1921

BUREAU OF FISHERIES.

HEADQUARTERS STAFF, 1920-21.

Commissioner,

HUGH M. SMITH.

Deputy Commissioner.—H. F. MOORE.
Assistants in Charge of Divisions:
Office.—IRVING H. DUNLAP.
Fish Culture.—GLEN C. LEACH.
Inquiry Respecting Food Fishes.—ROBERT E. COKER.
Fishery Industries.—LEWIS RADCLIFFE.
Alaska Service.—WARD T. BOWER.
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Accountant.—CHARLES W. SCUDDER.
Superintendent Central Station and Aquaria.—L. G. HARRON.

Bureau of Fisheries Document No. 900.

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REPORT

OF THE

COMMISSIONER OF FISHERIES.

Department of Commerce,
Bureau of Fisheries,
Washington, September 15, 1921.

Sir: I have the honor to present herewith a report giving a résumé of the operations of the Bureau of Fisheries during the fiscal year ending June 30, 1921. The major captions under which the activities are considered are inquiry respecting food fishes and fishing grounds, propagation and distribution of food fishes, artificial propagation of fresh-water mussels, relations with the fishery industries, Alaska fisheries service, Alaska fur-seal service, and miscellaneous administrative functions.

INQUIRY RESPECTING FOOD FISHES AND FISHING GROUNDS.

IMPORTANCE OF THE SERVICE.

The resources of the fresh and salt waters of the United States constitute great national assets as the means of livelihood of large numbers of people, as the basis of important industries, and as a conspicuous source of food. It is toward the manifold problems relating to the perpetuation of the supply of raw materials that the activities of the Bureau in biological investigation and experimentation are chiefly directed. It would be a shortsighted National or State policy that allowed the fishery resources to decline indefinitely or that failed to lay the basis of definite and exact knowledge necessary for their maintenance and increase.

Notwithstanding the importance of this matter, the Bureau's activities in this field have been seriously restricted, and at times altogether suspended in certain lines, by the low and inflexible salary scale which prevents the maintenance of a full staff of trained investigators. Under existing conditions some positions can not be filled, while in others assistants are retained for only brief periods. A further handicap is that promotions necessary to retain the services of a competent employee can often be made only by a transfer and change of duty from a field in which the employee has acquired skill to another in which he must have further experience before he can be expected to render service in proportion to his general ability. These and other disadvantageous conditions can readily be remedied by congressional action allowing the Secretary of Commerce to arrange salaries, within reasonable limits, with reference to the efficiency of employees rather than to the titles of positions. The entire subject of salary readjustment has been thoroughly studied in connection with the reclassification of Government employees, and a comprehensive and adequate salary schedule has been worked out by various competent agencies. It is hoped that all the time and thought devoted to the rectification of a chronic defect in the civil service may not terminate in mere discussion.

STUDIES OF FISHES.

General investigation of the life history of the chinook salmon, special studies of the salmons of Alaska, and an inquiry into the injurious practice of taking immature salmon by trolling and seining off the mouths of Pacific rivers have been continued. It has been determined in the last-named investigation that in the early part of the season nearly three-fourths of the salmon taken are immature, although later these fish constitute only a small proportion of the total catch. Relatively few immature salmon are taken at the mouth of the Columbia River, but a very considerable percentage of the chinook salmon obtained by trolling in Monterey Bay are not prospective spawners of the year. The facts ascertained obviously call for appropriate regulatory measures, for the killing of immature salmon is both economically and biologically wasteful. In the evident belief that the matter can not be fully handled by the several States, the United States Senate has passed a resolution requesting the President to negotiate such treaty or treaties as may be needed to secure to the salmon of the Pacific Ocean off the coasts of the United States and Canada protection from unnecessary destruction through wasteful practices, devices, and methods of capture. During the 1920 season there were taken on their return to the Columbia River a number of salmon that had been marked at the time of their planting several years previously. Although the number of marked fish recovered was limited, their study has afforded a basis for inferences on both the natural history of the salmon and the value of fish-cultural practices.

The study of the whitefishes and their relatives of the Great Lakes, which had previously been conducted on Lake Huron, was extended to Lakes Michigan and Ontario, and substantial progress was made. As soon as the necessary field work in other lakes can be completed a report of the results will be given out. The investigation takes account of species, distribution, places and seasons of propagation, life histories, and food. The results are expected to afford a proper basis for regulatory measures and guidance in artificial propagation and may therefore be a means of bringing about a restoration of the former abundance of these important fishes.

Considerable attention has been devoted to the food and distribution of fishes in interior lakes, the inquiries being intended not only to afford guidance in regard to the stocking of waters, but also to reveal the character of shores and border waters which should be preserved or maintained in order to promote the productiveness of lakes in food supply. It has not been possible to give the river systems the study which is evidently required if the continual decline of important commercial and game fishes is to be checked, but the Bureau has, nevertheless, availed itself of the opportunities occurring to study extensively the conditions prevailing in certain portions of the Mississippi River and to direct a special inquiry into the natural history and propagation of the paddlefish.

Coincidently with the prosecution and development of the marine fisheries there is required a full understanding of the life histories and migrations of the fishes involved and of the conditions of their reproduction and growth. The Bureau has been attempting to supply the necessary data, and to this end has been conducting special surveys of waters and special studies of individual fishes and groups of fishes and has accumulated much valuable material. During the year there was completed a report bringing together what was previously known and what has recently been learned of the natural history of the fishes of one of the most important commercial families, and there has been begun a compilation of the results of many years of collection and study of material bearing on the life histories and habits of the food fishes of the North Atlantic.

Announcement is made of the completion of the study of the fishes of Panama as the Bureau's cooperative part in the Smithsonian Biological Survey of the Panama Canal Zone. The survey was undertaken several years ago to lay a basis for comparison of conditions prevailing before and after the completion of the canal connecting the two oceans. The necessity of keeping the staff of the Bureau occupied upon problems of immediate importance has delayed the completion of the study of the fishes until during the past fiscal year.

MOSQUITO CONTROL BY THE USE OF FISH.

The cooperation of the Bureau of Fisheries having again been sought by the United States Public Health Service in the antimalaria campaign in southern States, an assistant was detailed, as last year, to give counsel and assistance to Federal, State, and local health officials concerning the use of fish for the control of mosquitoes. The value of this service is attested both by the statements of health officers as to the results gained and economies effected and by the report of the Surgeon General of the Public Health Service. Investigations have been continued to gain additional information as to the conditions of the most effective use of fish for destruction of mosquitoes both in southern waters, where the prevention of malaria is a primary object, and in northern waters, where mosquitoes have a recognized deleterious effect upon the efficiency of labor and upon property values. As a result of the inquiries conducted in the north the Bureau has been able to give helpful advice to various municipalities and individuals.

FISH-CULTURAL EXPERIMENT WORK.

While national attention is directed to the important object of promoting the productivity of lands, we generally take what the waters produce as a gift of nature, something to be exploited and perhaps protected, but not to be cultivated. As the culture of plants and animals of the land can be made responsive to the application of scientific principles and experimentation, so the culture of the products of the ponds, lakes, and rivers may be increased by discovering the favorable and the limiting factors of production. The necessary investigative work involves careful studies of conditions characteristic of rich and poor waters, observations of the relations existing between fish and the other animals and plants with which they are associated, and experimental work to test the effect of particular factors upon the growth and multiplication of fish.

While scant special provision has been made for strictly fish-cultural experiment work, the Bureau endeavors to take advantage of such opportunities as are offered for work of this character, and these are found principally at the fisheries biological station at Fairport, Iowa. Experiments are conducted at that station to appraise the capacity of small ponds to support fish life, to determine the best plans of pond management, to discover what species of aquatic plants or animals should be introduced or fostered in fish ponds, and to make fish-cultural methods applicable to species of fish not hitherto propagated by artificial methods. Some experiments have also been conducted in connection with fish-cultural stations to discover means of reducing losses of eggs, fry, and brood stock, and of preventing deterioration of fertility of brood stock. If adequate and permanent provision could be made for the facilities and personnel of experimental work of this nature, the interests of economy would be served in the long run by increasing efficiency in all fish-cultural operations affected. One of the results incidentally obtained at the Fairport station—the devising of a new form of pond outlet which has stood the test of several years' trial—has shown the possibility of effecting substantial economies in the construction and maintenance of ponds at all stations where earth ponds are used.

Another means of effecting permanent economies in fish-cultural operations can be found in the reduction of disease or other causes of mortality in hatcheries. To serve this purpose, the primary necessity is a competent and permanent employee for the study of fish diseases. The need was recognized by Congress when in 1915 it established the position of fish pathologist as a part of the regular scientific personnel of the Bureau. During the six years which have elapsed since the position was created it has been vacant for one-third of the time and during the remainder has been held by three incumbents, none remaining in the service long enough to make more than an encouraging beginning. The difficulty has been that the salary was inflexible and fixed at too low a rate to attract and hold the proper man. The remedy is easily found in a readjustment of salary conditions such as has been referred to in a preceding paragraph. The position of fish pathologist was occupied during half of the past fiscal year, and investigations were directed at the ovarian diseases of fishes and the high mortality rate prevalent in all pike-perch hatcheries. Utilizing the services of temporary investigators, the Bureau has also made investigations of the losses of fish rescued in warm weather, finding a practicable remedy, and studies of injurious parasites of fishes.

SURVEYS OF PARTICULAR WATERS.

For the proper conservation of fishery resources and for gauging the necessity for and results of fish-cultural work it is important to have the most complete knowledge of the natural conditions in waters where fish propagate, grow, appear, and disappear under the control of factors now but little understood. During the past year such general investigations and surveys have been conducted both in the North Atlantic Ocean and in Chesapeake Bay—two of the most important sources of fish food and the locations of some of our principal fisheries. A comprehensive report embodying the results of observations gathered during a number of preceding years in the Gulf of Maine is now in preparation, special consideration being given to the life histories of the useful fishes and the conditions governing their distribution. In Chesapeake Bay the field work of the general survey has been completed, and it remains to compile and report upon the large mass of data accumulated. The special field studies of the occurrence and distribution of fish in the bay and tributary waters is being actively prosecuted. Other studies of a general nature have been conducted at relatively small expense in certain interior lakes, in cooperation with the Wisconsin Geological and Natural History Survey, and in the Mississippi River as a part of the work of the biological station at Fairport.

An event of interest and promise was the formation during the year of an international committee on marine fishery investigations composed of three representatives from Canada, one from Newfoundland, and three from the United States. The function of this committee is not to engage in joint work, but to serve as a ready means of effecting interchange of counsel, coordination of plans, and harmony in methods of marine investigations.

AID TO THE SHELLFISH INDUSTRIES.

The Bureau is rendering every practicable service to the oyster growers in the difficult circumstances which confront them in certain regions because of the failure of natural seeding. The conditions during the season of 1920 were very unfavorable to experimentation, and the work was further hampered by the loss in course of the season of the assistant charged with major responsibility for the investigations. The natural conditions in the beginning of the season of 1921 seemed favorable for experimental work, and the Bureau was able, as the results of the methods of study worked out and followed during preceding years, to render direct service to planters in the waters where investigations were being conducted. Progress has been made in the investigations to determine the effect of pollutions upon oyster propagation, both through direct action on the larvæ and through impairment of the vitality of oyster larvæ or of the fertility of breeding oysters by exhaustion of oxygen supply in the water.

Investigations of previous years had opened the way for artificial propagation on a commercial scale of fresh-water mussels, on which a very important button industry depends. The nature and extent of this work in the past fiscal year are elsewhere shown. Further and practically continuous efforts will be necessary in order to supply deficiencies in existing knowledge and to determine the effects of fishing operations and regulatory measures on the mussel resources of particular water areas. During the year there were distinct advances in experimentation, artificial propagation, and protection. An experiment in recovering young mussels dropped from infected fish retained in an inclosure gave a proportionate yield much greater than had been assumed to be necessary to justify the expenditures for artificial propagation. Protection is, of course, a function of the several States, but the Bureau has done much to stimulate interest in the matter, and almost invariably the counsel of representatives of the Bureau is sought by the States in determining the portions of rivers to be closed against shelling operations for the protection of mussels.

NEW SOURCES OF SEAWEED GELATIN.

The investigation of gelatin derivable from seaweed was extended during the year to certain species of red algæ of the Pacific coast, with the result that a new source of agar-agar of superior quality was disclosed.

Agar-agar is the commercial name applied to a gelatinous product of certain red algæ which is imported from Japan, China, and other places. The importations in 1919 amounted to nearly a half million dollars. Agar is used in making foods and confections, but its principal importance arises from the fact that it is a necessary medium for bacteriological work and is, therefore, essential to medical laboratories and hospitals. Four species of algæ from the Pacific coast were the subject of experimentation, and agar prepared from one of these tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar, while another species yielded a product apparently of like quality.

The discovery of domestic raw materials from which this important peculiar product may be made is a noteworthy event. In order that both Government and private interests may hereafter be independent of foreign sources of supply, further investigations should be conducted to determine the availability and locations of the proper algæ on our coasts as well as the suitability of other species than those used in the experiments already made.

ACTIVITIES OF THE BIOLOGICAL LABORATORIES.

The situation with regard to the marine biological laboratories remains distinctly unsatisfactory. The anomalous salary conditions make it hopeless to secure and retain a competent scientific staff, and the positions are generally vacant. While the stations at Beaufort, N. C., and Key West, Fla., have been virtually nonproductive during the past year, it has nevertheless been necessary to incur expenditures for maintaining the property. It has not, however, been practicable to prevent deterioration of the properties without more drastic curtailment of activities in other directions than seemed consistent with the accomplishment of a reasonable measure of public service. The Woods Hole (Mass.) laboratory was in operation with a small scientific staff in the summer of 1920, but it was impracticable to reopen it in the summer of 1921.

In the last annual report (pp. 22 and 62) reference was made to the new building nearing completion at the Fairport (Iowa) station. The building was occupied in August, 1920, and has been found excellently suited for the purposes of fishery investigations. On two occasions during the year it was the scene of conferences of national scope for consideration of questions affecting the conservation of resources of interior waters and the application of scientific studies to that end. Both conferences, but particularly the one held June 8–10, 1921, brought together persons of varied interests from many States and were most helpful in affecting interchange of ideas and promoting harmonious action to the end that more care may be taken to insure the permanency of fishery resources.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

OUTLINE OF THE WORK.

The fish-cultural activities of the Bureau are directed to the maintenance of the existing aquatic resources of the country and the development of new sources of supply by the stocking of barren waters and the introduction of useful species into waters to which they were not indigenous. In this work the Federal Government operates along the same lines and with the same object as do many of the States. Five distinct functions are involved in this service, namely, the collection and fertilization of the eggs of food fishes, the incubation of the eggs in hatcheries, the feeding and rearing of the young of certain species, the distribution of fishes (and, in some cases, eggs) for planting in suitable waters, and the rescue of fishes from landlocked flood waters of the Mississippi Valley.

The principal source of the fish eggs handled by the Bureau continues to be the commercial fisheries, in which vast numbers of eggs that would otherwise be sent to market in the fish and be a total loss are obtained for hatching purposes by experienced spawn takers. In the case of some important fishes, notably, but not exclusively, the salmons of the Pacific coast, where commercial fishing does not extend to or is not permitted in the spawning areas, the ripe fish are caught in seines or traps and their eggs are removed, the object being to bring about a higher percentage of fertilization than is possible under natural conditions and to afford to eggs and resulting young protection from enemies and physical fatalities during and immediately after the hatching period. Eggs in noteworthy numbers are obtained also from domesticated fish held from year to year in ponds at the stations.

No material increase in the scope and magnitude of the fish-cultural work was possible during the year. With the available operating funds remaining the same, the most careful scrutiny of expenditures and the closest application of employees to their duties have been required to maintain the service at its existing standard of efficiency.

The fish-cultural operations in 1921 were conducted in 33 States, Alaska, and the District of Columbia, and the output reached every

State and Territory. The number of fingerlings handled was 226,-589,545, fry aggregated 3,626,262,730, and the fertilized eggs assigned to State hatcheries or planted on the natural spawning grounds of the respective species numbered 1,109,637,130. The following table gives a summary of the output of each species:

SUMMARY, BY SPECIES, OF THE OUTPUT OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1921.

Species.	Eggs.	Fry.	Fingerlings.	Total.
Catfish			35,257,070	35,257,070
Carp		106,043,000	3,918,580	109,961,580
Buffalofish		108,307,000	1,645,835	109,952,835
Shad		32,792,275		32,792,275
Alewife		43,815,000		43,815,000
Whitefish	181,650,000	238,800,000		420,450,000
Cisco	186,510,000	89,800,000		276,310,000
Silver salmon		600,000	6,486,150	7,086,150
Chinook salmon	6,780,000		32,780,765	39,560,765
Sockeye salmon	350,000	38,778,500	30,434,500	69,563,000
Chum salmon		7,000,000	19,436,400	26,436,400
Steelhead salmon	493,000	38,810	2,928,915	3,460,725
Atlantic salmon		1,387,000	280	1,387,280
Landlocked salmon	575,000	208,115	124,250	907,365
Rainbow trout	2,553,240	414,100	3,872,225	6,839,565
Blackspotted trout	820,000	3,899,100	1,000,300	5,719,400
Loch Leven trout			64,000	64,000
Lake trout	2,824,000	16,563,300	208,500	19,595,800
Brook trout	856,890	3,642,330	7,559,625	12,058,845
Grayling		1,400,000		1,400,000
Smelt	600,000	7,000,000		7,600,000
Pike and pickerel			540,510	540,510
Fresh-water drum			34,080	34,080
Crappie			37,303,900	37,303,900
Large mouth black bass		585,050	1,221,905	1,806,955
Small mouth black bass		303,700	54,590	358,290
Rock bass			108,305	108,305
Warmouth bass			100	100
Sunfish			30,371,475	30,371,475
Pike perch	296,475,000	57,385,000	108,515	353,968,515
Yellow perch	12,000,000	176,369,450	6,166,435	194,535,885
White bass			27,170	27,170
Striped bass		20,184,000		20,184,000
Cod	208,800,000	175,341,000		384,141,000
Pollock		455,066,000		455,066,000
Haddock	188,940,000	271,880,000		460,820,000
Winter flounder		1,768,660,000		1,768,660,000
Pole flounder	19,410,000			19,410,000
Miscellaneous fishes			4,935,165	4,935,165
Total	1,109,637,130	3,626,262,730	226,589,545	4,962,489,405

As compared with 1920, there was a general increase in production of nearly 200,000,000. Species handled in larger numbers were whitefish, cisco, alewife, chum salmon, blackspotted trout, brook trout, carp, pike perch, yellow perch, striped bass, and haddock, while the output of catfish, buffalofish, shad, various Pacific salmons, lake trout, cod, and pollock was less.

DISTRIBUTION OF FISH.

The increased cost of railroad transportation has been accompanied by no increase in the funds available for the distribution of fishes and has necessitated curtailments. The five special railroad cars that were in commission during the year traveled 85,060 miles and detached messengers in charge of minor shipments of live fish traveled 385,988 miles in planting fish in public waters and in filling upward of 9,000 special applications. The cars were employed principally in distributing fishes of the interior waters, which are assigned on requests of individuals, fish associations, State fishery officials, and officers of the National Park Service and Forest Service. Fishes representing the commercial species are usually planted on the Bureau's initiative on the spawning grounds from which eggs are derived and, in some instances, in barren waters where the conditions favor the development of new and promising fisheries.

In the Bureau's estimates of appropriations for the fiscal year 1923, under the item for the propagation of food fishes, there has been inserted a clause which is intended to bring to the attention of Congress the desirability of instituting a new policy in the distribution of fish produced at the Government hatcheries or obtained in the course of the regular operations. This clause provides that the Secretary of Commerce may make a reasonable charge for fish supplied for planting in any waters in which the public is not allowed to take fish.

RELATIONS WITH THE STATES IN FISH CULTURE.

The numerous States engaged in fish culture are laboring for the same purposes that actuate the Bureau in its operations within the respective States. The field is large, the need for very extensive work is nearly everywhere apparent, and there is no conflict of authority or duplication of effort between the States and the Federal Government. Under the cooperative arrangements that have been made the practical efforts of one agency supplement and augment those of the other, with maximum benefit to the public.

The Bureau acknowledges invaluable assistance afforded by the States during the past year, resulting in reduced expense, augmented output, and increased efficiency in stocking waters. Joint occupation of productive collecting fields and the use of State hatcheries for the incubation of eggs provided by the Bureau, the young fish being planted by the State in local waters in accordance with previous plans, have continued to be features of the interrelations with the States. In the fiscal year 1921 the fish commissions of 28 States were assigned fish and eggs, as set forth in detail in the following table:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS DURING THE FISCAL YEAR 1921.

[All figures are for eggs unless otherwise indicated. Fingerlings are designated *a* and fry *b*.]

State and species.	Number.
California: Chinook salmon	3,000,000
Colorado: Rainbow trout	50,000
Connecticut: Brook trout	*a* 52,000
Idaho:	
Blackspotted trout	50,000
Landlocked salmon	15,000
Rainbow trout	50,000 *a* 7,000
Whitefish	500,000
Illinois:	
Black bass	*a* 200
Catfish	*a* 25,300
Crappie	*a* 5,800
Drum	*a* 175
Pickerel	*a* 410
Pike perch	*a* 250
Rock bass	*a* 500
Sunfish	*a* 26,325
White bass	*a* 175
Whitefish	500,000
Iowa:	
Lake trout	50,000
Rainbow trout	62,000
Maine:	
Lake trout	50,000
Landlocked salmon	475,000
Maryland:	
Cisco	300,000
Lake trout	4,000
Pike perch	1,000,000
Rainbow trout	150,000
Whitefish	100,000
Massachusetts: Rainbow trout	50,000
Michigan:	
Landlocked salmon	10,000
Lake trout	1,000,000
Pike perch	223,200,000
Smelt	200,000
Whitefish	20,000,000

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, ETC.—Con.

State and species.	Number.
Minnesota:	
Black bass	*a* 9,340
Catfish	*a* 6,800
Crappie	*a* 5,200
Sunfish	*a* 5,200
Steelhead salmon	70,000
Yellow perch	*a* 2,250
Missouri:	
Rainbow trout	*a* 100
Sunfish	*a* 100
Montana:	
Blackspotted trout	350,000
Rainbow trout	150,000
Steelhead salmon	75,000
Nebraska:	
Brook trout	*a* 32,900
Rainbow trout	*a* 30,000
Nevada: Rainbow trout	50,000
New Hampshire:	
Landlocked salmon	20,000
Lake trout	25,000
Pike perch	2,000,000
Whitefish	250,000
New Jersey: Pike perch	1,000,000
New York:	
Cisco	104,410,000
Lake trout	1,500,000
Landlocked salmon	100,000
Steelhead salmon	199,000
Whitefish	29,200,000
Ohio: Whitefish	23,640,000
Oklahoma:	
Rainbow trout	100,000 *b* 41,000 *a* 8,000
Rock bass	*a* 100

State and species.	Number.
Oregon:	
Chinook salmon	3,650,000
Rainbow trout	604,940
Pennsylvania:	
Chinook salmon	*a* 10,000
Cisco	65,000,000
Lake trout	50,000
Steelhead salmon	30,000
Whitefish	10,000,000
South Dakota:	
Brook trout	*a* 2,100
Rainbow trout	*a* 3,000
Tennessee: Rainbow trout	55,000
Utah: Lake trout	50,000
Vermont:	
Lake trout	25,000
Landlocked salmon	20,000
Pike perch	14,700,000
Steelhead salmon	25,000
Yellow perch	12,000,000
Washington:	
Blackspotted trout	75,000
Rainbow trout	75,000
Steelhead salmon	49,000
Wyoming:	
Black bass	*a* 2,150
Blackspotted trout	100,000
Brook trout	100,000
Catfish	*a* 1,200
Rainbow trout	309,800
Smelt	200,000
Total	484,114,740 *a* 236,575 *b* 41,000

In realization of the great and growing need for more adequate laws for the protection of food and game fishes in various parts of the country, the Bureau has been in communication with the fishery authorities of a number of States. Attention has been directed in certain cases to the lack of suitable laws or to the lack of stringent enforcement of the laws, and the States have been reminded of the stipulation made by Congress in connection with the annual appropriation for the propagation of food fishes, which prohibits the expenditure of funds for hatching or planting fish in any State where, in the judgment of the Secretary of Commerce, inadequate protection is afforded the particular species handled. In every instance the response to the Bureau's communication has shown a desire on the part of the States to bring about any needed reforms in fishery legislation, and there is reason to believe that some States that have been derelict in this matter will enact new and better laws in the near future. It has been the Bureau's policy not to summarily recommend the discontinuance of fish-cultural work in any State, but to use every proper influence to bring the States in line for the maintenance of their fish and other aquatic animals.

The shad hatchery at the head of the Chesapeake Bay, near Havre de Grace, Md., closed by the Secretary of Commerce in 1917 for reasons fully set forth in published reports, has been definitely abandoned, as the State gives no indication or intimation of an intention to meet the conditions imposed by law. The equipment and machinery have been transferred to other stations, the major buildings have been razed, and the lumber therein has been used in construction work elsewhere.

Mutually profitable cooperative relations have continued between the Bureau and the Dominion and provincial fishery authorities of Canada. The collecting of spawn of the whitefish and the cisco in the Great Lakes has thus been facilitated, and an exchange of trout eggs for Atlantic salmon eggs has been effected.

COOPERATION WITH FISH-PROTECTIVE ASSOCIATIONS.

A matter of great interest in connection with the fish-cultural work in interior waters is the rapid increase within recent years in the number of fish-protective associations throughout the country. Generally speaking, these organizations are composed of the leading citizens of the community, and the influence they exert in maintaining the fishery resources of the minor waters and in securing a proper utilization of those resources is most beneficial to the public at large. They make a practice of securing the services of men of experience in the stocking of local waters with fish life, and in some cases they maintain, at their own expense, ponds in which to rear to a larger size consignments of young fish obtained from State and Federal hatcheries for planting in public streams, ponds, and lakes. Another important service rendered by such organizations is the respect they inspire for the State fish laws, as most of them advocate adequate protective laws and their rigid observance by their members and the public. The Bureau has been pleased to cooperate with such organizations in the stocking of local waters with the most suitable kinds of fish. The cooperation has had the effect of reducing the expense of distribution and of increasing the chances of survival of the fishes planted.

HATCHING OF RIVER FISHES OF THE ATLANTIC SEABOARD.

Hatcheries for the commercial fishes of the Atlantic coast rivers are located on the Penobscot River in Maine, the Potomac River in Maryland and Virginia, and Albemarle Sound and Roanoke River in North Carolina.

A full discussion of the circumstances attending the artificial propagation of Atlantic salmon on the Penobscot River was contained in the last annual report. The disinclination of the Bureau to continue paying to Penobscot fishermen a bonus for the careful handling of adult salmon purchased from them resulted in the refusal of many of them to sell their fish to the Bureau. The local collection of Atlantic salmon eggs was therefore considerably smaller than usual, but it was augmented by the receipt of 600,000 eggs from Canadian hatcheries, in return for which the Canadian Government was furnished an equal number of eggs of the black-spotted trout and rainbow trout. While it is probably true that the careful handling of salmon taken in the weirs involves a small amount of extra work to the fishermen, this is believed to be more than offset by the benefits accruing to them from the hatchery. Hence, the Bureau feels justified in discontinuing the payment of this so-called bonus. Under the existing arrangement each fisherman receives the market price for his fish at the time of delivery, and to avoid constant weighing an average weight of 11½ pounds per fish has been established as a basis for computing the cost, this being conceded by the fishermen as a very fair average. The fish thus purchased are released immediately after their eggs are secured, and they undoubtedly return to the river in appreciable numbers in subsequent years. The point of greatest importance, however, is the salvage of a very large percentage of the immature spawn contained in the fish at the time of capture for market.

The shad hatcheries on both the Potomac River and Albemarle Sound were adversely affected by peculiar climatic conditions that prevailed during the spring of 1921. In the former field the first eggs were taken on March 22, the earliest recorded date for spawning shad on the river. This premature spawning was undoubtedly brought about by the warm weather and consequent high water-temperatures prevailing in the latter part of February and in March, the minimum water temperature recorded at the Potomac River station during March being 40° F. An unfavorable reaction was occasioned by the abnormally cold weather in April and early May, when the season was brought to a close. Equally unsettled weather prevailed in the Albemarle Sound region, and to this fact, together with the very extensive fishing operations permitted in the sound, the reduced output of the station is due.

It should not be necessary to emphasize the great need for immediate restrictive measures if the shad is to be saved in the few remaining rivers where the run still persists in sufficient volume to be commercially attractive. The subject has been a prolific source of discussion, but the various States most intimately concerned and responsible for the conditions have apparently made no progress toward ameliorating the situation. It is pertinent to note that the weather which was so unpropitious for the hatcheries actually favored a large catch of fish in the pound nets in the lower reaches of Chesapeake Bay and Albemarle Sound.

Very good results attended the initial attempt to propagate the glut herring or alewife on Albemarle Sound, and over 55,000,000 eggs were collected for the Edenton hatchery and nearly 44,000,000 fry were produced. The hatching of striped bass on the Roanoke River was conducted as usual in the spring of 1921, and, notwithstanding unfavorable weather, the collection of eggs, amounting to 24,620,000, was larger than in any previous season.

PROPAGATION OF COMMERCIAL FISHES OF THE GREAT LAKES.

The most important commercial species of the Great Lakes—whitefish, cisco, lake trout, and pike perch—were handled along the customary lines, and, with the exception of the lake trout, all showed a satisfactory increase in output as compared with the previous year. This increase was made possible largely by favorable weather conditions, although in the case of the cisco the egg collections were greatly augmented by the receipts from new fields in the Canadian waters of Lake Ontario.

The need of a hatchery at some point on Saginaw Bay to take care of the immense numbers of pike perch and yellow perch eggs available in that field and now going to waste was again demonstrated by the collection of upward of 277,000,000 eggs of the former species. Owing to the lack of hatching facilities most of these eggs had to be sent to the State hatchery at Detroit for development.

In response to the continued demand for Government aid in maintaining the supply of carp in the western end of Lake Erie, large numbers of eggs of that important fish were obtained for hatching in cooperation with the Ohio fishermen.

PROPAGATION OF THE PACIFIC SALMONS.

Hatching and rearing of the Pacific salmons are conducted in California, Oregon, Washington, Idaho, and Alaska, and all of the five species, together with the steelhead, are usually handled, although in the past fiscal year no eggs of the pink salmon were secured.

There was a good run of chinook salmon in the Oregon and California fields, and the only reason for not obtaining record-breaking collections of eggs was that very heavy floods occurred at the height of the spawning season, permitting the escape of the fish that were being held below the racks. The floods were especially severe in California, interrupting all railroad and highway travel for a number of days. The work was therefore a practical failure at all points in those States.

At the new location on Snake River, Idaho, a collection of 6,000,000 chinook eggs from the spring run of salmon was made. The floods in this region during the fall of 1920 were in sharp contrast to the conditions encountered during the preceding fall, when the prevailing drouth and low-water stages in the spawning streams were such as to seriously handicap the work.

Owing to the limited funds available for salmon work in the Washington field, the two substations closed last season were not reopened. The run of chum salmon in Hood Canal was considerably larger than last year, thus permitting increased egg collections at all the Federal stations in that region. This outcome is attributed to less extensive commercial fishing as a result of the decided drop in price. The operations at Baker Lake were even more favorable than last year, and the collection of sockeye salmon eggs, amounting to nearly 12,000,000, was the largest since the establishment of the station more than 20 years ago; these eggs were taken from 3,645 fish.

The experiment recently undertaken at the substation at Quinault Lake for the purpose of demonstrating the relative efficiency of artificial propagation and natural reproduction has been temporarily postponed, as it was found that many of the fish passing through the counting weir were being gilled in the 4-inch mesh webbing used in its construction. Approximately 12,000 fish had been counted before the necessity for discontinuing the work became apparent.

At the Yes Bay (Alaska) hatchery no egg collections whatever were attempted during the fiscal year, and fish-cultural work was restricted to the incubation of a limited number of eggs transferred from other points. This course was necessitated by the condition of buildings, water-supply system, and equipment. In order to prevent complete deterioration of valuable property, extensive repairs and improvements were required. No special appropriation for this purpose was allowed by Congress, and the allotment ordinarily made for the regular operations of the station had to be devoted to upkeep of the plant.

There was again a large run of sockeye salmon into Litnik Lake, on which the Afognak station is located, and while the egg collections were not equal to the previous year's, when the hatchery was filled and additional eggs were taken for incubation in gravel boxes, the shortage was caused by the occurrence of floods during the spawning period rather than to any diminution in the run of fish.

As evidence of the trend and progress of salmon culture on the Pacific coast, it may be noted that of the 124,484,000 salmon planted by the Bureau in the last fiscal year 92,066,000, or over 71 per cent, were of the fingerling size.

CULTIVATION OF FISHES OF INTERIOR LAKES AND STREAMS.

The diversified and widespread fish-cultural work addressed to the food and game fishes of the streams and minor lakes of the interior has been conducted along the usual lines. The principal species involved are various trouts, landlocked salmon, black basses, crappies, sunfishes, and buffalofish. One of the fishes in this class most in demand and most desirable for planting over a wide range of country is the eastern brook trout. The production at all the trout stations is not sufficient to meet the demand, and recourse has been had to private hatcheries for supplies of eggs. The high prices now asked for such eggs, however, have necessitated a curtailment of purchases, and the shortage has been augmented by a poor take of eggs in Colorado, usually one of the most productive fields. The situation emphasizes the desirability of developing as rapidly as possible the proposed brook-trout station in the White Mountain National Forest at a site that has been made available to the Bureau through the courtesy of the Forest Service and the State of New Hampshire. A large part of the preliminary work connected with this project has been completed, surveys have been made, a road constructed, telephone line installed, a portion of the pond extension site cleared, and a temporary dam constructed. The officers of the Forest Service have rendered valuable assistance in the accomplishment of this work, but the station can not be fully developed and put in operation until additional funds are provided. The special appropriation requested for the purpose seems very small when compared with the results that may reasonably be expected from such an undertaking.

Successful results attended the fish-cultural activities of the stations in the Rocky Mountain region, with the single exception of the Colorado field, where the work was adversely affected by the inclement weather and the serious difficulty in transporting the eggs from the isolated field stations. Good collections of rainbow trout eggs were made in Madison Valley, Mont., notwithstanding the continuous cold and stormy weather prevailing throughout the spawning season. Aside from other valuable assistance rendered by the Montana Game and Fish Commission, the Bureau is indebted to it for its entire output of grayling. The work in the Yellowstone National Park was of a satisfactory nature, and upward of 2,000,000 young blackspotted trout were returned to its waters during the season. The Glacier National Park hatchery was well stocked with eggs shipped from other hatcheries and produced therefrom an output of over 2,000,000 fry and fingerlings of the brook trout, rainbow trout, blackspotted trout, and grayling, in addition to approximately 450,000 fingerlings which were on hand at the close of the year.

Under the handicap of exceedingly difficult natural conditions successful rainbow trout collecting operations were conducted in Wyoming on Sage Creek, Lost Creek, and Canon Creek, the two last named being in fields which have never heretofore been exploited. The results obtained, despite the very limited means available, appear to demonstrate beyond question the wisdom of establishing a permanent collecting station on Sage Creek in order that the work may be handled in a manner in some degree commensurate with the potential value of the field. This stream is a tributary of the North Platte River, and as the other streams mentioned are within a few miles of it the eggs obtained from them and from other collecting points in the Pathfinder reclamation project could be assembled and incubated in a properly equipped hatchery on Sage Creek.

The efficiency of the Spearfish (S. Dak.) station has recently been increased as the result of an arrangement with the city authorities of Spearfish. Under the provisions of a long-term lease the Bureau has secured without cost all surplus water from a reservoir lately constructed by the city. While this arrangement is satisfactory and gives the station an ample amount of water during the greater part of the year, with a surplus most of the time, the supply falls to a minimum during summer, when unusually large amounts of water are used for domestic purposes. In order, therefore, to provide against a shortage of water for the work at any season, it will be advisable to provide a storage reservoir for emergency use. A suitable reservoir can be constructed at small cost by placing a dam in a canyon on property adjacent to the Bureau's reservation, and with this additional outlay the station would be assured of an adequate water supply for an indefinite period of time.

In the propagation of the domesticated rainbow trout the results show continued improvement as to both quality and quantity of eggs and fry. Small consignments of eggs taken from wild rainbow trout at the western stations have been transferred to the eastern hatcheries from time to time to maintain the virility of the brood stock, and by this means no difficulty whatever is experienced in producing this species in sufficient numbers to meet all requirements. Recent anatomical studies of the rainbow trout conducted by the division of scientific inquiry have disclosed a number of facts relating to the reproductive organs of the female fish that have heretofore been overlooked or were not understood at the hatcheries and may have an important bearing on fish culture, especially with regard to the manipulation of spawning fish. The experiments were conducted at the Wytheville (Va.) station, and preparations have been made to continue them indefinitely at the Erwin (Tenn.) station, or until the problems involved can be fully worked out. The scientific division has also rendered assistance in overcoming the mortality which usually occurs among adult trout at spawning time. A careful examination of specimens of trout dying during that time has revealed the cause of death in many cases, and remedial measures have been suggested to the superintendents of trout stations.

Efforts to find a satisfactory food for young salmonoid fishes at a lower price than the expensive meat products in general use have been continued. Canned herring milt has been found to have some value when used in combination with meat, but used alone it has not yielded good results, as it appears to lack some important requirement of a full meat diet.

Climatic conditions during the 1921 nesting season of the basses were very unfavorable for a large output of fish. A period of unseasonable warmth in March unduly advanced the spawning season. This was followed by a cold spell in April and variable weather in May, such conditions appearing to prevail all over the country. A sudden fall in water temperature invariably causes spawning bass to desert their nests, with a subsequent loss of the eggs deposited. The bass output was therefore curtailed at practically all stations, and at some of them it was a complete failure.

In cooperation with the fishery authorities of Minnesota, investigations were made with the view of determining the feasibility of making collections of pike-perch eggs in the Rainy Lake region of that State. Operations were conducted at two sites, and eggs to the number of 13,680,000 were obtained as the Bureau's share of the returns.

On the Atchafalaya River, in Louisiana, 96,440,000 eggs of the buffalofish were taken between February 27 and March 25, 1921, the collections being materially reduced below those of the preceding year by the short spawning season and the small numbers of fish available. These unfavorable conditions are attributed to the late rise in the river, which, occurring in January, acted as an incentive to the fish to pass by their usual spawning grounds and seek more inaccessible spots in the denser portion of the flooded swamps. The catch of fish along the river was reported by local fishermen to be the smallest since 1913.

Taking advantage of an opportunity to save eggs of buffalofish and carp on the Mississippi River at Bellevue, Iowa, and Lynxville, Wis., during the spring of 1921, the Bureau collected 68,267,000 eggs of the former and 42,712,000 of the latter species, all of them being secured from fish caught for the market by commercial fishermen. The eggs were fertilized and immediately planted on the spawning grounds in the river.

HATCHING OF MARINE FISHES.

Operations in this branch were conducted at the usual points in Maine and Massachusetts and were addressed to the cod, pollock, haddock, winter flounder, and pole flounder. The weather throughout the spawning season of the various species was favorable, resulting in the taking of eggs of better than average quality at a lowered cost of production. There was a reduction in the number of cod and pollock eggs taken as compared with the previous year. A rather sharp decline in the price of pollock deprived the local fishermen of an incentive to pursue the fishery, and the catch at Gloucester fell off about 70 per cent. The collection of eggs for hatching purposes was necessarily affected, as the only source of supply is the fish caught for market. As against more than 954,000,000 taken in 1920, the past season's collections reached only 650,000,000.

The shortage in cod eggs may be ascribed to somewhat similar, though not identical, conditions. The body of cod on the shore grounds appeared to be smaller than usual, and as the market price of haddock offered more lucrative employment for the fishermen comparatively few boats engaged in the cod fishery. Egg collections of this species in the Gloucester field amounted to 210,040,000, while 214,702,000 were secured from brood fish held at the Woods Hole hatchery. Haddock eggs to the number of 629,120,000 were obtained for the Gloucester station between January 22 and April 29, 1921, this number exceeding the previous records for that species.

Weather conditions were generally favorable for flatfish propagation, and the egg collections at all stations aggregated 1,980,291,000, an increase of 175,000,000 over the previous year. High water-temperatures occurring toward the latter part of the season in the Woods Hole region and an unusually early ending of the spawning in Maine waters were factors in curtailing the take of eggs.

The artificial propagation of the pole flounder (*Glyptocephalus cynoglossus*) was undertaken by the Bureau for the first time during the past year. The presence of this fish in New England waters has long been known, but, because of its peculiarly small, soft mouth it was not taken by fishermen on the hand lines and trawl lines commonly used. With the coming into general use of the otter trawl in the shore fisheries of the section the pole flounder has made its appearance in the markets in constantly increasing numbers, and because of its food value and excellent flavor it commands a ready market at a high price. With the view of encouraging and assisting a new and growing industry an experienced spawn taker was detailed to investigate the spawning habits of this species. A close watch was kept on the fish landed at the markets during April and May, but no fully matured eggs were found until May 22. From that date to the end of June 19,410,000 eggs were collected, fertilized, and planted on the spawning grounds, and several small lots were taken to the Gloucester hatchery for observation. The eggs are semibuoyant, nonadhesive, and about 0.05 of an inch in diameter, measuring approximately 462,000 to the fluid quart. Those placed in a Chester jar for incubation did not survive, but the freer circulation of the McDonald tidal box appeared to meet their requirements. It is believed that the hatching of this fish can be profitably extended during the coming season.

RESCUE OPERATIONS IN MISSISSIPPI VALLEY.

The salvaging of food fishes in the overflowed waters of the Mississippi and Illinois Rivers has continued to be a prominent adjunct of the fish-cultural service. In the 1920 season, as early as the water stages would permit, this work was begun and continued without intermission as late as weather conditions were favorable. Owing to the persistence of high water much beyond the usual time, many millions of young fish, which under ordinary circumstances would have been left to perish in isolated pools and sloughs, were able to return to the main river channels. The permanent employees of the Bureau, supplemented by a force of temporary men, were organized into units equipped with boats, seines, and vessels for holding the fish, and the most productive river sections were systematically covered in the manner fully described in previous reports. When the operations were brought to a close on November 10, the number of fishes rescued and replanted had reached 120,656,420, consisting of catfish, buffalofish, carp, black bass, sunfish, crappie, and other food fishes of the region.

The striking results, undoubted benefits, and low cost of this work commend it to everyone familiar with it and warrant its extension over all parts of the Mississippi Valley where flood waters become cut off from the main streams. There are both opportunity and need for the annual salvaging of untold millions of food fishes in this region, and the Bureau has noted with great satisfaction the passage by the House of Representatives of a bill giving formal recognition of this intensely practical work and making financial provision for enlarged facilities and personnel for its prosecution.

DISTRIBUTION OF MOSQUITO-EATING FISHES.

The fish-cultural service has been called on to supply lots of the mosquito-eating fish Gambusia for consignment to foreign countries. The fish were collected at several southern stations and were desired because of the success that has attended their employment in this country in eradicating malarial mosquitoes.

In response to requests from the League of Red Cross Societies, with headquarters in Geneva, Switzerland, shipments of these little minnows were made to Italy and Spain, and pursuant to a request coming through the usual diplomatic channels, a consignment was furnished for the Government of Argentina. A lot supplied to the international health board was destined for Porto Rico. All these fish were intended to be used in antimalarial work.

Inasmuch as the top minnows can be grown in the reserve ponds of various southern stations or collected in near-by waters at little or no expense, it seems proper for the Bureau to be in position to meet reasonable demands for this fish, especially in view of the active participation of the Bureau in recent campaigns for the eradication of mosquitoes by the use of this species.

ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS.

Under the general direction of the fisheries biological station at Fairport, Iowa, extensive work has been done, as heretofore, in the propagation of pearly mussels native to the Mississippi River and tributaries. During the fiscal year 1921, 169,740,050 glochidia, or larval mussels, in a condition of parasitism on fishes, were liberated in public waters, as compared with 183,021,720 in the previous year. The fish hosts used for inoculation with glochidia were salvaged from overflowed waters, chiefly in the vicinity of Fairport, Iowa, and New Boston, Ill. The number of fishes rescued was 976,550, of which 40,020 were adults, and the number infected with the glochidia of appropriate mussels before being liberated was 50,268.

Two species of commercial mussels were handled in this work, the Lake Pepin mucket (*Lampsilis luteola*) and the river mucket (*Lampsilis ligamentina*), the last being propagated in only limited numbers. The infected fish were liberated in Lake Pokegama, Minn., and in the Mississippi River at the following places: Lake Pepin, Minn. and Wis.; Minneiska, Minn.; Lynxville, Wis.; Fairport, Iowa; New Boston, Ill.; and Lake Keokuk, Iowa and Ill. Operations were not conducted in Arkansas as in previous years, owing to the impracticability of obtaining the necessary labor and equipment. The cost of mussel distribution, including overhead station expense, was $0.0581 per thousand, as compared with $0.0562 in 1920 and $0.0689 in 1919.

Following is a detailed tabular statement of the number of larval mussels of each species deposited in the stated places:

Locality.	Mucket.	Lake Pepin mucket.	Total.
Lake Pokegama, Minn.		77,781,750	77,781,750
Mississippi River at Lake Pepin		44,128,800	44,128,800
Mississippi River at Minneiska, Minn.	2,153,000		2,153,000
Mississippi River at Lynxville, Wis.	250,000	1,196,300	4,146,300
Mississippi River at Fairport, Iowa		14,300	14,300
Mississippi River at New Boston, Ill.		28,158,850	28,158,850
Mississippi River at Lake Keokuk, Iowa and Ill.		13,057,050	13,057,050
Total	2,403,000	167,337,050	169,740,050

In order to supplement the efforts of the Bureau in increasing the supply of pearly mussels on which the pearl-button industry depends and to demonstrate the possibilities of mussel propagation in connection with the extensive operations in rescuing food fishes, the National Association of Button Manufacturers offered to cooperate with the Bureau by providing men to accompany each rescue crew on the upper river and to inoculate all fishes with the glochidia of the Lake Pepin mucket, the most important of the local mussels. Seven agents of the button manufacturers cooperated with seven crews working under the direction of the superintendent of the Homer (Minn.) station, and during October and November inoculated nearly 6,000,000 fish with glochidia, estimated to number upward of 478,705,000. Material cooperation of this nature by an association of business men is a source of gratification to the Bureau as evidence of a cordial spirit and of faith in the practical value of the service rendered in the propagation of river mussels.

RELATIONS WITH THE FISHERY INDUSTRIES.

SUMMARY OF CONDITIONS AND ACTIVITIES.

For several years the American fishing industry has been experiencing a critical condition to which various factors have contributed. During the Great War there was a universal demand for increased food production, to which the fisheries responded by providing augmented facilities for capturing and handling fishery products. Immediately following the war the demand for and the consumption of fish declined sharply at home and abroad, and an immediate curtailment in production became necessary before the program of expansion had been completed and while the costs of labor and materials were still advancing. Prices of fishery products for domestic use and for export fell and operations in many fields became unprofitable. Thus the fishing industry was one of the first to feel the necessity for postwar readjustments and to respond to that necessity.

As instances of recent marked changes in the fishery industries it may be noted that the decreased production of the New England vessel fisheries between 1918 and 1920 exceeded 25,000,000 pounds, the pack of sardines in Maine and California fell off 800,000 cases, and the output of canned salmon dropped 3,000,000 cases. The curtailment of operations in 1921 promises to be even greater in certain branches, as the trawler fleet of New England has been idle much of the time and a reduction of 50 per cent in the number of operating canneries is reported, and because of unsettled conditions in the oil and fertilizer trades a number of whaling and menhaden plants have been idle. As indicative of the trend of the great foodfish fisheries out of New England ports the landings during the first six months of 1921 compared with the same period of 1920 showed a decline of nearly 15 per cent in quantity and over 31 per cent in value, and the average price of all fish dropped from 4.6 cents to 3.68 cents per pound. The unfavorable situation has been further complicated by high transportation rates on fresh fish, which have discouraged shipments and shortened the distances over which it is practicable to send many of the low-priced fishes. It is to be said to the credit of the industry that it is striving wholeheartedly to meet the untoward conditions, to make sacrifices, and to practice such economies and to adopt such new policies as may be necessary to cope with the situation.

Under these circumstances it is not surprising that there should have been a widespread public appeal to the Bureau for some kind of assistance. Without enlarged provision of authority and funds for work in this field the Bureau's ability to serve the industry has of necessity been limited. Nevertheless, it has been able to render practical aid in numberless cases by suggesting ways and means for effecting improvements or economies in the methods of handling, manufacturing, and merchandizing water products and by widely disseminating timely statistical and other information for the use of fishermen, dealers, manufacturers, and consumers.

The following may be mentioned among the activities during the past year: The initiation of a fishery intelligence service on the northeast coast for supplying information relative to the presence of schooling fish; the effecting of arrangements for an extended trial of seaplanes as an adjunct of the fisheries; the collection of information regarding the construction and operation of little-known types of fishing gear that are adapted for more general use in our fisheries; recommendations for improvements in the methods of handling and shipping fish as an aid to increased consumption and better prices; assistance to producers in securing and transporting materials, such as salt and barrels, required for immediate use at a time when fish were available; the practical application of methods developed in fish-salting investigations; the dissemination of information on the preservation of fish nets; the stimulation of the saving and use of by-products of the fisheries, including the manufacture of fish meal, leather, and pearl essence; the initiation of a series of surveys of certain primary inland markets; and studies of the methods of conducting certain fisheries and their effects on the supply.

The statistical inventories completed during the year included the vessels fisheries centering at Boston and Gloucester, Mass.; Portland, Me.; and Seattle, Wash.; the shad fishery of the Hudson River and the shad and alewife fisheries of the Potomac River; the sardine industry of Maine; and the fisheries of the New England States. There has been an increased demand for and use of the general statistical information gathered and published by the Bureau, and there is evidence of growing appreciation of the need of support for worthy conservation measures, the necessity for which is disclosed by the statistical data. A full account of the activities of this branch of the service, with detailed tables and discussions of the results of various canvasses, is embodied in a report of the division of fishery industries for 1920 (issued as Document No. 908).

FISHERY INTELLIGENCE SERVICE.

The daily patrols by seaplanes of the Naval Aviation Service of the menhaden fishing areas in Chesapeake Bay and along the coast between Assateague and Bodie Island Lights begun in June, 1920, were continued until October, when the Navy Department abandoned them on the ground that the experiment had fully demonstrated the commercial value of planes in this fishery. This service was very beneficial to the menhaden industry and was the first thorough test of the value of seaplanes in spotting schools of fish. Under the present unsettled conditions in the fish oil and fertilizer industries it is not to be expected that a service of this kind will be established by the fishery interests.

The Bureau has obtained the cooperation of the Director of Naval Communications and the Commissioner of Lighthouses whereby reports of the presence of schooling fish are transmitted daily by radio by the keepers of certain New England lightships to shore stations from which they are forwarded to the Bureau's local agent in Boston. This service was begun about November 1, 1920. Reports of schooling fish are forwarded to the Bureau's local agents in Gloucester, Mass., and Portland, Me., by the Boston agent. Lightkeepers have reported the presence of such fish as mackerel, menhaden, and pollock. The subject has not received a sufficient trial to determine its practical value to the industry or the desirability of extending it to include a number of advantageously located lighthouses.

STUDIES OF FISHERY METHODS.

Descriptions and diagrams of little-known fishing gear, such as paranzella and lampara nets used in the fisheries of California, have been published for the information of the trade. The paranzella net has been used in the Mediterranean for a long period and was introduced into California in 1876. It is a heavy, strongly constructed net, intended for dragging the bottom chiefly in deep water. It is operated with steam and power boats in a manner similar to the otter trawl, except that two vessels are required. The nets vary in length from 25 to 35 fathoms, and the catch of food fish consists principally of flounders. The lampara net, used chiefly in the capture of sardines, anchovies, and other small surface fish, was introduced from the Mediterranean about 1900. It is fished at or near the surface, usually on dark nights, as these fish can more easily see the net in daylight or moonlight and avoid it, and may be operated by one or two boats, the net being laid around the school of fish after the manner of the purse seine. Studies of the methods of conducting the fisheries and of the effects of various methods of fishing on the supply are in progress.

IMPROVEMENT IN HANDLING FRESH FISH.

Fresh fish being a highly perishable commodity, whose delicate flavor and attractive qualities may be quickly impaired by improper handling, the first requisite to an increased appreciation of the value of such fish for food and to increased consumption is to improve the quality of the product offered to the consumer by the adoption of improvements in handling and distribution. The more important of these recommended by the Bureau are: The elimination of the pew or fork, and where its use is unavoidable or can not be immediately suppressed the employment of only a one-tined fork to be inserted into the head or tail but not in the body of the fish; the avoidance of needless bruising and rough handling; the prompt removal of the body heat by precooling, either on the vessel or at the landing wharf; the use of shallow boxes rather than barrels for shipping purposes, as fish in such receptacles keep longer and have better appearance; the use of an abundance of crushed ice to properly preserve the fish without unnecessary bruising; the observance of every precaution which will tend to retard deterioration; and to offer for sale only sound fish displayed in an attractive manner amid sanitary surroundings. The fish trade should exercise as much care in handling fresh fish as is now used in the handling of choice fruits.

FISH-MARKETING SURVEY.

Appreciating the lack of detailed information on marketing conditions existing in the larger inland distributing and consuming centers, and believing that a survey of certain of these markets may yield information of intrinsic value to the fresh and frozen fish trade and aid in increasing the consumption of fish, the Bureau initiated such a survey in June, 1921, beginning with Louisville, Ky., a city of nearly 235,000 inhabitants.

Among the items concerning which it is planned to secure information are the following: Lists of wholesale and retail dealers, indicating the kinds of fish each handles; geographical sources of supply; available transportation facilities and rates; character of containers in which fish are received and reshipped; population and preference by nationalities for particular classes of fish; months of abundance of the leading species; opinions of the trade regarding trade prospects, etc.

In the Louisville market less than 40 species of fresh and frozen fish and other aquatic forms are marketed. There are but 2 wholesale firms who also retail and 12 firms engaged solely in the retail business, half of whom are located on the same street. The disadvantages of this centralization are counterbalanced in part by the fact that a large number of grocers and butchers handle fish on Fridays. This market has a decided preference for fresh-water species and a prejudice against salt-water forms, which must be overcome by educational means if the demand for salt-water forms is to be largely increased. The estimated consumption of fish is about 6 pounds per annum per person.

INCREASING THE CONSUMPTION OF FISH.

Owing to the lack of funds for continuing the demonstrations in fish cookery and in popularizing the less-used fishes, the operations in this field have been largely limited to the issuance of printed matter and its judicious distribution. Economic circulars and placards emphasizing the food values, good qualities, and low prices of haddock and of pink and chum salmons were prepared for the use of the trade, as were also a poster and a leaflet recommending frozen fish.

With the introduction of steam trawlers there has been a heavy increase in the production of haddock, the vessel landings at Boston and Gloucester in the 1918–1920 period being about double the landings for 1908–1910. The haddock catch in New England in 1919 amounted to 89,405,600 pounds, and the average price received for the fish was 2.84 cents per pound. The haddock is taken in quantity throughout the year, can be distributed well if properly handled, and is an excellent white-meated fish similar to the cod. The demand for this fish in some of the inland markets is increasing, but the prejudice against marine fishes is a retarding factor. The economic circular contains 31 recipes for cooking this fish.

The consuming public has been educated to the high quality of red-meated salmon, but does not appreciate the excellence of pale-fleshed fish. While pink and chum salmons usually have less fat than the more highly colored forms, they contain as much tissue-building material. More than 3,250,000 cases of these fish were packed in 1920, and at recent prices they represent one of the lowest priced protein foods on the market. The Bureau has lent its assistance in educating the public to an appreciation of these fishes, which may be kept indefinitely when canned, are ready for immediate use, and may be prepared in many ways.

The Bureau has encouraged the wider use of frozen fish, as freezing conserves fish in times of abundance and cheapness for use in times of scarcity, and as a rule fish are now frozen under excellent conditions. The printed matter distributed through the trade stresses the importance of keeping frozen fish at a low temperature, of never thawing and refreezing, of avoiding bruises and rises in temperature, and of buying the fish while frozen and placing them in an ice box or cool place for thawing before cooking.

TECHNOLOGICAL INVESTIGATION.

Owing to lack of funds for operation, the fishery products laboratory in Washington City was practically idle during the year, and the temporary laboratory at San Pedro, Calif., was loaned to the California State Fish and Game Commission.

The practical application of methods evolved in the investigation of the principles of preserving fish with salt has been embodied in a report entitled "Improvements in Process of Salting River Herring, Especially Adapted to Warm Climates" (issued as Document No. 903). The report is based on the results of actual field tests in Florida designed to overcome the failures heretofore experienced by fishermen, and the fundamentals of the method, which should be followed wherever fish are to be preserved by salting in a warm temperature, are: Careful handling of the fish before salting, thorough cleaning and removal of all blood, use of salt of a high degree of purity, and application of the salt in a dry state.

A report on the preservtion of fish nets has been prepared and published (as Document No. 898). This important means of economizing in the expense of nets has been largely neglected in this country. In view of the fact that our fishermen employ gear to a value exceeding $15,000,000, a large part of which is in twine, and in view of the increasing cost of such netting such information is greatly needed and has been appreciated. The document sets forth the fundamental principles governing net preservation and gives for use those recipes which seem best calculated to serve the purpose of the fishermen. The Bureau has initiated some additional studies in net preservation which it plans to continue as opportunity affords in order that the industry may benefit to the fullest possible extent through the application of desirable methods.

For investigations in the refrigeration of fish the Bureau has a modern air-freezing plant with a sharp freezer capable of producing a temperature of —40° and automatic carbon-dioxide compressor and controls; a plant for freezing fish in brine; a precision temperature-measuring apparatus consisting of precision thermometer, Wheatstone's bridge, precision double potentiometer, conductivity apparatus, etc.; and a commercial apparatus for the experimental utilization of frozen fish. This equipment has been assembled and prepared for use in the conduct of investigations for which the trade lacks information as well as facilities. In view of the widespread interest in the industry in the freezing of fish in brine, this subject is to be investigated in detail, and considerable preliminary work has been completed.

INCREASING THE USE OF BY-PRODUCTS OF THE FISHERIES.

The Bureau has continued to aid in increasing the saving and use of the by-products of the fisheries with most gratifying results. It is inevitable that the year 1921 will show a heavy curtailment in production owing to unsettled market conditions. Fish oils now command about a fourth and fish scrap less than half war-time prices, while costs of operation and transportation have declined but little.

It is estimated that in 1920 the production of scrap and meal from all fishery products in the United States including Alaska was in excess of 125,000 tons. Of this amount the Pacific coast is to be credited with nearly 17,000 tons. As a result of the Bureau's work on the Atlantic seaboard there was a large increase in the production of fish meal for stock-feeding purposes, and menhaden and other interests are well pleased with the advantages accruing from the development of an additional outlet. The trade is energetically building up markets to care for the increased production. The Bureau of Animal Industry has continued its cooperation in the conduct of feeding tests and in educating farmers to the value of this commodity and is issuing a publication giving the results of the feeding tests. There are numerous problems that have arisen in connection with the utilization of waste fish which should receive attention from the Bureau of Fisheries, and it is hoped that means for studying these may soon be provided.

On the basis of reports published by the Bureau of the Census the production of fish and marine mammal oils in 1920 amounted to 8,803,574 gallons, distributed as follows: Menhaden oil, 3,676,453 gallons; whale oil, 3,073,574 gallons; sperm oil, 416,737 gallons; herring oil, 380,379 gallons; cod and cod-liver oil, 196,108 gallons; and all other, 1,060,322 gallons.

The fishery for sharks is developing satisfactorily despite unsettled conditions in the fishery industry, and the number of persons and companies attempting to place the fishery on a permanent basis is increasing. Shark hides are being tanned into leathers which are excellent for shoes, bags, brief cases, collar boxes, bill folds, and similar articles. Wearing tests of shoes with uppers of shark leather indicate that such leather is fully comparable to the best grades of calfskin, and shark leather has been produced whose tensile strength exceeded 6,500 pounds per square inch.

As the Bureau's small special appropriation for work in this field has lapsed, the future aid that can be given this industry will of necessity be limited. With the establishment of the facts that high-grade leathers can be made from the hides and that the remainder of the fish can be converted into marketable commodities, the chief purposes of the Bureau's assistance have been served. There is still need for information relative to the possible extent of the fisheries and areas and seasons of greatest abundance of sharks, but with a certainty of markets for the products it is believed that private enterprise will be able to cope with the situation.

It is worthy of report that a number of American manufacturers are now engaged in the manufacture of "pearl essence" or "fish-scale essence" from the scales of native fishes, such as the river herring, sea herring, and shad, and that considerable quantities of the scales are now being utilized for the purpose. In 1919, 5.2 tons of alewife or river herring scales, valued at $5,200, or 50 cents per pound, were so used in Massachusetts, and at present silvery scales are being saved by the fishermen of Maine, Massachusetts, and Virginia.

FISHERY CONFERENCES.

The Secretary of Commerce has adopted the practice of calling from time to time conferences of men interested in the upbuilding of the fishing industry. These conferences have been well attended and promise to mark an epoch in the history of the industry by establishing closer relations between the industry and the Federal agencies concerned and by affording a better understanding of the problems which the industry is attempting to meet, of the means whereby Federal agencies can cooperate, and of the limitations beyond which these agencies can not go.

The first of these conferences, attended by about 30 men prominently identified with the industry from the Atlantic and Gulf coasts, the Great Lakes, and the Mississippi Valley, representing the fresh, frozen, salt, and canned fish trades, and the oyster, crab, shrimp, and menhaden industries, was held at the Department of Commerce on May 9 and 10, 1921. The conference in a formal expression of views emphasized the seriousness of polluted coastal waters as affecting the fisheries and the need for remedial legislation; the effects of high transportation rates on the marketing of fish, especially of the lower-priced grades; the desirability of educational work among all classes to improve the quality of fish marketed and increase the consumption of fish; and the need of closer cooperation for the protection of important migratory fish.

The second conference, held on June 16, 1921, was called to consider measures for the prevention and control of water pollution and the protection of anadromous and shore fishes and other aquatic forms. It was attended by about 70 conferees, State fish commissioners, fish producers, and anglers from the Atlantic and Gulf coasts, as well as by Members of Congress and interested Federal departmental officials. The conference revealed a very great increase in the quantity of undesirable material dumped into our coastal waters in recent years, with impairment of their use for bathing and other recreation purposes and resultant damage to aquatic life, to which may be added the menace to our cities from fire due to oil on the water. There was indicated a general failure or inability of the States to cope with the many important and complex problems involved, and the demand for assistance from the Federal Government was practically unanimous.

On the question of the control of migratory fishes there was a greater diversity of opinion, but it was the sentiment of the meeting that our anadromous fishes and certain shore forms require greater protection that may be attained through uniform State action, the Department of Commerce to use its best offices to the accomplishment of this end in an advisory capacity.

NEW ENGLAND VESSEL FISHERIES.

The Bureau, through its local agents, has collected detailed statistics of the extensive vessel fisheries centering at Boston, Gloucester, and Portland, which have been published in monthly and annual bulletins. Two annual bulletins have been issued, one showing the catch by months, the other by fishing grounds. The number of trips and the catch at these ports were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the fishery products landed at Boston during the year, but a decrease in the receipts at Gloucester and Portland.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline-screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at $6,136,-569; at Gloucester 2,381 trips, aggregating 46,740,296 pounds, valued at $1,460,336; and at Portland 1,883 trips, aggregating 12,981,503 pounds, valued at $630,108. The totals for the three ports were 7,606 trips and 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of $8,227,013.

The foregoing totals include 54 trips—43 at Boston, 1 at Gloucester, and 10 at Portland—landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at $119,028. Of this quantity, 1,308,774 pounds, valued at $62,147, were landed at Boston; 271,580 pounds, valued at $13,606, at Gloucester; and 1,007,864 pounds, valued at $43,275, at Portland. As compared with the previous year, there was an increase of 9 vessels and 15 trips but a decrease of 707,929 pounds, with an increase of $12,767. These fish were brought into American ports in accordance with an arrangement with the Canadian Government as an emergency war measure that granted reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918. The arrangement was terminated by departmental order effective July 15, 1921.

Compared with the previous year, there was a decrease of 663 trips, or 8.01 per cent, in the total number landed at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of $678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent, and $354,630, or 91.59 per cent; the mackerel catch increased 1,580,525 pounds, or 27.66 per cent, and $215,852, or 39.44 per cent; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, and $281,834, or 132.71 per cent. The yield of cod decreased 3,108,838 pounds, or 4.75 per cent, but increased in value $54,456, or 2.10 per cent; haddock decreased 7,436,708 pounds, or 8.99 per cent, and $53,886, or 1.92 per cent; pollock decreased 10,191,066 pounds, or 54.34 per cent, and $118,387, or 31.11 per cent; cusk decreased 208,459 pounds, or 10.10 per cent, and $14,099, or 22.67 per cent; and herring decreased 3,361,901 pounds, or 32.45 per cent, and $73,487, or 30.64 per cent. The output of hake increased 381,880 pounds, or 8.80 per cent, but decreased in value $27,177, or 15.01 per cent. The Newfoundland herring fishery had a decline of 404,753 pounds, or 11.55 per cent, and $79,626, or 41.95 per cent. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, and of $60,368, or 37.85 per cent.

The fishery products landed at Boston, Gloucester, and Portland by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds; 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from off the coast of Newfoundland; and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33

per cent of the value of the fishery products landed during the year. The herring were taken from the treaty coasts of Newfoundland and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds.

Haddock ranked first in the New England vessel fisheries in 1920, with a catch of 75,279,477 pounds, valued at $2,740,052. The yield of cod was 62,265,582 pounds, valued at $2,637,637. There was unusual activity in the halibut fishery during the year. The catch of 3,789,330 pounds, valued at $741,821, was the largest in five years. There was a large increase in the receipts of halibut at Portland, the catch in 1920 amounting to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a noteworthy increase in the receipts of halibut at Boston in recent years but a decrease at Gloucester. The output of pollock was the smallest in many years, amounting to only 8,560,901 pounds, valued at $262,128, as compared with 18,751,967 pounds, valued at $380,515, in 1919, and 26,560,620 pounds, valued at $962,085, in 1918. The hake product amounted to 4,721,356 pounds, valued at $153,876, an increase of 381,880 pounds but a decrease of $27,177, as compared with the previous year. The yield of this species has been comparatively small in recent years. The catch of other fish was as follows: Cusk, 1,854,739 pounds, valued at $48,070; swordfish, 2,531,669 pounds, valued at $494,202; flounders, 3,637,774 pounds, valued at $166,895; and herring, 6,997,984 pounds, valued at $166,301. The herring output included 3,900,960 pounds, valued at $56,144, taken off the coast of the United States and landed fresh, and 3,097,024 pounds of salted Newfoundland herring, valued at $110,157.

The mackerel fishery in 1920 yielded 79,799 barrels of fresh fish, compared with 53,992 barrels in 1919, and 4,897 barrels of salt fish, compared with 7,007 barrels in 1919. The value of the catch was $671,310 for the fresh fish and $91,784 for the salt fish, an increase of $215,852 over the previous year. In 1921 the total yield of mackerel up to July 1 was 33,632 barrels fresh and 3,143 barrels salted, compared with 60,842 barrels of fresh and 3,357 barrels salted for the same period in 1920. In the southern mackerel fishery the purse-seine vessels had a poor season and the gill-net vessels had only fair success. The weather most of the time was unfavorable for fishing. The seiners reported seeing more fish in the South than for many years. The weather was good on the Cape Shore, and this fishery was comparatively successful, three vessels making second trips. The fish were caught mostly at night and in small schools. The fish averaged large, and the fresh sold from 6.60 to 16 cents per pound and the salted from $12 to $13.50 per barrel.

VESSEL FISHERIES AT SEATTLE, WASH.

The fishing fleet at Seattle, Wash., during the year 1920 brought in 822 fares, consisting of 14,355,450 pounds of fish, having a value to the fishermen of $1,992,759, from the fishing grounds along the coast from Oregon to Alaska. The largest quantities were taken from Flattery Banks, off the west coast of Vancouver Island, and in

Hecate Strait. The products included 12,683,450 pounds of halibut, valued at $1,913,849; 950,200 pounds of sablefish, valued at $49,963; 513,035 pounds of "lingcod," valued at $21,153; and 208,765 pounds of rockfishes, valued at $7,794. Compared with the previous year, there was an increase of 152 trips landed and an increase of 704,430 pounds, or 5.16 per cent, in the quantity, and of $462,475, or 30.22 per cent, in the value of the products. The yield of halibut increased 1,572,730 pounds, or 14.15 per cent, and $491,330, or 34.53 per cent, but there was a decrease in the catch of other species. Sablefish, for which there was an augmented demand during the war period, decreased 603,400 pounds, or 38.83 per cent, and $24,327, or 32.74 per cent; "lingcod" decreased 209,965 pounds, or 29.04 per cent, and $3,280, or 13.42 per cent; and rockfishes decreased 54,935 pounds, or 20.83 per cent, and $1,248, or 13.80 per cent.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year aggregated 9,813,966 pounds, valued at $881,066. This quantity included 7,911,820 pounds of salmon, valued at $765,145, and the remainder consisted of herring, steelhead trout, smelt, rockfishes, flounders, crabs, and other species. Compared with the previous year, there was a net decrease in the products landed by collecting vessels of 1,995,484 pounds, or 16.89 per cent, and $102,753, or 10.44 per cent, which decline was due to a large falling off in the catch of salmon. The decrease in salmon was, however, offset to some extent by a considerable increase in various less important species.

SHAD FISHERY OF THE HUDSON RIVER.

Figures gathered in a special canvass of the shad fishery of the Hudson River for 1920 indicated a reduction in the number of shad taken amounting to 40,986, or 45.38 per cent, and a diminished revenue to the fishermen amounting to $27,415, or 32.74 per cent, compared with the season of 1919. The persons engaged in this fishery numbered 368, an increase of 69 over the previous year. The equipment included 185 rowboats, valued at $10,011; 10 gasoline boats, valued at $2,050; 200 gill nets, valued at $23,710; 10 seines, valued at $1,655; and shore and accessory property valued at $2,925, the total investment being $40,351.

The catch comprised 49,315 fish, or 199,844 pounds, valued at $56,309, of which 39,692 fish, or 157,715 pounds, valued at $43,882, were taken on the New York side of the river, and 9,623 shad, or 42,129 pounds, valued at $12,427, were taken on the New Jersey side. The possibility of reestablishing a run of shad on a considerable scale in this river is still a matter of conjecture.

SHAD AND ALEWIFE FISHERIES OF THE POTOMAC RIVER.

The shad fishery of the Potomac River is of special interest to the Bureau owing to the long continuance of shad hatching operations thereon and the very active fishing that has been conducted in Chesapeake Bay. Statistics for the season of 1920 showed a catch of 529,358 shad, weighing 1,979,780 pounds, valued at $334,464. The number of fish taken was 15,111 less than in the previous year. Maryland fishermen are credited with only 80,944 shad, weighing 302,237 pounds and selling for $55,963, as against 448,414 fish, weighing 1,677,543 pounds and valued at $278,501, taken by Virginia fishermen.

The production of alewives or river herrings was 8,759,336 fish, or 4,352,668 pounds, valued at $55,137, of which 7,681,561 fish, weighing 3,813,780 pounds and having a value of $41,197, were taken by Virginia fishermen.

The combined fisheries for shad and alewives gave employment to 753 persons, who used 451 boats, valued at $83,889; 271 pound nets, valued at $126,455; 211 gill nets and one haul seine, valued at $39,620; and shore and accessory property worth $1,375.

THE FROZEN-FISH TRADE.

From compilations made from the monthly memoranda issued by the Bureau of Markets it appears that fish frozen between January 15, 1920, and January 15, 1921, aggregated 85,324,366 pounds. The quantity of halibut frozen was 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, hake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds, with smaller amounts of other species. The maximum quantity in storage at one time during the year, amounting to 67,827,934 pounds, was reported on November 15, and the minimum, amounting to 20,284,470 pounds, on May 15, 1920. A study of the data over a period of several years indicates that the storage peak is reached about November 15 and the low point between April 15 and May 15 of each year.

FISHERIES OF THE SOUTH ATLANTIC STATES.

Tabulated returns of the statistical canvass of the fisheries of the South Atlantic States concluded by the Bureau in 1920 indicate that in 1918 the industry gave employment to 15,046 persons, of whom 8,036 were credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to eastern Florida. Compared with the returns for 1902, there was a decrease of 8,406, or 35.84 per cent. The capital invested was $7,423,971, distributed as follows: North Carolina, $4,222,043; South Carolina, $221,251; Georgia, $769,998; and eastern Florida, $2,210,679. Compared with 1902, there was increase of $4,432,822, or 148.19 per cent. The principal forms of apparatus employed in the fisheries were pound nets, gill nets, purse seines, haul seines, and otter trawls, the last-named device having been introduced in the shrimp fisheries about 1915.

The products of the fisheries aggregated 332,614,123 pounds, with a value to the fishermen of $5,348,616, distributed among the several States as follows: North Carolina, 210,501,750 pounds, $2,978,708; South Carolina, 3,746,932 pounds, $207,690; Georgia, 37,153,953 pounds, $416,043; and eastern Florida, 81,211,488 pounds, $1,746,175. Some of the more abundant species arranged in order of size of catch were: Menhaden, 257,757,799 pounds, valued at $1,605,117; shrimp, 15,656,903 pounds, valued at $470,346; alewives, fresh and salted, taken mostly in North Carolina, 15,185,585 pounds, valued at $412,067; mullet, fresh and salted, 11,757,318 pounds, valued at $508,044; oysters, 5,871,376 pounds, or 838,768 bushels, valued at $260,863; squeteagues or sea trouts, 5,105,249 pounds, valued at $360,527; Spanish mackerel, taken mostly in Florida, 3,211,405 pounds, valued at $232,355; cero and kingfish, credited mostly to Florida, 2,483,647 pounds, valued at $161,562, and spot, 1,692,775 pounds, valued at $72,795. As compared with the Bureau's returns for 1902, there was increase in the catch aggregating 226,168,051 pounds, valued at $2,508,983. The large advance over previous years was mostly due to the greatly increased output of menhaden, the 1902 catch amounting to only 18,862,000 pounds, as against 257,757,799 pounds in 1918. The yield of all other species in 1902 was 87,584,072 pounds and in 1918, 74,856,324 pounds. Other products which have shown a noteworthy increase are cero and kingfish, drums, Spanish mackerel, and shrimp.

FISHERIES OF THE NEW ENGLAND STATES.

A canvass of the fisheries of the New England States for the calendar year 1919 was completed early in 1921. The number of persons ascertained to be engaged in the fisheries was 30,767, credited to the different States as follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, there has been a decrease in the number of persons employed of 6,572, or 17.60 per cent. The investment in the fisheries of the different States arranged in the order of importance was as follows: Massachusetts $19,111,269; Maine, $17,544,969; Rhode Island, $2,249,536; Connecticut, $1,645,793; New Hampshire, $45,530; total, $40,597,097. This represents an increase of $18,066,377, or 80.18 per cent, as compared with 1905.

The yield for the region amounted to 467,339,870 pounds, valued at $19,838,657, distributed as follows: Massachusetts, 246,951,241 pounds, valued at $10,859,746; Maine, 147,956,369 pounds, valued at $3,889,035; Rhode Island, 48,250,883 pounds, valued at $3,296,578; Connecticut, 23,652,647 pounds, valued at $1,700,638; and New Hampshire, 528,730 pounds, valued at $92,660. The most important products were: Cod, 84,917,535 pounds, valued at $3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at $2,617,020; lobsters, 10,666,706 pounds, valued at $2,550,980; haddock, 89,405,609 pounds, valued at $2,544,617; and mackerel, 15,785,012 pounds, valued at $1,562,088. Compared with 1905, there was a net decrease amounting to 12,943,734 pounds, but a net increase of $5,654,452 in the first value of the products.

SARDINE INDUSTRY OF MAINE.

A complete enumeration of the sardine industry of the State of Maine was made by the Bureau for the calendar years 1919 and 1920. In 1919 the plants engaged in canning sardines numbered 53. The herring utilized amounted to 125,309,415 pounds, valued at $852,450, and the pack of canned fish was 2,450,268 cases, valued at $11,933,986, of which 1,902,430 cases, valued at $9,327,665, were quarter oils. In 1920 the plants numbered 50 and the herring consumed aggregated

104,700,010 pounds, valued at $767,141. The total pack was 1,877,757 cases, valued at $7,435,056, of which 1,458,670 cases, valued at $5,669,352, were quarter oils.

FLORIDA SPONGE FISHERY.

The sponge-inspection service, to make effective the law regulating the size of commercial sponges taken from waters off the Florida coast and landed at American ports, has been kept up throughout the year. The Florida sponge fishery appears to be maintaining a satisfactory equilibrium between the natural supply and the catch. It is regrettable that large quantities of small sponges barely meeting legal requirements continue to be taken. In the previous report attention was called to the large profit to be obtained if the small sponges were permitted an additional year's growth. This seems to have been demonstrated during the year by the quantity of large sponges taken on certain bars that had not been fished for several years. The continued demand for the larger sizes has somewhat encouraged the spongers to work in deeper water, say, from 9 to 12 fathoms. If a period of rest and recuperation for the shallower bars can be secured for a reasonable period, the sponge fishery as a whole will be greatly benefited.

The fishery has not escaped the fluctuations in value and general depression felt in other industries. The radical changes in price throughout the year, with considerable quantities of sponges remaining unsold from time to time, have not tended to simplify the financing of operations, but with a gradually improving market and the high quality maintained in the sponges taken the future may be viewed without concern.

INCREASED USEFULNESS TO THE FISHERIES.

The Bureau has recently been extending to the fishing industry a larger service than ever before, but it falls short of the opportunities and has been unable to meet various obligations that naturally devolve on the sole Federal agency charged by law with the duty of aiding the fisheries.

With due regard for the utmost economy in governmental expenditures, and having in view the efforts which the industry should undertake on its own behalf, there has existed and still exists a real need for additional Federal aid to the fisheries such as the Bureau is able to render but which it can not undertake with its present facilities. In an industry yielding an annual harvest of 2,500,000,000 pounds of products it is highly important from the standpoint of national welfare that the aquatic resources be utilized to the best advantage, and the Government would be amply justified in greatly increasing the appropriations that are available for such a purpose.

Some of the technological work that the Bureau felt should be undertaken in behalf of the fisheries has been indicated in estimates of appropriations that have been submitted to Congress in recent years and in special bills on which the Department has made favorable reports. At the present time an appeal is being made for an increase in the general funds for maintaining the division charged by law with duty toward the fisheries, to the end that the unique fishery-products laboratory in Washington and the temporary laboratory on the California coast be operated for the solution of various technological problems, that statistical canvasses showing the condition and trend of the fisheries may be prosecuted more frequently and more promptly, and that numerous field inquiries and investigations concerned with methods of taking, handling, preserving, and marketing fishery products may be carried on. A special appropriation is requested for the conduct of investigations in the development and standardization of methods of preservation of Pacific coast fishes.

When provision is made for enlarged investigations of wider scope, there will be required also such a readjustment of salaries as will enable the Bureau to secure and retain the services of persons properly qualified in the various branches and for an increased personnel that will include an assistant in fishery trade practices, three fishery technologists, a technical machinist capable of operating and caring for the highly specialized equipment of the fishery-products laboratory, and at least three additional statistical agents.

ALASKA FISHERIES SERVICE.

EXTENT OF THE ALASKA FISHERIES.

The 1920 salmon season had as its outstanding features a diminished catch in southeast Alaska and an increased catch in central and western Alaska as compared with 1919; an increase in the number of canneries operated but an output of canned fish that was less than in each of the five preceding years; a decline in the business in mild-cured, pickled, and fresh salmon; and a very dull market for canned salmon, especially the cheaper grades, many lots of which were sold for less than the cost of production.

The salmon taken in the Alaska fisheries in 1920 numbered 65,080,539 fish, of which 32,112,611 were humpback or pink salmon, 20,187,925 red or sockeye salmon, 10,113,677 chum or dog salmon, 1,890,859 coho or silver salmon, and 775,467 king or spring salmon. Apportioned by geographical districts the catch in southeast Alaska was 33,096,640 fish, central Alaska 19,574,332 fish, and western Alaska, 12,409,567 fish. Comparing these figures with the returns for 1919, it appears that there was a net increase of about 12 per cent; coho, chum, and king salmon were taken in less numbers and humpback and red salmon in greater numbers.

The canneries, which consumed the principal part of the salmon catch, numbered 146, an increase of 12 over 1919. The pack of canned fish was 4,429,463 cases, with a market value of $35,602,800, a decrease of 154,225 cases and $7,662,549 from the previous year. The pack both of red and king salmon was larger and that of the other species was smaller than in 1919.

Other salmon products were 1,857,800 pounds of mild-cured fish, valued at $364,219; 964,400 pounds of pickled fish, valued at $104,873; 1,916,595 pounds of frozen fish, valued at $161,143; 3,248,081 pounds of fresh fish, valued at $263,264; 244,840 pounds of dry-salted, dried, and smoked fish, valued at $40,785; 39,052 gallons of oil, valued at $16,370; and 1,778,000 pounds of fertilizer, valued at $88,382; giving

$36,641,836 as the total value of the products of the Alaska salmon industry in 1920.

The halibut fishery ranks next to the salmon fishery, and in 1920 yielded 7,506,763 pounds of fresh fish, valued at $1,034,380; 7,788,017 pounds of frozen fish, valued at $692,343; and 720 pounds of canned fish, valued at $75.

Products of the herring fishery consisted of 8,223,490 pounds of Scotch-cure fish, valued at $490,485; 344,619 pounds of Norwegian-cure fish, valued at $22,199; 3,602 cases of 1-pound cans, valued at $28,980; 681,067 gallons of oil, valued at $404,090; and miscellaneous commodities, valued at $357,860.

The cod fishery yielded a catch valued at $1,117,464. The products of the shore whale fishery had a value of $562,302. Minor items were: Clams, $46,812; crabs, $1,740; shrimps, $49,123; trout, $13,662; sablefish, $28,544; and miscellaneous fresh fish, $229.

The entire Alaska fishing industry, exclusive of fur sealing, gave employment to 27,482 persons, represented an investment of $70,986,221, and yielded products valued at $41,492,124.

A detailed account of the extent and condition of the Alaska fisheries in 1920 and of the activities of the Bureau under the laws and regulations for the protection of the fisheries is embodied in the annual report of the Alaska service for that year.[1]

ENFORCEMENT OF FISHERY LAWS AND REGULATIONS.

During the fishing season of 1920 the Bureau had in service for patrol purposes 13 vessels, and the same number was available in 1921. For the 1921 season the persons engaged in connection with the enforcement of laws and regulations numbered 63, of whom 23 were regular and 40 were temporary employees.

A number of violations of the fishery laws were detected and successful prosecutions were made in the local courts. The Bureau is doing its utmost, however, to prevent violations by maintaining watchmen or guards at the mouths of salmon streams throughout the fishing season. In some instances the stream guards, being equipped with small power boats, are able to look after two or three streams so close together that their absence from any one stream will not be so protracted as to permit illegal fishing within the stream or inside the protected area at its mouth. It is the policy to discourage and prevent violations, for thereby not only are the expense and annoyance of prosecution avoided but, what is of greater importance, the salmon which would have been killed through such illegal fishing are permitted to proceed to the spawning grounds. The extension of the stream-watchmen system will be made as fast as funds are available and should soon embrace every important salmon stream.

Attention has been devoted during the year to the erection of additional markers near the mouths of salmon streams to give fishermen notice as to the limits of the areas in which salmon fishing is prohibited. Suitably inscribed cloth notices have been posted conspicuously, and thus far upwards of 200 of the more important salmon streams have been marked.

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[1] Alaska Fisheries and Fur-Seal Industries in 1920, by Ward T. Bower, agent, Alaska service (Bureau of Fisheries Doc. No. 909).

The systematic stealing of salmon from fish traps in southeastern Alaska was renewed during the 1920 fishing season but was less extensive than in 1919. Some of the cannery owners augmented their force of watchmen and detailed fast boats to the special duty of protecting their traps from these marauders. It would seem that one of the most certain and effective methods of bringing this nefarious practice to an end would be for cannerymen or other purchasers of salmon to establish definitely the source of fish offered for sale by independent boats. The suppression of this practice does not fall within the functions of the Bureau.

Detailed instructions issued to the Bureau's employees in Alaska on May 25, 1921, prescribed methods of observance of the close season for fixed fishing apparatus and the proper labeling of all apparatus, also the procedure to be followed in inspecting such apparatus and in reporting and prosecuting violations of the laws and regulations.

PRIVATE SALMON HATCHERIES.

The private salmon hatcheries in Alaska have been inspected, as required by law. In 1921 two such hatcheries were operated. One of these, on Naha Stream, liberated 17,375,000 red salmon fry in the fiscal year 1921, and the other, located on Hugh Smith Lake, liberated 18,913,000 red salmon fry in the same period. The total rebate of taxes on canned salmon, at the rate of 40 cents a thousand fry released by these hatcheries, amounted to $14,515.20.

NEW SALMON-FISHERY REGULATIONS.

In accordance with announcements duly issued, hearings were held at Cordova on October 5 and at Seattle on November 18, 23, and 30, and December 3, 1920, for the consideration of necessary changes in the regulations regarding salmon fishing in Alaska. The waters affected are southeastern Alaska, the region between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, and the Kuskokwim and Yukon Rivers. As a result of these hearings the following order was issued on December 18, 1920:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all hereinafter-described waters of Alaska be, and is hereby, made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(*a*) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(*b*) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(*c*) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets, as well as with all other apparatus, is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anan Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes and within 500 yards of the mouths of such streams flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(*a*) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River is prohibited.

(*b*) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(*c*) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order, but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Announcement has been made of hearings to be held in the fall of 1921, as follows: Juneau, Alaska, October 19, and Seattle, November 15, to consider further restrictions on commercial fishing in waters of southeastern Alaska, and at Seattle, November 17, in regard to waters of western and northern Alaska.

In submitting to the Secretary of Commerce recommendations for the protection and maintenance of the salmon resources of Alaska, the Bureau is guided largely by the personal knowledge of conditions possessed by its staff of assistants regularly employed in Alaska or detailed thereto for special duty. The data that are considered cover both the practical aspects of the fishery and the biological situation as regards the salmon in given waters, and the established policy is to impose no greater restrictions on the fishery than are believed to be required for the perpetuation of the industry. In recent years very important and far-reaching investigations of the habits, age, growth, spawning grounds, etc., of the different species of salmon in different streams have been in progress, and the Bureau has been fortunate in retaining for this work the services of the leading authority on the Pacific salmons.

PROTECTION OF WALRUS AND SEA LION.

Pursuant to the provisions of the act of May 31, 1920, which transferred to the Department of Commerce the jurisdiction heretofore exercised by the Department of Agriculture with respect to the walrus and the sea lion in Alaska, the Secretary of Commerce approved a new set of regulations governing the killing of these animals within the territorial limits of Alaska, and in a circular issued under date of April 21, 1921, promulgated the regulations and quoted from the Alaska game law approved May 11, 1908, extracts in regard to the walrus and the sea lion. The new regulations are as follows:

WALRUSES.

1. The killing of walruses for their tusks or hides, or both, is prohibited as being wanton destruction within the meaning of the act of May 11, 1908.
2. The killing of walruses at their breeding places in Alaska is prohibited at all times.
3. The killing of walruses throughout the territorial limits of Alaska is prohibited from May 1, 1921, to April 30, 1923, both dates included, except by natives for food or clothing or by miners or explorers when in need of food.

SEA LIONS.

1. The killing of sea lions on their rookeries or hauling-out grounds is prohibited at all times.
2. The killing of sea lions is prohibited from May 1, 1921, to April 30, 1923, except by natives for food or clothing, or by miners or explorers when in need of food, or by anyone in the necessary protection of property, or while such animals are actually engaged in the devastation of runs of salmon. The killing of sea lions under any other circumstances than the foregoing will be deemed wanton destruction and punishable as a violation of this order.

NEW LEGISLATION NEEDED.

The act of June 26, 1906, which provides for the regulation and protection of the fisheries of Alaska, is obsolete in some of its features and in general is quite inadequate to meet the conditions that have existed for a number of years. The law is practically restricted to the salmon fishery, which, under its operation, has become so extensive that the salmon supply in certain waters has been seriously depleted and the future welfare of the industry and of the Territory is jeopardized. The law imposes no limit on the number of canneries and salteries that may be established and operated, the number of fixed and floating traps that may be constructed, the number of purse seines, haul seines, set and drift nets that may be used, the number of trolling boats and trolling lines that may be employed, the number and age of salmon that may be caught. Various restrictive features of the law have long since proved ineffective to prevent the capture of an undue proportion of the run of salmon in certain waters, and fishing operations in full compliance with law may be entirely incompatible with the welfare of the fishery.

One of the most serious defects of the law is its failure to give sufficient protection to salmon off the mouths of spawning streams. The maximum distance from the mouth of a stream to which the jurisdiction of the Department extends is 500 yards. It is entirely feasible to conduct fishing operations with various kinds of gear so actively beyond the restricted zone as to offset the effects of the protection afforded the salmon in streams and immediately off their mouth, and this, in fact, is occurring in various localities. A measure designed to meet this situation and furnish this limited relief pending the enactment of a new general fish law for Alaska is the bill (H. R. 2394) which confers on the Secretary of Commerce jurisdiction over the fisheries for a distance of 3 miles off the mouth of any stream in Alaska and authorizes him to prescribe for such area the regulations deemed by him necessary or desirable to perpetuate the salmon supply. The bill, which has received the indorsement of the Department, has been favorably reported by the House Committee on the Merchant Marine and Fisheries and is now on the calendar.

The present law has no application to whales, crabs, shrimp, clams, and various other valuable products, and the taking of such animals is permitted without any restriction whatever. In the absence of any protection very extensive and valuable clam beds in central Alaska have been depleted, and other instances of the kind might be cited.

FUTURE DEVELOPMENT OF ALASKA FISHERIES.

While the salmon and halibut fisheries of Alaska will undoubtedly hold a dominant place for many years, the greatest development of the fishing industry is to be expected in other branches, particularly in the increased attention given to cod and herring, and ultimately to certain minor resources which are now almost untouched but which in the aggregate constitute a potential source of food and wealth that will mean much to the future welfare of Alaska. The herring supply of Alaska is possibly unsurpassed anywhere in the world, and there may be anticipated such a growth in herring fishing and herring curing that a formidable rival of the salmon industry may arise. Vast expanses of water in all parts of Alaska abound with bottom food fishes of a kind in good demand in other parts of the world, but their surface has remained practically unbroken by the boats of fishermen equipped to take such fishes. Substantial development may be expected also in the crab and shrimp fisheries. The Alaska shrimps are not surpassed elsewhere in size and quality and are undoubtedly destined to enter largely into commerce in a fresh, frozen, and canned condition.

CONTROL OVER THE ALASKA FISHERIES.

There has been the usual agitation for the transfer to the Territory of Alaska of the control over the aquatic and other natural resources that has heretofore been exercised by the Federal Government. The desire for this change of jurisdiction, while not entertained by a conspicuously large number of the representative people of the Territory, is a legitimate aspiration of those who hope to see Alaska soon take her place as a sovereign State. As regards the fisheries, the feeling is quite generally prevalent among those having property interests that the time is not yet ripe for the assumption of the responsibilities of statehood.

While constantly dwelling on real and imaginary defects of the fishery administration, it is a fact that interests ostensibly friendly to Alaska have successfully opposed all efforts on the part of the Department to have Congress give to Alaska a new fishery code adapted to the needs of the industry and have prevented the passage by Congress of constructive measures that have received favorable action in committee after protracted hearings.

It is the well-known desire of the Department to give to Alaska the most direct administration of the fisheries compatible with the requirements of law, and a large measure of independent action has been vested in the responsible representatives in various parts of the Territory. As a matter of fact, the fisheries of Alaska are now administered largely without reference to the Washington office, and the criticism properly made about the attempts at long-range control does not apply. With the exception of the power of appointment to statutory positions which is vested in the Secretary of Commerce, and the interpretation of questions of law which is vested in the Department of Justice, practically full authority without recourse to Washington is reposed in the Department's agents charged with the protection of the fisheries of Alaska. Of the 63 persons employed in the enforcement of law and regulation for the protection of the Alaska fisheries in 1921, 40 were regular residents of Alaska. An even larger proportion of appointments from Alaska would be made if suitable persons could be secured at the salaries that are available.

ALASKA FUR-SEAL SERVICE.

GENERAL ACTIVITIES AT THE PRIBILOF ISLANDS.

The administration of the Pribilof Islands, with their dependent native inhabitants and with their valuable herds of fur seals and blue foxes, is one of the most important duties devolving on the Bureau. The material interests of the Government arise from international relations having to do with the utilization of the fur seals and from the fact that the annual return from the islands is more than a million dollars.

The affairs of the Government on the Pribilofs are managed by a staff of about 15 white people, augmented by more than 300 natives. These natives, the descendants of Aleuts taken to the islands by the Russians more than a century ago, are undoubtedly as well cared for as any other native people in Alaska. They are furnished food, fuel, clothing, shelter, and other necessities, and have the benefit of schools and competent medical supervision. In return they perform most of the labor involved in taking and caring for the valuable products of the islands and in maintaining the Government plants. They receive cash remuneration in proportion to the amount and grade of service rendered. In recent years the local force of able-bodied natives has been supplemented during the few weeks of the active sealing season by 30 native laborers from the Aleutian Islands.

In 1920 a dentist was engaged to spend a few months at the Pribilof Islands. An excellent start was made in this much-needed field, for which special provision had never before been made. In order to continue the work thus inaugurated a dentist was sent to the Pribilofs in the summer of 1921; he will remain through the winter or until such time as his services are no longer required.

The important problem of housing the natives has received attention, and improvements in the native dwellings on St. Paul Island will be made as funds are available. One additional dwelling on St. Paul Island was completed and occupied during the past year. School buildings and dwellings were repaired, a new shop and warehouse was built on St. George Island, extensions to the salt houses were made on St. Paul Island, additional roadwork was undertaken, and, in conjunction with the Navy Department, preliminary work in drilling an artesian well was done. The by-products plant on St. Paul Island was operated, and 8,759 pounds of seal meal and 5,271 gallons of various grades of oil were produced.

The Bureau's vessel *Eider* has given valuable service in transportation of supplies and persons between Unalaska and the Pribilof Islands, and also made trips to King Cove and Kodiak. While returning from the latter place in December, the *Eider* rendered noteworthy assistance in locating at Chignik the disabled mail boat *Pulitzer*, long overdue, whose passengers, crew, and mail were taken to Unga. Credit is due the master and crew of the *Eider* for this work, as well as for other hazardous voyages during the winter to the Pribilof Islands.

Acknowledgment is made of courtesies extended by the Navy Department in the transportation of supplies and passengers on the *Saturn* from Seattle to the Pribilof Islands and in carrying sealskins and fox skins on the return voyage of that vessel. The operation of the radio stations on St. Paul and St. George Islands has been of great value to the Bureau. The Bureau is also pleased to acknowledge numerous courtesies by the Coast Guard in the transportation of personnel and supplies upon vessels of that service.

THE SEAL HERD.

The 1920 census of the seal herd, taken as of date of August 10, indicated 552,718 animals of all ages, an increase of 28,483 over 1919. The census for 1921 gave 587,820 animals on the same date, an increase of about 35,000. The number of pups born in 1921 was 176,655. The seals killed from one census date to the next are not included in these figures. The 1920 enumeration was made by Dr. G. Dallas Hanna, who had been in charge of this work for several years; the 1921 census was placed under Edward C. Johnston, who had participated in the work of the previous year.

An innovation connected with the census in 1921 was the construction of two runways 6 feet above the ground leading to observation towers on one of the large rookeries on St. Paul Island, where in former years much difficulty and danger were experienced in making accurate observations on the large number of massed seals. To further facilitate the census, a number of concrete markers were prepared and placed on the rookeries at important points.

The average number of cows per harem in 1920 was 41; in 1921 the average was 45. These figures are regarded as indicating a very satisfactory condition of the herd.

In order that the Bureau might have the views and counsel of persons familiar with the fur-seal herd, an important conference was held in Washington on January 10, 1921, at which there were discussed methods and results of the seal census, the quota of 1921 and subsequent years, the length of the seal-killing season, etc. It was the sentiment of the conference that representatives of the interested nations should visit the Alaskan, Japanese, and Russian seal islands at an early date.

In June, 1921, a representative of the Bureau authenticated at Sitka 199 fur-seal skins legally taken by natives in the spring of this year, when the seal herd was migrating northward. A patrol of the sealing grounds was maintained by the Bureau's vessels *Murre* and *Auklet* in the latter part of May, while the herd was in that vicinity.

THE TAKE OF SEALSKINS.

The number of seals killed under governmental supervision on the Pribilof Islands in 1920 was 26.648, of which 25,978 were taken during the regular season ending on August 10 and the remainder in fall and winter for the food purposes of the natives. Seals 3 and 4 years old yielded 25.297 of the total skins secured.

The quota of seals to be killed during the calendar year 1921 was tentatively fixed at 30,000. The first drives were made in June, and the season closed on August 5, five days earlier than usual, to avoid the risk of killing cows which about that time began to resort to the hauling grounds of the bachelor seals. The seals taken numbered 22,546, mostly 3 years of age. The usual fall killing, beginning October 20, will add some hundreds to the skins available for sale.

As a result of extensive experimental work in 1920 certain innovations and improvements in the taking and handling of fur-seal skins were developed and put into effect along practical lines in 1921. It was found that the highest grade of finished product could be secured by removing the pelt from the carcass with the least possible use of the knives, thus practically eliminating all cuts or flays on the underside of the pelt previously unavoidable at times even by the most skillful skinners. This was accomplished by suspending the seal from a tripod, cuts being made around the flippers, head, and down the abdomen, and the skin then being simply stripped off the carcass. In continuance of the new methods, the skins are then blubbered and washed in sea water before salting, the experiments last season having shown the great advantage of washing the pelts. An improved method of spreading and stretching them at the time of salting has also been tried. By another year it is contemplated that all skins will be taken in accordance with the new and improved processes, for which special facilities have had to be provided.

SALE OF SEALSKINS.

In the fiscal year 1921 two public auction sales of fur-seal skins were held at St. Louis. At the sale on February 21, 1921, 10,120 skins brought $355.689, and on May 23, 1921, 10,060 skins were sold for $359.715, a total of $715,404. The lower prices received reflected the general depression in the fur markets of the world.

At the sale on February 21, 1921, there were also sold 111 sealskins from the Japanese herd on Robben Island, representing the share of the United States in the skins taken in the years 1918 and 1919. The 111 skins brought $3,434.

As a net result of the sales of fur-seal skins in the fiscal year 1921 there will have been deposited in the Treasury of the United States the sum of $341,543.46. In addition to this amount the sum of $123,058.42 has been set aside for payment to Great Britain and Japan as their share of skins to which they are entitled under the North Pacific Sealing Convention of 1911.

FOXES AND REINDEER.

A valuable natural asset on the Pribilof Islands are the herds of blue foxes. The animals have to be held in check, and the taking of a certain number of pelts each winter is desirable. Under the plan in effect on St. George Island, involving the systematic feeding of the foxes during the winter on preserved seal carcasses, the herd has increased steadily and further improvement may be expected.

The foxing operations in the winter of 1920–21 were most satisfactory. Blue foxes to the number of 1,125 were taken for their skins, together with 14 foxes in the white phase. This is the largest number of foxes taken since 1892–93, when 1,301 skins were reported by the lessees of the islands.

During the past winter 240 pairs of the best blue foxes entering the large trapping inclosure on St. George Island were released as breeders.

The fox skins taken in the season of 1919–20, numbering 901 blues and 37 whites, were sold at public auction in St. Louis on February 21, 1921. The price realized was $80,699, an average of $88.12 for blues and $35 for whites.

The introduction of reindeer on the Pribilof Islands in 1911 has proved very successful. The original stock consisted of 40 animals. The most recent computation indicated 192 on St. Paul Island and 125 on St. George Island, or 34 more than the number reported for the previous year. These figures do not include 53 animals used for food purposes during the intervening period. The herds are becoming more and more valuable as a splendid source of fresh meat for both the whites and natives.

MISCELLANEOUS.

SEMICENTENNIAL OF THE BUREAU.

The Bureau of Fisheries attained the fiftieth year of its existence on February 9, 1921, having had its origin in a joint resolution passed by Congress on February 9, 1871.

At the time of its establishment, and for many years thereafter, the Bureau was an independent commission and its duties were largely investigatory. Scientific investigation, the initial function imposed on the service by law, has remained a prominent branch of the work, recognized as an essential aid to fish culture and the fisheries. From time to time in the early years Congress imposed new responsibilities and duties, and the growth was rapid. The collection of statistics of the commercial fisheries, which was undertaken at an early date to meet a pressing national need, soon expanded into a comprehensive study of all phases of the fisheries which reached a high degree of progress in the second decade of the

Bureau's existence, and in more recent years has been extended and amplified, with a view to supplying practical aid to the fishing industry.

The early investigations of the food-fish resources of the coastal and interior waters of the country, undertaken in response to acts of Congress, convinced the first Commissioner that, with the control and regulation of the fisheries vested in the various States, an important rôle for the Federal Government to play in the maintenance of those resources was in the field of artificial propagation. This soon became the most extensive branch of the service, and has continued to employ the most people and receive the largest appropriations, but in the organization and administration of the Bureau fish culture has never been more than a coordinate division of the work. In 1910 there was imposed on the Bureau for the first time responsibility for the administration of protective laws, when the fishes and fur seals of Alaska were transferred to its custody.

The early operations of the Bureau attracted to its service an able corps of men who became pioneers in various branches of fish culture, aquatic biology, and fishery technology, and who gave to the work a trend and character which have continued to serve as a guide.

As evidence of the scope and character of the Bureau's activities during the 50 years of its existence, there has been issued an analytical subject bibliography of its publications from 1871 to 1920, inclusive. This document lists many thousand separate titles covering the fisheries, fish culture, aquatic biology and physics, oceanography, fishery legislation and protection, etc., constituting the most extensive series of reports in this field ever published.

NEW BUILDINGS AND IMPROVEMENTS.

A very satisfactory new fireproof building has been constructed at the Woods Hole (Mass.) station, under a contract awarded January 6, 1921, for $51,000. The new structure replaces a storehouse and machine shop destroyed by fire and an old boiler house and pump house which had become so permeated with dry rot that it had to be demolished. From the special appropriation provided for this purpose the equipment, machinery, and stores consumed by the fire have been replaced, a salt-water filter has been provided, and various other improvements have been brought about.

The balance of the special appropriation for the Bozeman (Mont.) station after the repairing of the superintendent's residence was used for the purchase and erection of a bungalow for the foreman containing five rooms, a cellar, and a spacious attic.

The new laboratory building of the fisheries biological station at Fairport, Iowa, has been completed and equipped and has been actively used for the purposes for which the station was established. Formal acceptance of the building from the architect and its dedication to the service of the fisheries occurred on October 7, 1920. The structure, which replaces a frame building destroyed by fire in 1917, is of concrete, stone, and brick, is about 100 by 50 feet, with three stories and basement, and is superior to the old building in respect to capacity, convenience, and serviceability. The normal accommodations for 16 investigators may be increased as circumstances demand. Among the useful features are a library, a chemical laboratory, a photographic room, a museum, a mess hall and kitchen, and tank and aquarium rooms, in addition to offices.

At the beginning of the year reconstruction work at the Baker Lake (Wash.) station was well under way, and though hampered by difficulties in transportation and by high prices of material and labor has progressed to a point where the station is again on an efficient working basis. In addition to the hatchery described in the last report a bunk house, sawmill, and workshop have been erected, all of which are of frame construction with iron roofs. Practically all the tools and appliances, including nets, seines, hatchery equipment, and furniture of all kinds, were destroyed and have been replaced. Communication with Baker Lake station is by means of pack horses over an 18-mile trail, and the large amount of heavy material needed in the reconstruction of the plant has made it necessary to undertake considerable improvements to the trail, including the rebuilding of bridges, corduroy work over swampy portions, and grading at other points.

The construction work at the Yes Bay (Alaska) station has included the installation of a new water-supply system, the main line consisting of about 4,000 feet of 16-inch and 18-inch wood-stave pipe for conveying water to the hatchery and ponds, with 1,250 feet of 6-inch pipe to supply water for domestic use and fire protection. New foundation timbers have been laid under the hatchery, the worn-out floors of the building have been replaced with new ones, 240 hatching troughs and a 196-foot supply trough have been constructed, and important repairs have been made to other buildings and equipment.

VESSEL SERVICE.

Owing to the Bureau's inability to secure qualified personnel for investigation and research work, the operations of the steamers *Albatross* and *Fish Hawk* were restricted during the fiscal year. The *Albatross* (excepting one trip in connection with the Chesapeake Bay survey, when the *Fish Hawk* was in quarantine) was not actively engaged and advantage was taken of the opportunity to make needed improvements to the crew's quarters, to modernize sanitary arrangements, to repair and strengthen deck houses, to replace sounding and dredging gear with approved appliances, and to renew the equipment generally. The ship has been lying at the Coast Guard depot at South Baltimore, and the advisability of placing her out of commission and releasing her naval officers and crew is under consideration.

The physical and biological survey of Chesapeake Bay, undertaken in the previous year, was continued by means of the steamer *Fish Hawk*, and has been practically completed in so far as need for that vessel is concerned. Seven trips, extending the entire length of the bay, were made, with a total mileage of 2,275. The plan of the work embraced observations at about 35 stations, and while each one was not occupied on every trip, 190 stations were made in all and 29 stations were made by the *Albatross*.

During the fiscal year three cruises were undertaken by the steamer *Halcyon*—two for the purpose of oceanographic investigations in the Gulf of Maine and one at the request of Massachusetts fishing interests in an endeavor to locate schools of mackerel. The latter cruise occurred in August and covered some 1,000 miles of fishing grounds in the Gulf of Maine and to the southwest and west of South Shoal Lightship. The results were almost entirely negative. The vessel was accompanied by practical mackerel fishermen who represented the Gloucester Board of Trade. The oceanographic cruises were made in December, January, and March, and were under the charge of Dr. Henry B. Bigelow. None of the trips was of long duration, but 23 stations were occupied with the use of appropriate apparatus and 1,286 miles were steamed between Cape Cod and Nova Scotia. During July and August the vessel was overhauled and contemplated improvements were completed. She is now equipped with a single drum hoist for dredging purposes and a complete electric-light system.

The auxiliary schooner *Eider* performed excellent service during the year as a tender for the Pribilof Islands, 10 round trips having been made between Unalaska and the islands for the transportation of cargo and passengers and one trip to King Cove. In November, 1920, it was necesary for the vessel to go to Kodiak for repairs which could not be made at Unalaska. The vessel was at sea every month in the year and cruised about 7,800 miles.

The small fishery patrol boats *Murre* and *Auklet* were engaged the greater part of the year in their usual work in southeastern Alaska for the protection of the fisheries. Transportation was afforded to a number of employees of other Government bureaus. In May the two vessels maintained a patrol in the vicinity of Sitka for the protection of the migrating fur-seal herd. The *Auklet* made a trip to Prince Rupert during May for the purpose of procuring foodstuffs needed by merchants of Wrangell and Ketchikan to relieve the shortage resulting from the steamship strikes. In June the *Auklet* towed the *Osprey* from Wrangell to Seattle and on the return trip towed the *Petrel* from Seattle to Wrangell. Each of the two boats cruised about 4,400 miles.

The *Phalarope*, *Gannet*, and *Shearwater* were occupied as usual in fish-cultural work, the first two on the New England coast, the last on Lake Erie.

The motor boats obtained by transfer from the Navy have been renamed, and two, the *Petrel* (formerly the *Cobra*) and the *Merganser* (formerly the *Calypso*), have been transported to Puget Sound on a naval collier and prepared for fishery patrol work in Alaska. A third, the *Curlew* (formerly the *Polly*), has been taken to Cape Vincent, N. Y., and is doing good service in connection with the fish-cultural operations on Lake Ontario. The *Fulmar* (formerly the *Wachusetts*) is being fitted out for similar duty on Lake Michigan.

APPROPRIATIONS.

The regular appropriations for the support of the Bureau of Fisheries for the fiscal year 1921 aggregated $1,216,310. The specific purposes for which the appropriations were made and the amounts thereunder were as follows:

Salaries	$448, 810
Pay of officers and crews of vessels for Alaska service	26, 000
Miscellaneous expenses:	
Administration	11, 000
Propagation of food fishes	400, 000
Maintenance of vessels	120, 000
Inquiry respecting food fishes	45, 000
Fishery industries	7, 500
Protecting sponge fisheries	3, 000
Protecting seal and salmon fisheries	140, 000
Special appropriations:	
Fur-seal islands, repairs and improvements	10, 000
Fairport (Iowa) biological station, equipment	5, 000

Deficiency appropriations as follows, amounting to $13,775, became available during the year:

Maintenance of vessels	$4, 422
Protecting seal and salmon fisheries	9, 353

In accordance with law, a detailed statement of the expenditures under the regular and deficiency appropriations will be duly submitted.

Respectfully submitted.

HUGH M. SMITH,
Commissioner of Fisheries.

To Hon. HERBERT HOOVER,
Secretary of Commerce.

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FIG. 1.—SALMON ON THE SPAWNING BEDS.

PACIFIC SALMON FISHERIES.[a]

By John N. Cobb.

CONTENTS.

[a] Appendix I to the Report of the U. S. Commissioner of Fisheries for 1921. B F. Doc. No. 902.

INTRODUCTION.

The most valuable commercial fisheries in the world, excepting only the oyster and herring fisheries, are those supported by the salmons. Of these the most important by far are the salmon fisheries of the Pacific coast of North America, where California, Oregon, Washington, and Alaska, including also British Columbia, possess industries representing millions of dollars of investment and millions of output annually. In Siberia the fishery is increasing in importance annually as means of transportation become better, while Japan is also becoming a large factor in the salmon markets of the world through her investments in the salmon fisheries of Siberia and, to a lesser extent, through fisheries prosecuted in her own waters.

In this third edition of the report[a] considerable new material has been added, while some chapters have been entirely remodeled and materially enlarged. The statistical data have been brought up to January 1, 1920. The author is indebted to the Pacific Fisherman, of Seattle, Wash., for certain illustrations and to George C. Teal for permission to use his copyrighted picture shown as figure 11. Most of the illustrations are from pictures taken by the author.

THE SPECIES OF SALMON AND THE RUNS.

The Pacific coast salmons are all included in the genus *Oncorhynchus*. With them the fishermen incorrectly class the steelhead trout, which really belongs to the closely related genus *Salmo*.

As long ago as 1731 the species of *Oncorhynchus* were first made known by Steller, who, almost simultaneously with Krascheninikov, another early investigator, distinguished them with perfect accuracy under their Russian vernacular names. In 1792 Walbaum adopted these vernacular names in a scientific nomenclature for these fishes.

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[a] First edition: The Salmon Fisheries of the Pacific Coast. By John N. Cobb. U.S. Bureau of Fisheries Document No. 751, 180 pp. Washington, 1911.
Second edition: Pacific Salmon Fisheries. By John N. Cobb. U. S. Bureau of Fisheries Document No. 839, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, 255 pp., 29 pls. Washington, 1917.

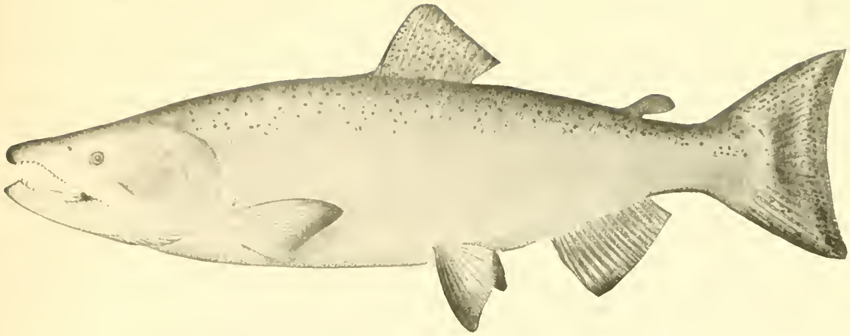

FIG. 2.—CHINOOK SALMON. BREEDING MALE.

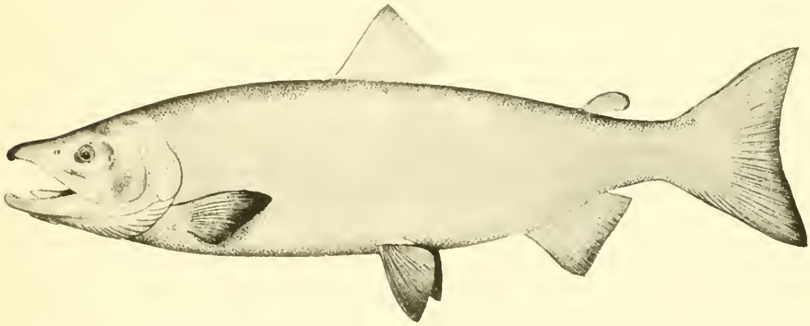

FIG. 3.—SOCKEYE SALMON. ADULT MALE.

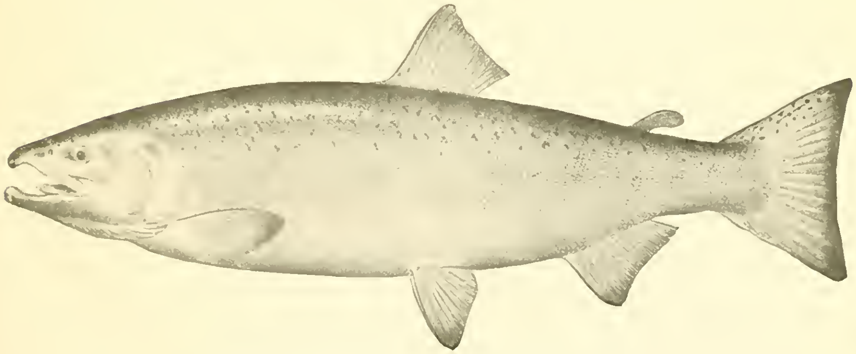

FIG. 4.—COHO SALMON. BREEDING MALE.

FIG. 5.—CHUM SALMON. BREEDING MALE.

FIG. 6.—HUMPBACK SALMON. ADULT MALE.

FIG. 7.—STEELHEAD TROUT.

Five species of salmon (*Oncorhynchus*) are found in the waters of the north Pacific, ranging northward from Monterey Bay on the American coast and Japan on the Asiatic, the extreme northern distribution of certain of the species having not yet been accurately determined. The five species are: (1) *Oncorhynchus tschawytscha,* quinnat, tyee, chinook, spring, or king salmon; (2) *Oncorhynchus nerka,* blueback, red, sukkegh, or sockeye salmon; (3) *Oncorhynchus kisutch,* silver, coho, or white salmon; (4) *Oncorhynchus keta,* dog, keta, or chum salmon; and (5) *Oncorhynchus gorbuscha,* humpback or pink salmon.

CHINOOK, QUINNAT, OR KING SALMON.

The largest, best known, and most valuable of these is the chinook or king salmon (*O. tschawytscha*). It is found throughout the region from the Ventura River, Calif., to Norton Sound, Alaska, and on the Asiatic coast as far south as northern China. As knowledge extends, it will probably be recorded in the Arctic.

In the spring the body is silvery, the back, dorsal fin, and caudal fin having more or less of round black spots, and the sides of the head having a peculiar tin-colored metallic luster. In the fall the color is, in some places, black or dirty red. The fish has an average weight of about 22 pounds, but individuals weighing 70 to over 100 pounds are occasionally taken. One was caught near Klawak, Alaska, in 1909, which weighed 101 pounds without the head. The Yukon River is supposed to produce the finest examples, although this supposition is not based on very reliable observations. The southeast Alaska fish average as high as 23 pounds in certain seasons, followed by an average of about 22 pounds in the Columbia River and about 16 pounds in the Sacramento.

In most places the flesh is of a deep salmon red, but in certain places, notably southeast Alaska, Bristol Bay, Puget Sound, and British Columbia, many of the fish, the proportion being sometimes as much as one-third of the catch, have white flesh. A few examples have been taken with one side of the body red and the other white, while some are found with mottled flesh. No reasonable explanation of this phenomenon has yet been given.

In its southern range the quinnat strikes in at Monterey Bay in sufficient numbers to justify commercial fishing about the middle of April, where it is seen feeding upon the inshore moving schools of herring and sardines, continuing until in August. There are two runs of spawning fish in the Sacramento, the first or "spring run" beginning in April and continuing throughout May and June, these fish spawning mainly in the cold tributaries of the Sacramento, such as the McCloud and Fall Rivers. The second or "fall run" occurs in August, September, and October, and these fish spawn in the riffles in the main river between Tehama and Redding, also entering the tributaries in that vicinity. The two runs merge into each other. It is also claimed that there is a third run which comes in December.

In former years the San Joaquin and the American and Feather Rivers of the Sacramento system had large runs of salmon, but excessive fishing and the operation of various mining and irrigation projects have practically depleted them.

The Eel and Mad Rivers of northern California have only a late or fall run, while the Klamath River has both a spring and a fall run, and Smith River has a spring run alone. Rogue River in Oregon has both a spring and a fall run, and the Umpqua and several other coast streams of Oregon have small early runs.

The Columbia River has three runs, the first entering during January, February, and March, and spawning mainly in the Clackamas and neighboring streams. The second, which is the best run, enters during May, June, and part of July, spawning mainly in the headwaters. The third run occurs during late July, August, September, and part of October, and spawns in the tributaries of the lower Columbia.

In Puget Sound chinook salmon are found throughout the year, although it is only during the spawning season that they are very abundant. In the Fraser River, a tributary of the Sound, the run occurs from March to August.

In the Skeena River, British Columbia, the run occurs from May to July, the same being approximately true of the Nass also.

In southeast Alaska they are found all months of the year. From March to the middle of June they are abundant and feeding in the numerous straits and sounds; in May and June the spawning fish enter the Unuk, Stikine, Taku, Chilkat, Alsek, and Copper Rivers in large numbers, and in a few smaller streams in lesser abundance. In August, September, and October they are again to be found in large numbers feeding in the bays and sounds, while during the winter months a few have been taken on trawls set for halibut, showing that they are living in the lower depths at this time.

In Cook Inlet the run occurs during May and June and is composed wholly of red-meated fish; in the rivers of Bristol Bay the run comes in June and July, principally in the first-named month, and the same is true of the Togiak, Kuskokwim, and Yukon Rivers, the late appearance of the fish in the upper courses of the Yukon being due to the immense distance the fish have to cover.

SOCKEYE, BLUEBACK, OR RED SALMON.

The red or blueback salmon (*O. nerka*), which forms the greatest part of the canned salmon of the world, when it first comes in from the sea is a clear bright blue above in color, silvery below. Soon after entering the river for the purpose of spawning the color of the head changes to a rich olive, the back and sides to crimson, and finally to a dark blood red, and the belly to a dirty white. The maximum weight is about 12 pounds, and length 3 feet, with the average weight about 5 pounds, varying greatly, however, in different localities. Observations of Chamberlain [a] in Alaska show that the average weight of a number of sockeyes taken from Yes Bay was 8.294 pounds, while the average weight of a number from Tamgas was only 3.934 pounds. Evermann and Goldsborough [b] report as a result of the weighings of 1,390 red salmon, taken from as many different places in Alaska as possible, an average weight for the males of 7.43 pounds; for the females, 5.78 pounds; or an average weight for both sexes of 6.57 pounds. A run of small, or dwarf, males accompanies certain of the main runs, being especially noticeable in the Chignik Lagoon

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[a] Some Observations on Salmon and Trout in Alaska. By F. M. Chamberlain, naturalist, U. S. Fisheries steamer *Albatross*. U. S. Bureau of Fisheries Document No. 627, p. 80. Washington, 1907.

[b] The Fishes of Alaska. By B. W. Evermann and E. L. Goldsborough. Bulletin, U. S. Bureau of Fisheries, 1906, Vol. XXVI, p. 257. Washington, 1907.

(Alaska) run. This species usually enters streams with accessible lakes in their courses.

These fish are occasionally found landlocked in certain lakes, especially in the State of Washington, and are always much smaller in size than the sea-run fish. In Bumping Lake, near North Yakima, Wash., they are quite abundant and are mature when about a pound in weight. Despite the fact that these fish have a soft mouth, anglers consider them very gamey. They take bait, the fly, and the trolling spoon. Large numbers are hatched and distributed by the Washington Fish and Game Commission under the name of "silver trout."

A few specimens of the sockeye have been taken as far south as the Sacramento River. In Humboldt County, Calif., small runs are said to occur in Mad and Eel Rivers, while 20 sockeyes are reported as having been taken in the Klamath River in the autumn of 1915. Only an occasional specimen appears in the coastal streams of Oregon. The Columbia is the most southern river in which this species is known to run in any considerable numbers, entering the river with the spring run of chinooks. From here south the species is called blueback exclusively. A considerable run enters the Quinault River, Wash., and there is also a small run in Ozette Lake, just south of Cape Flattery.

In the Puget Sound region, where it is known as the sockeye, this species ascends only the Skagit River in commercial numbers, although a small run appears in the Lake Washington system of lakes and, possibly, in the Snohomish, Stillaguamish, and Nooksack Rivers.

At one time the greatest of all the sockeye streams was the Fraser River, British Columbia, a stream famous from very early days for its enormous runs of this species, a peculiar feature of which is that there is a marked quadrennial periodicity in the run. The maximum run occurs the year following leap year, the minimum on the year following that. The greater part of the catch of the Puget Sound fishermen is made from this run as it is passing through Washington waters on its way to the Fraser. The fish strike in during July and August on the southwest coast of Vancouver Island, apparently coming from the open sea to the northwest. They pass through the Straits of Juan de Fuca, Rosario, and Georgia, spending considerable time in the passage and about the mouth of the river. Small numbers run as early as May and as late as October, but the main body enters about the first week in August.

The sockeye occurs in most of the coastal streams of British Columbia, and is usually the most abundant species. The principal streams frequented are the Skeena, Rivers Inlet, Nass, Lowe Inlet, Dean Channel, Namu Harbor, Bella Coola, Smith Inlet, Alert Bay, and Alberni Canal.

In Alaska, where this fish is generally known as the red salmon, it is abundant and runs in great numbers in all suitable streams, of which the following are the most important: In southeast Alaska, Boca de Quadra, Naha, Yes Bay, Thorne Bay, Karta Bay, Nowiskay, Peter Johnson, Hessa, Hetta, Hunter Bay, Klawak, Redfish Bay, Stikine, Taku, Chilkoot, Chilkat, Alsek, Situk, Ankow, etc.; in central Alaska, Copper, Knik, Kenai, Susitna, Afognak, Karluk, Alitak, Chignik; and in the Bristol Bay region, the Ugashik, Ugaguk, Naknek, Kvichak, Nushagak, and Wood. It is also supposed to occur in small numbers in the Togiak, Kuskokwim, and Yukon Rivers, which debouch into Bering Sea, and possibly occurs in the Arctic streams of Alaska. The run in western Alaska begins usually early in June and extends usually to the middle of August, the bulk of the run occurring in the first three weeks of July. It begins earlier in Prince William Sound, however, and sometimes extends into September in southeast Alaska. The duration of the run averages about the same in each section.

SILVER OR COHO SALMON.

The silver or coho salmon (*O. kisutch*) is silvery in spring, greenish on the upper parts, where there are a few faint black spots. In the fall the males are mostly of a dirty red. The flesh in this species is of excellent flavor, but paler in color than the red salmon, and hence less valued for canning purposes. The maximum weight is about 30 pounds, with a general average of about 6 pounds.

The silver salmon is found as far south as Monterey Bay, where it appears during the month of July, and is taken by the trollers. From Eel River, in California, north, it is found in most of the coastal streams. It usually appears in July, and runs as late as November, the time of appearance and disappearance varying somewhat in different sections. Owing to its late appearance comparatively few, and they usually in the early part of the season, are packed by the canneries, most of which shut down in August and September. This fish also tarries but a short time about the mouth of the stream it is to enter, and is wary of nets, which makes it rather unprofitable to fish for the latter part of the season when it is running alone.

HUMPBACK OR PINK SALMON.

The humpback or pink salmon (*O. gorbuscha*), the smallest of American species, weighs from 3 to 11 pounds, the average being about 4 pounds. Its color is bluish above, silvery below, the posterior and upper parts with many round black spots, the caudal fin always having a few large black spots oblong in shape. The males in fall are dirty red and are very much distorted in shape, a decided hump appearing on the back, from which deformity the species acquires its name. The flesh is pale, hence its canned name, "pink" salmon.

The southern limit of the fish is the San Lorenzo River, Santa Cruz County, but only occasional specimens are found here and in the rivers to the northward until Puget Sound is reached. Here a large run appears every other year, the only place on the coast where such is the case.

The humpback occurs in varying abundance in the waters of British Columbia, but it is in the waters of southeast Alaska that it appears in its greatest abundance. Many of the canneries in this region and some of those operating in central Alaska depend mainly upon the humpback for their season's pack, and the canned product now occupies an excellent position in the markets of the world. The fish spawn in nearly all of the small, short streams.

In western Alaska the runs are much smaller and the humpback is not much sought after by the cannery men, who are usually able to fill their cans with the more valuable species.

In southeast Alaska the run begins in June and continues until September. In western Alaska the period is somewhat shorter. In Puget Sound it continues until late in the fall, although but few are taken after September 15.

DOG OR CHUM SALMON.

The dog or chum salmon (*O. keta*) reaches a maximum weight of 16 pounds, the average being about 8 pounds. When it first appears along the coast it is dirty silvery, immaculate or sprinkled with small black specks, the fins dusky, the sides with faint traces of gridironlike bars. Later in the season the male is brick red or blackish, and its jaws are greatly distorted. Its flesh is light yellow, especially when canned. It is especially good for freezing, salting, and smoking.

This species has a wide distribution. It is found as far south as San Lorenzo River, Santa Cruz County, Calif., but is not utilized commercially in California except on Eel River. It is found in most of the coastal streams from here north, being especially abundant from Puget Sound northward to southeast Alaska, both inclusive. In this region it is being utlized in greater abundance each year, as the market for it widens.

In central, western, and arctic Alaska the species occurs in varying abundance, but it is utilized sparingly, except by the natives, with whom it is the favorite species dried for winter food for their dogs.

The run of dog salmon comes later than that of any other species except the coho. In Alaska it begins in June, but the height of the season does not occur until late in August or early in September, and fish are found as late as November. In Puget Sound they run from about the middle of August till late in November, and practically the same is true in the Columbia River.

STEELHEAD TROUT.

The steelhead trout (*Salmo gairdneri*) is commonly classed as one of the salmons by the fishermen of the Pacific coast, and it has been included in this report on this account. It is said to have received its common name from the hardness of the skull, several blows of the club being required to kill the salmon when taken into the boat. In different localities the average weight is placed at from 8 to 15 pounds, while extreme sizes reach 45 pounds. The excellent quality of its flesh causes it to be highly prized for the fresh and frozen markets, but owing to its pale color only limited quantities are canned.

The principal center of abundance of this species is the Columbia River. It is found from Carmel River, Calif., north to central Alaska, and possibly has an even wider range in Alaska. As a result of extensive plants made during the last five or six years the range has been much extended on the Pacific coast as well as elsewhere in this country. It seems to be found in the rivers during the greater part of the year. In the Columbia River the spawning season is from February to May, in Puget Sound in the spring, and in southeast Alaska in May and June. The best commercial fishing is in January, February, and March. In California the catching of this species is restricted to hook and line fishing.

AGE OF SALMON AT MATURITY.

As practically all salmon which have the opportunity spawn but once and then die, knowledge of the age at which this occurs is of great interest both from an economic and scientific standpoint. Many attempts have been made to solve the problem with the sockeye and king salmon, the most important commercially of the five species, by means of marking artificially reared fry, usually by clipping one of their fins before they are liberated, as noted elsewhere in this report, but with unsatisfactory results.

Fortunately, certain experiments carried on in Tomales Bay, Calif., and in New Zealand, where king fry were planted in streams not frequented by the species in question and the return of the adults noted, have yielded some interesting and accurate information on the subject. These indicated that the age was four or more years, as no run was reported until the fourth year.

A more certain method of determining the age of salmon has been developed in recent years through the adaptation by American scientists of the discovery by European investigators that the ridges observed on the scales of certain fishes indicated a period of growth of the animal itself.

Dr. Charles H. Gilbert, of Stanford University, as early as 1910, applied this method to the determination of the age of the various species of Pacific salmon. As to its application to the Pacific salmon and the general method followed, Dr. Gilbert has the following to say:

> While the method is new as regards Pacific salmon, it has been experimentally tested and fully approved by the Fisheries Board of Scotland in the case of the Atlantic salmon, and is now universally accepted as furnishing reliable data as to the age and many other facts in the life history of that fish. It has been shown to be applicable also to various species of trout, and its value has been demonstrated in fishes as widely divergent as the carp, the eel, the bass, the flounder, and the cod. Descriptions of this scale structure and its significance have appeared in a large number of papers, both scientific and popular. It will suffice here to repeat that the scale in general persists throughout life, and grows in proportion with the rest of the fish, principally by additions around its border. At intervals there is produced at the growing edge a delicate ridge upon the surface of the scale, the successive ridges thus formed being concentric and subcircular in contour, each representing the outline of the scale at a certain period in its development. Many of these ridges are formed in the course of a year's growth, the number varying so widely in different individuals and during successive years in the history of the same individual that number alone can not be depended on to determine age. For this purpose we rely upon the fact that the fish grows at widely different rates during different seasons of the year, spring-summer being a period of rapid growth and fall-winter a season when growth is greatly retarded or almost wholly arrested. During the period of rapid growth the ridges are widely separated, while during the slow growth of fall and winter the ridges are crowded closely together, forming a dense band. Thus it comes that the surface of the scale is mapped out in a definite succession of areas, a band of widely spaced rings always followed by a band of closely crowded rings, the two together constituting a single year's growth. That irregularities occur will not be denied, and this is natural, inasmuch as growth may be checked by other causes than the purely seasonal one. Also a considerable experience is requisite for the correct interpretation in many cases, and a small residue of doubtful significance has always remained. This element is too small to affect the general results, and further investigation will almost certainly eliminate the doubtful cases altogether.[a]

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[a] Age at Maturity of the Pacific Coast Salmon of the Genus Oncorhynchus. By Charles H. Gilbert Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 4, 5. Washington, 1913.

As a result of his investigations up to this point, Dr. Gilbert presented the following conclusions drawn from the data collected:

1. The sockeye spawns normally either in its fourth or fifth year, the king salmon in its fourth, fifth, sixth, or seventh year, the females of both species being preponderatingly 4-year fish.

2. The young of both sockeye and king salmon may migrate seaward shortly after hatching, or may reside in fresh water until their second spring. Those of the first type grow more rapidly than the second, but are subject to greater dangers and develop proportionately fewer adults.

3. Coho salmon spawn normally only in their third year. The young migrate either as fry or yearlings, but adults are developed almost exclusively from those which migrate as yearlings.

4. Dog salmon mature normally either in their third, fourth, or fifth years, the humpback always in their second year. The young of both species pass to sea as soon as they are free swimming.

5. The term "grilse," as used for Pacific salmon, signifies conspicuously undersized fish which sparingly accompany the spawning run. They are precociously developed in advance of the normal spawning period of the species. So far as known, the grilse of the king salmon, coho, and dog salmon are exclusively males; of the sockeye, almost exclusively males, except in the Columbia River, where both sexes are about equally represented. The larger grilse meet or overlap in size the smaller of those individuals which mature one year later at the normal period.

6. Grilse of the sockeye are in their third year, of the king salmon in their second or third year, of the coho and the dog salmon in their second year.

7. The great differences in size among individuals of a species observed in the spawning run are closely correlated with age, the younger fish averaging constantly smaller than those one year older, though the curves of the two may overlap.[a]

Since 1910 Dr. Gilbert has devoted much of his time to investigations[b] along this line, especially on the sockeye, with most interesting and valuable results.

His observations on the sockeye runs of British Columbia indicate that they consist principally of four and five year fish and that these two classes appear during successive seasons in widely differing proportions; that each stream has its distinctive race of sockeye, the progeny returning at maturity to the parent stream; that sockeye fry rarely survive when they proceed to sea within the year in which they are hatched; and that sea feeding, with the consequent rapid growth, is the most important factor in producing early maturity, an equal number of years in fresh water producing comparatively little effect.

MARKING SALMON.

A favorite recreation for quite a number of Pacific coast people has been the marking of salmon fry in order to find out the age at which they return to spawn, the rate of growth, etc. Scattered through the reports of the various State fish commissions, and occasionally in the reports of the United States Bureau of Fisheries, are to be found detailed reports of such markings and the sometimes remarkable

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[a] Age at Maturity of the Pacific Coast Salmon of the Genus Oncorhynchus. By Charles H. Gilbert. Bulletin, U. S. Bureau of Fisheries, 1912, Vol. XXXII, pp. 21, 22. Washington, 1913.

[b] Contributions to the Life History of the Sockeye Salmon. (No. 1.) By C. H. Gilbert. Report of British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1913, with Appendices, pp. R53–78. Contributions to the Life History of the Sockeye Salmon. (No. 2.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1914, with Appendices, pp. N45–75. Contributions to the Life History of the Sockeye Salmon. (No. 3.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1915, with Appendices, pp. S27–64, 6 pls. Contributions to the Life History of the Sockeye Salmon. (No. 4.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1917, with Appendices, pp. Q33–80, 14 pls. Contributions to the Life History of the Sockeye Salmon. (No. 5.) By C. H. Gilbert. Report British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1918, with Apepndices, pp. X26–52, 24 pls. Contributions to the Life History of the Sockeye Salmon. (No. 6.) By C. H. Gilbert. Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, with Appeneices, pp. U35–68, 6 pls. Victoria, British Columbia.

results attained, apparently at varying periods subsequent to the marking.

All sorts of marks were employed. The favorite was the removal of the adipose fin, the experimenters appearing to be of the opinion that the fish would miss this the least of any. However, the entire or partial removal of nearly every fin was practiced by some one or other of the many experimenters. Sometimes a V or a U was punched out of the tail or the gill cover, and in one or two instances a tag was employed.

In time these marking experiments became so numerous, and so imperfect a record was kept of them by any central authority, that frequently it was impossible to tell, when an apparently marked specimen was obtained, where and when it was marked, and as a result but little dependence could have been placed upon them even had there been no other factors conspiring to vitiate their value.

Fishermen are continually finding in their nets salmon which they feel sure have been marked by some hatchery. Scores of times in the course of his various investigations of the fisheries of this coast the writer has been told of or shown specimens which the fishermen thought had been marked. Many of these marks were on the side of the fish and represented an M or W, depending upon the angle from which viewed, and it was impossible, generally, to convince the fishermen that this mark was caused by the twine of his gill net pressing on the side of the fish. The obvious fact that a fish could not survive when in the fry stage the infliction of such a mark did not occur to them.

Frequently the scars left by the suctorial organs of the lamprey have been mistakenly supposed to be hatchery marks. This scar resembles very closely a date stamp on a canceled letter.

One of the most interesting cases of salmon marking, and one which drives home the necessity for accepting reports of returns from such markings with extreme caution, is that of F. M. Chamberlain, then naturalist of the Bureau of Fisheries steamer *Albatross,* on the Naha Stream in Alaska.

In August, 1903, 1,600 red salmon fry, reared for the purpose from the 1902 eggs, at the Fortmann hatchery of the Alaska Packers Association, near Loring, Alaska, were marked by Mr. Chamberlain by excising both ventrals with fine curved scissors. The fry were released in the Naha River as soon as marked, at which time they were about three months old.

In 1906 between 50 and 100 adult reds with ventral fins missing were reported by the superintendent of the hatchery at Yes Bay, which is located on the northern side of Behm Canal (Naha being on the southern side) and some 15 miles farther up the canal than the mouth of Naha Stream. Some of these also had the adipose removed, this mark having also been used on some of the fry. At the Fortmann hatchery, where they were marked, only two of these fish were obtained in 1906.

From then on until 1912, a period of $9\frac{1}{2}$ years, the return of a number of these supposedly marked fish is noted each year at the two hatcheries in question, the number reported in the latter year being larger than in some of the intervening years. In 1912 Mr. Chamberlain himself pointed out the impossibility of these all being from the fry he had marked and no further attention was paid to them.

The principal thing that this and some of the other many experiments in salmon marking prove is that the percentage of salmon which accidentally lose, either through disease or the attacks of their many enemies, one or more of their fins, or portions of same, is much larger than most people suppose. Out of the many millions taken annually in commercial and fish cultural operations it is not surprising that some should be minus such exposed portions of their anatomy and this percentage would doubtless be found to be considerable were particular attention directed toward it. As it is now, it is only occasionally that the fisherman notices such loss, or mentions the same when he does, unless his attention has been directed to it by particular inquiry. In the Chamberlain experiment, for instance, after 1907 considerable publicity was given to the search for such marked fish, and the writer, in his travels through southeast Alaska during the succeeding years until the end of 1911, frequently was told by fishermen that they had caught salmon with missing fins. Inquiry developed that while a few of the lost fins were the same as Chamberlain had excised, a number were entirely different fins, showing that when the attention of fishermen was directed especially in this line many deformed fish would be found.

The confusion resulting from the many marking experiments carried on by different people shows the absolute necessity of some central authority regulating them if any real results are to be achieved from this line of endeavor. In 1908 the Secretary of Commerce, under authority of sections 11 and 12 of the Alaska fisheries law, directed that any persons desiring to mark and release salmon in Alaska first consult with and secure the written consent of the Commissioner of Fisheries or of the agent at the salmon fisheries of Alaska. It would be an excellent thing if some such control could also be exercised over these operations in the coastal States.

During the year 1916 Dr. Charles H. Gilbert, of Stanford University, assisted by Willis H. Rich, conducted salmon-marking experiments on an extensive scale. Late in the fall of 1915 a consignment of 100,000 eggs of the red salmon was forwarded to Seattle, Wash., from the station of the Bureau of Fisheries at Yes Bay, Alaska, of which 50,000 were reshipped to the Anderson Lake hatchery of the British Columbia Fisheries Department, located on the ocean side of Vancouver Island. The remaining 50,000 were sent to the Bureau of Fisheries hatchery at Quinault Lake, near the coast of Washington. The intention was as soon as the fry, hatched from these eggs, had developed into fingerlings to mark each lot with a distinctive marking and plant them in waters near the hatcheries, with the object of proving that the adult fish would return to the stream in which they had passed their early existence, no matter where the eggs were taken.

This plan could not be carried out at Anderson Lake, as the young fish resulting from the eggs, which were sent there, were not strong enough to survive the experiment. They were therefore liberated without marking. Those hatched at Quinault Lake were marked, however, and liberated in the summer of 1916. Dr. Gilbert has strong hopes that upon the return of the marked fish important data relating to the life history of the species will be obtained.

During February, March, and April, 1916, some 50,000 yearling sockeyes, which had been reared at the Bonneville hatchery of the Oregon Fish and Game Commission from eggs obtained from the Yes

Bay (Alaska) hatchery of the United States Bureau of Fisheries, were marked by the removal of the adipose and both ventral fins, and the fish then liberated in Tanner Creek, a tributary of the Columbia. The fish were in an apparently healthy condition when liberated. In order to make sure that they suffered no ill effects from the marking a few were held until the wounds had healed perfectly, and these were not affected adversely.

During the summer of 1918 a number of marked fish were reported to have returned and been caught.

During the same period close watch was kept on the Quinault River for the return of marked sockeyes from that marking experiment but none were observed so far as known.

OCEAN HOME OF THE SALMON.

All sorts of conjectures have been hazarded as to the ocean home of the salmon after the young fish have gone to sea and disappeared apparently from the ken of man. Many have conjured up visions of the vast schools of adult salmon surging along the coast hundreds of miles seeking for some suitable river in which to spawn, explaining in this wise the variations in the seasonal runs in different sections. Others think the fish go out into the greater depths of the ocean and there hide from man until the spawning instinct leads them back to the coast and thence to the stream in which they were born or planted.

Discoveries of recent years have quite altered this uncertainty, and we now are reasonably certain that the vast majority of the salmon are comparatively near our coast line, while others stay in the bays, straits, and sounds virtually all the time when not in the rivers.

Some years ago it was first noticed that king salmon would take the hook while in salt and brackish waters. At first only the anglers were interested in this fact, but as the demand for king salmon for mild curing became more insistent the commercial fishermen, attracted by the high prices paid, began to devote some attention to the fish during the early spring months, and soon trolling became a recognized branch of the industry. It was first taken up on a considerable scale in southeast Alaska in 1905.[a] As the demand for the fish increased, the fishermen extended operations until almost all of southeast Alaska waters were being fished. The length of the fishing season was also increased until now only the severe weather of winter prevents them from fishing. However, the halibut trawls occasionally come up during the season with king salmon on them, showing that they are still on the ground.

The above is also true to a certain extent of the waters of British Columbia and Puget Sound and to a lesser extent, so far as has been disclosed, of Monterey Bay and the Oregon coast.

It has been known for some years that the silver, or coho, salmon would also take the hook under practically the same conditions as the king salmon, and the only reason this species has not been fished for to the same extent as the king has been because it was not large enough to be attractive to the mild curers, and hence there was a much lesser demand for it.

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[a] Report on the Fisheries of Alaska. By John N. Cobb. Bureau of Fisheries Document No. 618, pp. 19–21. Washington, 1907.

It had been supposed that the other species did not feed when in coastal waters, but Marsh and Cobb [a] state quite differently:

Other species of salmon, in addition to the king, are found to take the trolling hook. For several weeks in July trollers in Union Bay, in southeast Alaska, caught a number of cohos and humpbacks while trolling for kings. The humpbacks were caught mainly with a spoon, no bait being used. Most of them appeared to have been feeding on needlefish and herring, according to the cutter who dressed them. A few red salmon are reported to have been caught on the trolling line by fishermen operating for king salmon in the neighborhood of Mary Island, near Dixon Entrance. Several fishermen report having in previous years frequently taken dog salmon on a hook in the bays along Chatham Strait.

In 1909, Mr. J. R. Heckman, of Ketchikan, Alaska, a well-known cannery man, told the writer that, while he was trying to install a floating trap near Cape Chacon, at the lower end of Prince of Wales Island, southeast Alaska, he on several occasions observed red salmon feeding on what he called a red shrimp.

This was also observed in 1912, when Dr. Gilbert reported, in connection with his observations of salmon fishing on Swiftsure Bank, off the Straits of San Juan de Fuca, that "during the past summer it was observed by Mr. J. P. Babcock and the writer that the sockeye on the Bank were feeding extensively on a small shrimp-like crustacean (*Thysanoessa spinifera*, Holmes), which floats in incredible numbers on the tides and forms a favorite food for the other species as well as for the sockeye." [b] He also found all the other species feeding voraciously in this neighborhood.

The experience of the fishermen operating in and off Port Moller, in Bering Sea, also affords confirmatory evidence along this line. A cannery was established on Port Moller in 1913, the avowed purpose of the owners being to catch what they claimed would be the enormous schools which annually resort to the great rivers of Bristol Bay, some 210 miles to the eastward from Port Moller. This cannery made a fairly large pack for a season or two, using purse seines in Bering Sea and traps along the shore. Misled by this, three other canneries were built in 1916 and 1917. In a season or two the catches of the combined plants had dropped to much less than the catch of the one cannery when operating alone, thus showing that the fishermen were operating on a run which was local to that neighborhood. This is borne out by the fact that the Bristol Bay runs showed no appreciable diminution when the catch was lowest at Port Moller. The pack of the Port Moller canneries follows.

PACK OF THE PORT MOLLER CANNERIES.

Year.	Number of canneries.	Cases packed.	Year.	Number of canneries.	Cases packed.
1913	1	44,150	1917	4	39,688
1914	1	87,175	1918	4	124,884
1915	1	105,674	1919	2	29,849
1916	2	132,367			

[a] The Fisheries of Alaska in 1909. By Millar C. Marsh and John N. Cobb. U. S. Bureau of Fisheries Document No. 730, p. 26. Washington, 1910.

[b] The Salmon on Swiftsure Bank. By Charles H. Gilbert. Report of British Columbia Commissioner of Fisheries for Year ending Dec. 31, 1912, and Appendix, p. 1 16. Victoria, British Columbia.

These observations would tend to confirm the belief which has been steadily growing in favor for some years that the salmon either spend the greater part of their life in the bays, straits, and sounds, or else in regions adjacent to the coast line.

The reason they had not been found in this region earlier is doubtless due to the fact that during the fall, winter, and spring months the weather on the north Pacific coast is such that fishing operations can not be carried on along the open coast, while in summer the fishermen are all busy on the spawning runs and have no time to devote to fish not yet arrived at maturity, which are probably feeding along the coast as usual.

FISHING GROUNDS AND HISTORY OF THE FISHERIES.[a]

WASHINGTON.

Puget Sound.—Strictly speaking, the name Puget Sound should be restricted to that long, narrow arm extending south from the Strait of Juan de Fuca, but a practice has developed, and is now common among fishermen and others, of designating all the great water area in the State of Washington comprising Puget Sound proper, Strait of Juan de Fuca, Canal de Haro, Rosario Strait. the Gulf of Georgia, and the smaller straits, bays, and sounds, as Puget Sound, and this practice, for the sake of convenience, has been followed in this report.

This great indentation in the coast, with its numerous islands and many fine harbors, has greatly aided the development of this portion of Washington and has been specially favorable to the prosecution of the salmon and other fisheries. Numerous rivers and creeks enter the Sound, the more important of these being on the eastern shore and comprising the Nooksack, Skagit, Stillaguamish, Snohomish, Duwamish, Puyallup, and Nisqually. On the southern and western shores the tributary streams are nearly all small, the more important being the Skokomish, Quilcene, Dungeness, and Elwha.

As on other bodies of water on the Pacific coast frequented by salmon, the Indians were fishing for them when the first whites visited the country. The natives at this time, and for many years after, used reef nets and hooks and lines in the salt water, and spears, dip nets, and weirs in the rivers. Traders first reached the headwaters of the Fraser River and gradually worked down the same until they reached the sea.

For many years this region was comparatively isolated from the rest of the world, and the completion of transcontinental railroads has not completely changed this, owing to its distance from large consuming centers. As a result of this isolation, it was necessary for many years to resort to methods of preparation which would insure the preservation of the product for indefinite periods. Salting naturally came first, followed by canning, while the shipping of fresh salmon has been steadily growing in importance as transportation facilities increased.

The Northwest Co., a large fur-trading organization, about the beginning of last century first introduced the salting process and

[a] For some of the regions the historical data are fragmentary and can not be considered as other than historical notes. It is hoped that some one will write a history of the industry before all of the pioneers have passed away.

this was continued by the Hudson Bay Co. Both companies carried on the business primarily for the purpose of providing a winter stock for the use of their employees and for local sale. As shipping developed on the Pacific, a considerable export trade in salted salmon was developed with the Hawaiian Islands, Australia, China, and Japan, and with the eastern United States. Quinnat, or spring, and sockeye salmon were the principal species employed in the earlier years.

After the boundary line between Canada and the United States had been established in 1846, and what is now the State of Washington was acknowledged as part of the latter, a number of small traders and fish packers succeeded the Hudson Bay Co. In the early sixties several men were engaged in the business at Point Roberts, according to the Olympia Columbian of September 10, 1853. In 1873, V. T. Tull, of Olympia, established a salmon fishery at Mukilteo, principally for putting up fish in barrels. The first year 500 barrels were packed at Mukilteo, after which the fishery was moved temporarily to Seattle to take the late run up the Duwamish River, which is usually large. Fifteen hundred good large salmon have been taken at one haul of the seine in the Puyallup.

Bancroft's "History of Washington, Idaho, and Montana" contains among others the following references[a] to the early fishermen of the Sound:

In 1874 Corbette & Macleay, of Portland, founded a fishery at Tacoma. Sixty barrels were packed in five days, only three men being employed.—New Tacoma Tribune, November 14, 1874. In 1876, John Bryggot, a Norwegian, founded another fishery at Salmon Bay, 6 miles north of Olympia. In 1878 a company of Puget Sound men established a fourth at Clallam Bay. They put up the first season 600 casks of salmon and 700 of halibut.—Morse's Wash. Terr., MS., xviii, 17–18. In the following season D. D. Hume established a fishery near Steilacoom for the purpose of salting salmon. In 1880 H. Levy, of Seattle, went to London with 100 barrels to introduce Puget Sound salted salmon to that market. In 1882 a salmon packing establishment was opened at Old Tacoma by —— Williams. Salmon ran in great numbers this year. One boat brought in a thousand fish.

The extension of the railroad to Puget Sound, thus furnishing an outlet to the rapidly growing population in the Middle West, did much to aid the industry. This also gave opportunity to begin the shipping of fresh halibut and salmon to eastern points. Ainsworth & Dunn, of Seattle, operating later under the name of the Seattle Fish Co., were the first successful pioneers in this branch of the industry, beginning about 1889, and carrying it on until they sold out in 1901, as noted later.

In 1903 the San Juan Fishing & Packing Co., which had begun the fresh-fish business in 1899. bought this business from the Pacific Packing & Navigation Co., to which it had been sold in 1901

In 1893 A. E. Wadhams, who had operated on the Columbia River for some years, established a sockeye plant at Point Roberts.

In 1894 both canneries were sold to their present owner, the Alaska Packers Association, an organization formed not long before this by a combination of a number of Alaska plants.

About 1894 A. E. Devlin came up from the Columbia River and established a plant at Friday Harbor, which is now operated by the Friday Harbor Packing Co.

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[a] History of the Pacific States, Washington, Idaho, and Montana, 1845–1889, vol. 26, pp. 345–349. By Hubert Howe Bancroft.

In 1895 three new canneries were built at Anacortes—one by Philip S. Cook (later owned by the Porter Fish Co. and now by the Anacortes Fisheries Co.), one by the Anacortes Packing Co. (now owned by the Alaska Packers Association), and the other by the Fidalgo Island Canning Co. In the same year a cannery was built at Port Angeles by the National Packing Co. In 1902 this plant was sold to the Manhattan Packing Co., which company was absorbed by the Gorman interests in 1906.

In 1896 J. R. Young and B. L. Williams built a small cannery at Blaine. They failed in 1900 through the failure of their trap fisheries and J. W. & V. Cook Packing Co., of Portland, bought their plant and put J. L. Smiley in charge of it. In 1909 Mr. Smiley purchased this plant from the company and operated it until 1916, when he disposed of it to Lee Wakefield and E. Schoenwald, who sold it the following year to the Wilson Fisheries Co.

As Ainsworth & Dunn found that they were receiving more salmon than they could dispose of in a fresh condition (they were first, in 1889, to ship fresh salmon from here to eastern points), the firm built a cannery on the Seattle water front, at what is now Pier 8, about 1895 or 1896, and about 1897 built another at Blaine.

In 1900 the Blaine Packing Co. built a cannery at Blaine and operated it nearly every season until 1916, when it was sold to the Blaine Cannery Co.

In 1901 Ainsworth & Dunn sold all its fresh fish and canned salmon holdings to the newly organized Pacific Packing & Navigation Co. When the latter company failed and its assets were sold in 1904, the firm bought back its former Blaine plant and has operated it ever since. Mr. Ainsworth, the senior member of the firm, died in 1914, but the business is still operated under the name of Ainsworth & Dunn.

The Pacific American Fisheries Co. was incorporated in 1899. The company purchased at the time of its organization the cannery and trap properties of the Island Packing Co., San Juan Island, and the cannery of the Franco-American North Pacific Packing Co., at Fairhaven. The last-named cannery had been built the previous year.

By 1900 a number of canneries had been erected on the shores of Puget Sound, most of which were then in active operation. In 1901 the Pacific Packing & Navigation Co. was organized under the laws of the State of New Jersey, for the purpose of acquiring a number of salmon canneries on the coast. It was supposed to be backed by unlimited eastern capital, and its authorized capitalization was as follows: Common stock, $12,500,000; 7 per cent accumulative preferred stock, $12,500,000; and 6 per cent debentures, $7,000,000. It actually issued $6,037,000 common stock, $6,963,000 preferred stock, and $3,000,000 debentures. Subsequently the management effected an exchange of preferred stock for debentures, increasing the former to about $7,500,000 and decreasing the debentures to about $1,650,000.

The new company purchased a number of canneries in Alaska, also the following Puget Sound plants: Pacific American Fisheries Co.'s canneries at Fairhaven (now Bellingham) and Friday Harbor, the Ainsworth & Dunn canneries at Blaine and Seattle, and the Fairhaven Packing Co. cannery at Fairhaven.

The company had a very short career, ending up in the bankruptcy courts in 1903, and when all its affairs were wound up the stockholders received nothing, while the bondholders got but an exceedingly paltry sum out of all the money put into it.

Most of the canneries secured on Puget Sound were repurchased by their former owners or by new people.

The Apex Fish Co. was incorporated in 1904 and built a cannery at Anacortes which has been operated continuously since.

B. A. Seaborg, a well-known Columbia River packer, early in the century established a cannery in South Bellingham and operated it under the name of the Washington Packing Co. In 1905 it was purchased by R. A. Welsh, then of Vancouver, British Columbia, and Loggie Bros., of Bellingham, and has been operated since under the name of the Bellingham Canning Co.

The Hillside Canning Co.'s plant was built and operated for the first time at Port Townsend in 1905 by Andrew Weber, H. Ellerbeck, William McKee, and E. C. Seeley.

In 1906 T. J. Gorman, since deceased, purchased the cannery of the Rosario Straits Packing Co. at Anacortes.

In 1906 E. A. Sims leased the cannery at Port Townsend which had been built some years earlier by Mr. Cook and operated under the name of the Port Townsend Packing Co.

A one-line cannery was erected in the spring of 1906 by the Wadham-Curtis Canning Co. at Blaine, but it burned down the same year.

In 1897 the Chlopeck Fish Co. (now the Booth Fisheries Co.), which had been operating in Portland for several years, started a fresh fish and freezing business at Seattle.

The first salmon cannery on Puget Sound was erected by Jackson, Myers & Co., in 1877, at Mukilteo, in Snohomish County. The members of this firm had all been engaged previously in salmon canning on the Columbia River. The first pack was of 5,000 cases, composed wholly of silver, or coho, salmon. Later at this plant were put up the first humpbacks ever canned. In order to divert the minds of purchasers from the fact that the meat of the humpback was much lighter in color than the grades then known to the consuming public, the company printed on its label the legend, "Warranted not to turn red in the can." Even with this shrewd sizing up of the weak side of the consuming public the demand for humpback, or pink, salmon developed very slowly, and it was some years before it became a factor in the markets.

Within a year or two after the opening of the above plant another was started at Mukilteo by a man named Bigelow.

In 1880 the Myers's cannery was destroyed by a heavy fall of snow. It was rebuilt in West Seattle and was operated till 1888, when it was destroyed by fire. George T. Myers, now sole owner, built a new cannery at Milton, which was burned two years later, and he then came back to Seattle and built a cannery about where Ainsworth & Dunn's dock now stands. He remained here only one season, after which he moved to where the Pacific Coal Co.'s bunkers are now. Late in 1901 he sold out his plant to the United Fish Co., which company moved the plant to the foot of Connecticut Avenue, where they continued operations for two or three years and then quit.

In 1889 a man named Morse established a cannery at Seattle and operated it for only one year.

The first Puget Sound sockeye cannery was built at Semiahmoo, near Blaine, by J. A. Martin and John Elwood about the year 1891. It was bought in 1892 for $500 by D. Drysdale, who shortly afterward rebuilt and greatly enlarged the plant. In the same year Mr. Drysdale demonstrated the commercial success of fish traps. Traps had been in operation before this, however. In 1893 Ainsworth & Dunn had a trap at Five Mile Rock, just beyond the lighthouse at Magnolia Bluff (now a part of Seattle), and there had been a trap or two in Elliott Bay even prior to this. Traps had not been profitable in this section, however, owing to the cheapness and abundance of salmon, haul seines being cheaper and more profitable to operate. A man named H. B. Kirby, who came originally from Nova Scotia, and another named Goodfellow (now living at Point Roberts) put in the first trap for Mr. Drysdale.

From this time on the industry fluctuated considerably, 41 canneries, an increase of 10 over 1914, being operated in 1915, while 35 were operated in 1919.

During the early years of sockeye canning they were not sold to the trade as sockeyes, but as Alaska reds and Columbia River salmon, for which there had been an established market for some years.

H. Bell-Irving & Co., of Vancouver, British Columbia, were the pioneers in the labeling of the fish as sockeyes, this being in 1894–95. Like all virtually new products, sockeye salmon had a hard fight for several years to secure a foothold in the salmon markets, and it was not until the Spanish-American War in 1898 caused a heavy demand for canned foods that its position became finally established.

Soleduck River.—This is a small stream, about 30 miles in length, which flows through the southwestern part of Clallam County and empties directly into the ocean. The Quillayute Indian Reservation is located here and the natives formerly caught salmon and marketed them on Puget Sound, but a small cannery, started at Mora, on this river, in 1912, furnished a market for the catch up to the end of 1915, when it was abandoned.

Hoh River.—This is a comparatively small river, which is wholly within Jefferson County, and debouches into the ocean in the northwestern part of the county. It passes through the Hoh Indian Reservation in its lower reaches. A cannery was built here in 1917 by Fletcher Bros., and has been operated each season since. In the spring of 1919 it was moved to a more convenient location about a mile from the original site.

Queets River.—This river, which is about 35 miles long, rises in the northern part of Jefferson County and empties directly into the ocean in the northwestern part of Grays Harbor County, within the bounds of the Quinault Indian Reservation. A small salmon cannery was built at Queets, in Jefferson County, in 1905, and has been operated every season since.

Quinault River.—This river, which enters the ocean in the northwestern part of Grays Harbor County, has a length from the ocean to Quinault Lake of about 40 miles, wholly within the boundaries of the Quinault Indian Reservation.

This stream is especially noted for its long-continued annual run of Quinault salmon (*O. nerka*). These fish, which are noted for their especially red-colored flesh, make their appearance early in December, when the Indians generally catch them for their own use, as they fear that, if the whites got hold of the fish, they might throw away the hearts. Should a heart be eaten at this time by a dog or chicken, the Indians believe the run would not come. In January, when the fish begin to be abundant, all danger of this seems to have passed, for the Indians then usually have a considerable number for sale, and these are generally shipped to distant markets in a fresh condition by the buyers. As soon as the canneries open at Moclips most of the fish are disposed of at that place. The run continues up to July 1. May and June are the best fishing months.

There is a fall run of chinooks in this river, which usually arrives in August and ends about October 15.

The silver salmon appear about October 1 and the run is generally over by November 15; the dog salmon appear about November 1 and the run is usually over by the middle of the same month, while the steelhead trout run between November 20 and May 1. None of the latter are canned.

Moclips, the terminus of the railroad, is about 10 miles from the river, and the fish are all taken by team to this place. Twenty fish, weighing approximately 100 pounds, are put in each box, and these are piled onto the wagons until a load has been accumulated. The team owners get 50 cents a box for hauling the loaded ones to Moclips and 5 cents a box for bringing the empty ones back.

In 1915 the records of the Indian agent show that the Indians fishing on the north side of the river caught 219,654 Quinault salmon, valued at $49,820, while those on the south side caught 135,353 of these fish, valued at $30,528.60, or a grand total of 355,007 fish, valued at $80,348.60. This does not take into account the results of the fishing for the other species of salmon and steelhead trout, which quite materially swell the total.

Fishing is restricted to the Indians, who also make their own fishery laws, with the advice and approval of the Office of Indian Affairs, as the State laws have no force inside the bounds of the reservation. Under the regulations now in force, a clear channel of one-third the width must be left in the middle of the stream, which is from 250 to 300 yards in width. Each owner of a fishing location has to fish it in person; provided, however, that widows, orphans, minor children, old Indians, and those who are sick or have gainful occupations other than fishing, are allowed to lease their locations or hire some one to fish them, and then only with the approval of the officer in charge.

During the Quinault season stake nets are used, while the rest of the time, as a result of the freshets, drift gill nets are used in the eddies. The stake nets are arranged in a rather peculiar manner. A line of stakes is run out for about one-third the width at right angles to the shore, and to these are attached a net by short ropes. From each stake a section of net is run out and downstream, curving inward like a hook at the end, the latter part being held in place by three stakes.

The stake nets are 40 to 60 meshes deep, with $5\frac{1}{4}$-inch stretch mesh, and are set 85 yards apart. A set of these as described above forms one fishing location.

The chinook gill nets are usually $8\frac{3}{4}$ to 9 inches stretch mesh and 24 meshes deep, while the gill nets for silvers, dogs, and steelheads are of 7-inch stretch mesh and 35 meshes deep.

For some years the salmon from the Quinault River were brought to Hoquiam and Aberdeen for canning. In 1911 W. W. Kurtz, of the former place, began the erection of a cannery at Moclips for the purpose of packing these fish, and the same season his example was followed by Frank Shafer. Mr. Kurtz still operates his plant, but the other is now owned by the Pacific Fisheries & Packing Co.

Grays Harbor.—This is the first important indentation on the coast of Washington south of Cape Flattery. It is about 40 miles long from east to west and about 20 miles wide in the widest part. The principal tributary is the Chehalis River, but there are a number of small streams which debouch into the harbor.

In 1883 B. A. Seaborg, who operated a cannery on the Columbia River, established a plant at what was later to be the thriving city of Aberdeen, although at that time it was practically a wilderness.

In 1902 the North American Fisheries Co. built a plant at Aberdeen. Shortly after it came into the possession of the Grays Harbor Packing Co., and on June 8, 1903, it was destroyed by fire. It was rebuilt and operated by this company until 1906, when it was sold to S. Elmore & Co., who still own it.

The Hoquiam Packing Co. built a cannery at Hoquiam in 1904 and have operated it ever since.

In 1910 two canneries were in operation at Aberdeen and Hoquiam, respectively; in 1915 there were three at the former place and one at the latter, while in 1919 there were six in operation.

Willapa Harbor.—The entrance to this harbor, which also includes Shoalwater Bay, is about 27 miles south of Grays Harbor The harbor runs east and west and is about 25 miles long. Shoalwater Bay extends south from it a distance of about 30 miles, its southern portion ending about a mile from the Columbia River and its western side being separated from the ocean by a spit varying in width from three-fourths to 1 mile. The bay is shallow, excepting in the main channel. The principal salmon streams entering the harbor are the Nasel and North Rivers, in which most of the pound or trap nets are located.

In 1884 B. A. Seaborg, a Columbia River canner, established a plant on Shoalwater Bay, as the whole of Willapa Harbor was then known.

About 1900 F. C. Barnes established a cannery at Sunshine, on the Nasel River, but the run of salmon on this river soon became so small that the plant was abandoned and the machinery moved to Mr. Barnes's cannery at South Bend.

In 1904 P. J. McGowan, the Columbia River canner, opened a cannery on the North River. Mr. McGowan, who was over 80 years of age at the time, had turned the control of his important Columbia River canning interest over to his sons, but finding idleness not to his liking, started this cannery in order to have something to occupy his time. He operated it for several years and then abandoned the project.

In 1912 the Chetlo Harbor Packing Co. established a cannery at Chetlo Harbor, but operated it only that year and in 1914.

In 1919 only two canneries, both of them at South Bend, operated on Willapa Harbor.

COLUMBIA RIVER.

The Columbia, which is the largest river of the Pacific coast, rises in British Columbia, flows through Washington, reaching the northern border of Oregon about 75 miles west of the State's eastern boundary; from this point the river forms the dividing line between Oregon and Washington, its general course being westerly. It empties into the Pacific at Cape Disappointment. Its principal tributaries are the Spokane, Yakima, Snake, John Day, Deschutes, and Willamette Rivers, and through these the main river drains an enormous extent of territory.

This river, which has produced more salmon than any other river in the world, has had a most interesting history. Many years before the white man saw its waters the Indians visited its banks during the annual salmon runs and caught and cured their winter's supply of food. Along the shores of the river at The Dalles for 15 miles were notable fisheries where various bands, who lived south and north, had their respective fishing locations, and to which all others were forbidden access. They used spears and dip nets in catching the salmon, the majority of which were dried and smoked for winter use. This dip, or basket, net was fastened to a pole about 30 feet long and slid on a hoop. The Indian filled it by slinging it as far as possible up the stream and then hauling it up, the weight of the fish closing the net by drawing it on the hoop.

A favorite preparation of the Indians who resorted to the river was pemmican. This was the meat of the salmon cleaned of the bones, pounded up fine, and then packed in hempen sacks of home manufacture. A sack of pemmican weighed from 80 to 90 pounds and was worth in barter as much as an ordinary horse.

Capt. Wilkes, U. S. N., has the following to say with respect to salmon fishing by natives at Kettle Falls on the Columbia River near the present city of Colville, Wash., at the time of his visit there in 1841:

> There is an Indian village on the banks of the great falls, inhabited by a few families, who are called "Quiarlpi" (basket people), from the circumstance of their using baskets to catch their fish (salmon). The season for the salmon fishery had not yet (in June ?) arrived, so that our gentlemen did not see the manner of taking the fish; but, as described to them, the fishing apparatus consists of a large wicker basket supported by long poles inserted into it and fixed in the rocks. The lower part, which is of the basket form, is joined to a broad frame spreading above, against which the fish in attempting to jump the falls strike and are thrown back into the basket. This basket during the fishing season is raised three times in the day (24 hours), and at each haul not unfrequently contains 300 fine fish. A division of these takes place at sunset each day under the direction of one of the chief men of the village, and to each family is allotted the number it may be entitled to; not only the resident Indians, but all who may be there fishing, or by accident, are equally included in the distribution.[a]

The first American to engage in fishing on the Columbia River was Capt. Nathaniel J. Wyeth, of Massachusetts, who in 1832 crossed overland to Oregon with the purpose of establishing salmon fisheries in connection with prosecuting the Indian and fur trade. He dispatched a vessel via Cape Horn to the Columbia with trading goods, but she was never heard from after sailing. In the meantime Wyeth

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[a] Narrative of the United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, and 1842. By Charles Wilkes, U. S. Navy, commander of the expedition. In 5 volumes. Vol. IV, pp. 444, 445. Philadelphia, Lee & Blanchard, 1845.

had established a station at Fort Hall, on the Lewis River, a branch of the Columbia.

In 1833 Capt. Wyeth returned overland to Boston, while the rest of his party dispersed throughout the Columbia Valley. Far from disheartened by the disaster to his vessel, Capt. Wyeth dispatched the brig *May Dacre*, Capt. Lambert, laden with trading goods and supplies, to the Columbia River via Cape Horn, while he crossed overland with 200 men. He established a salmon fishery and fort at the lower end of Wappatoo (now Sauvies) Island, at the mouth of the Willamette River.

The salmon fishery did not prove successful and the brig sailed in 1835 with only a half cargo of fish and did not come back. The same year Capt. Wyeth broke up both the establishment here and on the Lewis River and, disheartened, returned to Massachusetts, having found the competition of the Hudson Bay Co. too powerful for him.

In August, 1840, Capt. John H. Couch, in command of the brig *Maryland*, which belonged to Cushing & Co., of Newburyport, Mass., arrived in the Columbia River. After taking a few salmon the vessel left in the autumn never to return. On April 2, 1842, Capt. Couch reappeared in the river with a new vessel, the *Chenamus*, named after the chief of the Chinooks. With his cargo of goods he established himself at the present site of Oregon City, the first American trading house to be established in the Willamette Valley. He also established a small fishery on the Columbia River. The vessel returned to Newburyport in the autumn.

The next American vessel to come in established a far from enviable record. There is no record of her name, but she was commanded by a man named Chapman and entered the river April 10, 1842. She came for the purpose of trading and fishing and remained till autumn. During her presence in the river it is charged she sold liquor to the Clatsop and other savages, as a result of which much bloodshed and discord resulted.

About 1857 John West began salting salmon in barrels at Westport, on the lower Columbia.

In February, 1859, the Washington Legislature passed an act prohibiting nonresidents from taking fish on the beach of the Columbia between Point Ellis and Cape Hancock.

Bancroft [a] states:

> On the 26th of January, 1861, J. T. Lovelace and W. H. Dillon were granted the exclusive right to fish in the Columbia for a distance of 1 mile along its banks and extending from low-water mark half a mile toward the middle of the stream.

In 1861, H. N. Rice and Jotham Reed began packing salted salmon in barrels at Oak Point, 60 miles below Portland. The first season's pack amounted to 600 barrels. The venture proved fairly profitable and was soon participated in by others.

In the spring of 1866 William Hume, who had assisted in starting the first salmon cannery in the United States on the Sacramento River in 1864, finding the run of fish in the latter stream rather disappointing, started a cannery for Hapgood, Hume & Co. on the Columbia at Eagle Cliff, Wash., about 40 miles above Astoria.

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[a] History of the Pacific States, Washington, Idaho, and Montana, 1845-1889, vol. 26, p. 349. By Hubert Howe Bancroft.

The year this first cannery operated the following fishermen were operating in the river: Jotham Reed used a trap and a small gill net opposite Oak Point; Mr. Wallace fished a small seine from the shore of an island of that name a short distance below; John T. M. Harrington (who was later to establish the Pillar Rock cannery), in conjunction with a man named Fitzpatrick, operated a seine at Tenasillihe, as did also a Mr. Welch; P. J. McGowan, who, with his sons, in 1884 started a cannery at McGowan, and later, at Warrendale, Ilwaco, etc., operated two small seines at Chinook Beach; and Hapgood, Hume & Co. had two small gill nets about 125 fathoms in length and 32 meshes deep. The gill net of Mr. Reed was much smaller than these. At this period the river literally swarmed with salmon, and the cannery had no trouble in packing 4,000 cases, which it increased to 18,000 the next year and to 28,000 cases in 1868.

In 1867 a crude cannery on a scow was started by S. W. Aldrich, a ship carpenter. The scow was about 50 by 20 feet, with a cabin on it, and in one end of this he constructed a brick furnace in which he set a large cast-iron cauldron for a cooker. Along one side he rigged a bench and manufactured the cans. Aldrich was a regular jack-of-all-trades, as he did everything from catching the fish to canning and cooking them ready for the market.

In 1868 a cannery was built near Eagle Cliff by one of the Humes, while in 1873 R. D. Hume built another at Bay View, Wash. He operated it until 1876, when Mr. Leveridge, of Leveridge, Wadhams & Co., of San Francisco, bought it and operated it during 1877 and 1878. George W. Hume took it then and a few years later sold it to David Morgan, jr., who got into financial difficulties, and the plant was ordered sold by the court. C. W. Fulton, of Astoria, later a United States Senator, had the matter in charge, but was unable to find a customer, and finally in desperation offered it to W. H. Barker, of George & Barker, for $600. Mr. Fulton closed with him the same day. It proved a most profitable transaction for the purchasers, who acquired a million and a half labels which could be utilized, the machinery was taken out for other plants, the timber on the land belonging to the tract sold, and the floating property sold for a considerable sum, after which the stripped plant and land were sold back to Mr. Morgan for $600, the purchase price. He sold it to George W. Hume, who wanted it to correct a title. It was sold for taxes a couple of years later and was bought in by B. A. Seaborg, who operated it for two years, since when it has been idle.

George W. Hume was the first salmon canner to employ Chinese. This was at Eagle Cliff in 1872. At this period the white laborers in the canneries were recruited from the riffraff and criminal element of Portland. He had a Chinese working for him and through this man secured a Chinese gang from Portland. This labor proved so satisfactory that the custom soon spread to the other canneries. It was not found that the Chinese could do the work any better or quicker than the white laborer, but they proved more reliable in their work and gave less trouble.

Donald and Kenneth Macleay, of Portland, and William Corbitt, of San Francisco, who were in business in Portland, were the first to make a direct shipment of canned salmon to Liverpool. This was in 1871, and the shipment abroad that year amounted to 30,000 cases.

Of the 35 canneries on the Columbia River in 1881, it is said that about one-half had been established by the Hume brothers. G. W. and William Hume were partners in the firm of Hapgood, Hume & Co., on the Sacramento River, and established the first cannery on the Columbia. In 1881 William was the proprietor of two canneries, one at Astoria, Oreg., and one at Eagle Cliff, Wash. R. D. Hume, a third brother, in the same year had a cannery in operation on the Rogue River, and established three others, one at Eagle Cliff (then owned by William Hume), one at Rainier (then belonging to Jackson & Myers), and one at Astoria. The fourth brother, Joseph, came to the coast in 1871 and some time later established a cannery on the river.

One of the pioneer canners on the river was the late F. M. Warren, operating as the Warren Packing Co., who established a cannery at Cathlamet, Wash., in 1869. The same company is still operating the plant. Later another cannery was established at Warrendale, Oreg., and it also is still operated by this company. Mr. Warren was the inventor of a retort, patented on April 10, 1877, which was in use by the principal canneries on the coast for a number of years.

John West was another pioneer. He built a cannery at Hungry Harbor, Wash., about 1869. In 1881 he moved his plant to Westport, on the Oregon side of the river. Mr. West was the inventor of a packing machine for placing the fish in the cans.

In 1871 the firm of Megler & Jewett established a cannery on the present site of Brookfield, Wash., and named it in honor of Mrs. Megler's birthplace, North Brookfield, Mass. In 1876 the plant was greatly enlarged and J. S. Megler bought out his partners and took in Mr. Macleay, of Corbitt-Macleay, wholesale grocers, of Portland and San Francisco, and changed the firm name to J. S. Megler & Co., under which title it still operates. In 1879 Mr. Megler bought out this partner and owned the plant until his death in 1915, since when it has been operated by his widow.

The first soldering machine used on the Columbia River was in this plant, while the steam box and lacquering machines were first put in use on the river in this plant.

In 1874 the Adair brothers, S. D. and John, jr., erected a cannery at Astoria, the second one to be built there. Before packing began, A. Booth, the well-known Chicago fish dealer, and progenitor of the present Booth Fisheries Co., acquired a half interest in the plant, which was then named A. Booth & Co. John Adair, jr., was the manager. The brothers established canneries on the Fraser River and in some seasons exchanged places in operating on the two rivers. S. D. Adair sold out his cannery on the Fraser and bought one on the Columbia and operated it under the firm name of S. D. Adair & Co. After selling out his interest in A. Booth & Co., S. D. Adair formed a partnership with Wm. B. Adair under the style of S. D. Adair & Co. in 1881. The brothers were active in the industry for a number of years.

J. O. Hanthorn, under the firm name of J. O. Hanthorn & Co., established one of the largest canneries on the river at Astoria in 1876. He invented a rotary can washer for washing cans after they were filled ready for soldering and before the tops were put on.

In the same year Marshall J. Kinney began his long and interesting career in the canning business by establishing a cannery at Astoria.

One of the most noted men the Columbia River produced was Mathias Jensen, a Dane, who fished there for some years. He achieved especial fame from his important inventions in canning machinery. His first invention, however, was a machine for filling needles for knitting salmon nets. He next invented a can-filling machine, which is in common use to-day. He also invented the first topping machine, which was a marked success. The patent rights of both these machines were sold to the Alaska Packers Association. The machines were all made at the plant of the Astoria Iron Works, at Astoria, of which Mr. John Fox was the founder.

The first fish trap or pound on the river was constructed by Mr. Graham, in Baker Bay, on the Washington shore, in 1879. In 1881 Mr. P. J. McGowan built some traps just below the bay. The traps were very successful at times.

The first purse seine on the river was operated by William Graham & Co. in 1906.

Below appears a list of the canneries operated on the Columbia River in 1881, together with the pack of each during the year in question:

J. Williams (Oregon side)	9,000
Astoria Packing Co	30,000
Elmore Packing Co	7,890
Astoria Fishery (M. J. Kinney)	26,000
Wm. Hume	20,000
Geo. W. Hume	18,000
Devlin & Co	20,000
Occident Packing Co	15,000
West Coast	15,000
Badollet & Co	25,000
Booth & Co	23,000
Eagle Cannery	17,300
Timmins & Co	8,000
Fishermen's Packing Co	19,000
S. D. Adair & Co	10,000
Anglo-American Packing Co	10,300
Hanthorn & Co	19,000
Scandinavian Co	20,000
J. W. & V. Cook	30,000
F. M. Warren	12,000
J. West	12,000
Jackson & Myers (2 canneries)	13,000
Aberdeen Packing Co. (Washington Territory side)	17,000
Jos. Hume, Knappton	20,225
Pillar Rock Co	15,000
J. G. Megler & Co	25,000
Columbia Canning Co	8,000
R. D. Hume & Co	8,300
Cathlamet Cannery	8,000
Jas. Quinn	5,000
Cutting & Co	20,000
Eureka Packing Co	20,000
Hapgood & Co	13,000
Eagle Cliff Cannery	10,000
Total	549,115

An interesting compilation prepared by the Portland Board of Trade [a] shows the total product in cases, the price per case of 48 pounds, and the price for each fish paid by the canneries to the fishermen from 1866 to 1881:

Year.	Total product.	Price.	Cost of fish.	Year.	Total product.	Price.	Cost of fish.
			Cents.				Cents.
1866	4,000	$16.00	15	1874	350,000	$6.50	25
1867	18,000	13.00	15	1875	375,000	5.60	25
1868	28,000	12.00	20	1876	450,000	4.50	25
1869	100,000	10.00	20	1877	460,000	5.20	25
1870	150,000	9.00	20	1878	460,000	5.00	25
1871	200,000	9.50	22½	1879	480,000	4.60	50
1872	250,000	8.00	25	1880	530,000	4.80	50
1873	250,000	7.00	25	1881	550,000	5.00	60

[a] The Commerce and Industries of the Pacific Coast of North America, pp. 372, 373. By John S. Hittell. San Francisco, 1882.

The banner year in the canning industry was 1884, when 620,000 cases of chinook salmon were marketed. At this time the runs were so enormous that tons and tons of salmon were thrown overboard by the fishermen because the canneries were unable to handle them.

As in other sections, there came a time when the market began to be glutted by the packs of the numerous canneries, and it was found necessary to combine some of the plants in order to operate more cheaply and also to reduce the output.

In 1885 W. H. Barker and George H. George, who had been connected with various canneries, formed a partnership as George & Barker and purchased the Astoria cannery of the Port Adams Packing Co., then 2 years old.

Shortly before this a combination which was named the Eureka & Epicure Packing Co. had been formed and comprised the following plants: Knappton Packing Co., Knappton; North Shore Packing Co., just below Knappton; and the Eureka Packing Co. This combination got into financial difficulties, and the reorganizers persuaded George & Barker to join the combination and take charge.

In 1887 the Eureka & Epicure Packing Co., the plants of Samuel Elmore, M. J. Kinney, and J. W. Seaborg, all of Astoria; J. O. Hanthorn & Co., Astoria; Fishermen's Packing Co., Astoria; Scandinavian Packing Co., Astoria; Columbia Canning Co., and J. W. & V. Cook, Clifton, were combined under the name of the Columbia River Packers Association. In 1889 the association built a new cannery at Rooster Rock. Mr. George was with the association until his death, but Mr. Barker left it to become general manager of the British Columbia Packers Association, where he is at present, the dean of the Pacific coast cannerymen.

Early in the eighties the California Can Co. was engaged in the business of making cans in San Francisco. Later the Pacific Sheet Metal Works absorbed the company. A factory was started at Astoria, with Mr. F. P. Kendall in charge. The latter, who is one of the deans of the industry, has had a long and interesting connection with all branches of the industry and in most sections. The American Can Co. later on bought the Pacific Sheet Metal Works, and the Astoria plant was moved to Portland.

The American Can Co. was the first to install sanitary can-packing machinery in the salmon industry, the venture being made in 1911, at the Sanborn-Cutting plant in Astoria.

At the present time (1919) there are 21 canneries in operation on the river, while large quantities of salmon are also frozen, mild cured, pickled, smoked, and sold fresh in the markets of the world.

Commercial fishing is carried on mainly between the mouth of the Columbia and Celilo, a distance of about 200 miles, and in the Willamette River. The most of it is in the lower part of the river, within about 40 miles of its mouth. Bakers Bay, on the Washington or north side, and just within the river's mouth, is the favorite ground for pound-net fishing. The principal gill-net drifting ground is from the river's mouth to about 20 miles above Astoria, but drifting is done wherever convenient reaches are found much farther up the river. Most of the drag seines are hauled on the sandy bars in the river near Astoria, which are uncovered at low water. Wheels are operated in the upper river above the junction of the Willamette with the main river.

Astoria is the principal center for all branches of the industry, but more especially for canning. Other places in addition to Astoria at which canneries are located are Ilwaco, Eagle Cliff, Altoona, Brookfield, Pillar Rock, Cathlamet, on the Washington shore, and at Warrendale, Rooster Rock, and Seuferts, on the Oregon shore.

OREGON.

Necanicum Creek.—This short stream is in Clatsop County and enters the Pacific Ocean about 10 miles south of the Columbia River. Its fisheries are of small importance.

Nehalem River.—The Nehalem is a small coastal river that rises in the mountains of Clatsop and Columbia Counties, and flows into the Pacific Ocean in the northern part of Tillamook County. As early as 1887 there was a small cannery here, and the business has been followed ever since. In 1911 an additional plant was built and both have operated each year since, except in 1913, when one was shut down.

Tillamook Bay and River.—Tillamook River is a very short stream which enters Tillamook Bay, the latter being in Tillamook County and about 45 miles south of the mouth of the Columbia River.

Fishing is carried on mainly in the bay. The earliest record we have of canneries on this bay is of 1886, when two were in operation. From 1891 to 1910 but one was operated, but in 1911 another plant was started. In 1915 a third cannery was built, and all three operated until 1918, when only one was in operation. In 1919, two operated.

Nestugga River.—This stream enters the ocean in the southwestern part of Tillamook County. A cannery operated here in 1887 and the business has been carried on each season with but one intermission since 1905.

Siletz River.—This river has its source in the mountains of Polk County and enters the ocean in the northern part of Lincoln County. The commercial development of the fisheries was hampered for many years owing to the fact that the river was within the boundaries of what was then the Siletz Indian Reservation. The first cannery was established here in 1896. An additional one was built in 1918.

Yaquina Bay and River.—The Yaquina ("crooked") River is about 60 miles long; its general course is nearly west through the county of Benton. The river is narrow throughout the greater part of its length. A few miles from its mouth it suddenly broadens out into an estuary from one-half to three-fourths of a mile wide, which is commonly called Yaquina Bay. The river enters the Pacific about 100 miles south of the Columbia.

Salmon canning was begun on this river in 1887, when two small canneries were constructed. The next year an additional plant was erected. The business has fluctuated considerably since then and there is now but one cannery, which has not been operated since 1911. In 1917 this plant was consolidated with the one at Waldport.

The fishing grounds are all in the bay and the lower section of the river. The fishermen of this section are fortunate in that they have railroad communication with the outside world.

Alsea Bay and River.—Alsea River rises in the southwestern part of Benton County, and flows in nearly a northwesterly direction to the Pacific, a distance of about 60 miles. Like the Yaquina, the "bay" is merely a broadening out of the river just inside its mouth.

The first cannery was established in 1886 and by 1888 there were three in operation. For many years but one was operated. In 1911 and each season since two canneries have been operated.

The best fishing grounds are from the mouth of the river to about 5 miles inland.

Siuslaw River.—This river has its source in the mountains of Lane County, and its course lies first in a northwesterly direction and to the westward until the Pacific is reached. Through part of its course it is the dividing line between Lane and Douglas Counties. In 1915 a railroad line from Eugene to the mouth of the Siuslaw River, at which point it connected with a line to the Coquille River, was opened for traffic.

As early as 1878 there were two canneries operated on this river, but from 1879 till 1888 there are no data available showing the extent of the fisheries. In 1888 the Florence Canning Co., the Lone Star Packing Co., and the Elmore Packing Co. each operated a cannery. In 1896 A. W. Hurd built a cannery which was destroyed by fire in 1908. At present there are two canneries, but of recent years only one has been operated. The opening of a railroad line from Eugene to here, thus furnishing an outlet for fresh salmon shipments, will doubtless greatly help in developing its fisheries.

The salmon fishing grounds extend from near the mouth of the river to about 20 miles upstream.

Umpqua River.—With the exception of the Columbia this is the largest and longest river in Oregon. It is formed by north and south forks, which unite about 9 miles northwest of Roseburg, and the river then flows northwestwardly and enters the Pacific. Practically all of this river is within the boundaries of Douglas County, one of the largest counties in the State. A railroad has recently been built along this river and in time there will doubtless be a large development of the fisheries of this region owing to the opportunities which will be offered for shipping fresh fish.

With the exception of Rogue River, this is the only river in Oregon south of the Columbia River in which a spring run of chinook salmon occurs.

As early as 1878 there were two canneries located on the Umpqua, one of which was built by George W. Hume. The number has never been larger than this, and usually there has been but one operating. In 1912 there was but one at Gardiner. In 1919 one was operated.

In 1918 the Reedsport Fish Co., of Reedsport, purchased the cannery of the Umpqua Cooperative Co., at Gardiner.

Coos Bay and River.—Coos Bay is a navigable semicircular inlet of the ocean with numerous arms or branches. There is much marshy ground in the bay, and a number of sloughs, or small creeks, which empty into the bay from both sides. Coos River proper is an unimportant stream, but a few miles in length. North Bend, Marshfield, and Empire are the principal towns on the bay. A branch railroad is being built to these points from the main line of the Southern Pacific Railway, and as soon as this is completed the fishing industry will receive a great impetus. Heretofore this region has depended upon steamers and sailing vessels plying to Portland and San Francisco for its communication with the outside world, and this slow and infrequent means of shipment has very seriously handicapped the fisheries.

Salmon canning began here in 1887, when two canneries opened for business. The business has fluctuated considerably since, most of the time but one cannery being operated; none was operated in 1919.

Fishing is carried on mainly in the bay. A few set nets are operated in the river.

Coquille River.—This river is formed by three branches, called the North, Middle, and South Forks, which rise in the Umpqua Mountains and unite near Myrtle Point, the head of tidewater, about 45 miles by river from the mouth of the stream. It is a deep and sluggish river, with no natural obstructions to hinder the free passage of fish. Its fisheries have been seriously hampered by the lack of railroad communication, but this has recently been remedied, as the railroad to Coos Bay connects with a short line now in existence between the Coquille River and Coos Bay, and thence on to the Siuslaw and from there to Eugene.

The principal towns on the Coquille River are Bandon, Prosper, Coquille, and Myrtle Point. Bandon is the shipping port.

Pickled salmon were cured and shipped from this river very early, the first recorded instance of any considerable quantity being in 1877, when 3,000 barrels of salmon were sent to San Francisco. The salt shipments were important until within recent years. The first salmon cannery was erected in 1883, at Parkersburg. In 1886 another was built at the same place, and the following year still another was erected close by. This was the largest number ever in operation in any one year. Since 1909 two canneries have been operated, both at Prosper. In 1916 the Macleay estate took over the Coquille River Fishermen's Cooperative Co.'s cannery near Bandon.

The fishing grounds are from the mouth to Myrtle Point, about 45 miles inland.

Sixes River.—This small river is located in the norther part of Curry County, and is about 40 miles in length, enterin t e Pacific a very short distance above Cape Blanco. The salmon caught here are either salted or shipped fresh to the canneries on the Coquille River.

Elk River.—This is another small stream about 40 miles in length, which enters the Pacific just south of Cape Blanco. As on the Sixes River, the salmon are either salted or sold fresh to the canneries on the Coquille River.

Rogue River.—This river has as its source Crater Lake in the Cascade Mountains, on the western border of Klamath County, flowing a distance of about 325 miles to the ocean, which it enters at Wedderburn. Its principal tributaries are the Illinois, Applegate, and Stewart Rivers. Owing to canyons and falls in the main river between the mouth of the Illinois River and Hellgate, the latter near Hogan Creek which runs through the town of Merlin, navigation and fishing are impossible in that section. Except at the mouth of the river the population is very sparse until about the neighborhood of Hogan Creek, where the river approaches the railroad, and from here on for some miles there are numerous growing towns.

Owing to the fact of there being both a spring and a fall run of salmon in this river, the fisheries early became of importance, although sadly hampered because of being compelled to depend wholly on vessel communication with San Francisco, many miles away. In the early years the salmon were pickled and shipped to San Francisco. Strong, Baldwin & Co. started in the business as early as 1859. In 1877 R. D. Hume, who had been canning salmon on the Columbia River, removed to the Rogue River, and established near the mouth a cannery which he operated every season (except 1894, when the cannery burned down) until his death in November, 1908, after which date it was operated by his heirs. Mr. Hume also operated a large cold-storage plant at Wedderburn for several years.

The development of the fisheries of the lower Rogue River was very much hampered by the monopoly which Mr. Hume acquired and maintained until his death. He bought both shores of the river for 12 miles from its mouth, and also owned an unbroken frontage on the ocean shore extending 7 miles north from the mouth of the river. As a result of this, independent fishermen could find no convenient places for landing, which was necessary in order to cure, handle, and ship the fish caught. Since Mr. Hume's death the property has been sold to the Macleay estate, but the people of Oregon, upon an initiative and referendum petition, voted in 1910 to close Rogue River to all commercial fishing, and it was so closed in 1911 and 1912 but reopened in 1913. A second cannery was built here in 1915 by the Seaborg Canning Co.

In the upper river ranchers living along the banks have engaged in fishing for a number of years, the catch for the most part being sold fresh. In recent years, as the country has developed, this fishery has become fairly important.

Chetco and Windchuck Rivers.—These two unimportant streams empty into the Pacific in the lower part of Curry County, not far from the California line. The former is about 20 miles and the latter about 25 miles in length. Both have runs of salmon, and small fisheries have been maintained for some years, the catch being either pickled or sold to the California canneries.

CALIFORNIA.

Smith River.—This river, which is the most northerly one in the State, rises near the Siskiyou Mountains, and runs in a westerly direction to the Pacific Ocean.

The river has only a spring run of salmon, and the early recorded history of the fisheries is fragmentary. The pickling of salmon was the main business at first and has been important ever since, as the cannery, which was first established in 1878, operated irregularly, and seems to have shut down entirely in 1895. Canning began again in 1914 by H. E. Westbrook and has been prosecuted each year since.

Klamath River.—This is the most important river in California north of the Sacramento. It issues from the Lower Klamath Lake in Klamath County, Oreg., and runs southwesterly across Siskiyou County, passes through the southeastern section of Del Norte County, keeping its southerly course into Humboldt County, where it forms a junction with the Trinity River, and thence its course is directed to the northwest until it reaches the Pacific Ocean.

The Klamath River is important as a salmon stream because it has both a spring and fall run of salmon. In 1888 a cannery was established at Requa, at the mouth, and this has been operated occasionally ever since. The pickling of salmon has been done here for a number of years. Some years part of the catch has been shipped fresh to the cannery on Smith River or to the Rogue River (Oreg.) cannery. Since 1908 the cannery has been operated continuously by the Klamath River Packers Association.

Humboldt Bay and tributaries.—The shore line of Humboldt County is bold and high, except in the vicinity of Humboldt Bay, where it is rather flat. The latter is the only harbor along the county shore, and it is quite difficult of access, owing to the bar at the entrance upon which the sea breaks quite heavily. The bay is about 12 miles long and about 3 miles wide. Mad River, which has its rise in the lower part of Trinity County, runs in a northwestly direction, then makes a sharp turn and enters the bay from the north side. Eel River, which has its rise in Lake County, far to the southeast, runs in a northwesterly direction and enters the bay at its southern extremity. Small railroads running south from Eureka traverse the shores of both rivers for some miles. A railroad now runs from the north side of San Francisco Bay to Eureka, and it has aided very materially in extending the market for salmon caught in these rivers.

Mattole River.—This is a small and unimportant river in the southern part of Humboldt County, and is said to have a good run of salmon each year, but no commercial fishing has as yet been carried on here.

Noyo River.—In 1915 salmon fishing began at Fort Bragg, in Mendocino County, where the Noyo River debouches into the ocean. The building of a branch railroad to this point made the shipping of salmon a possibility. In 1915 and 1916 considerable salmon were caught and shipped fresh. In 1917 the Tillamook Ice & Cold Storage Co., built and operated a cannery here, while the Columbia & Northern Fishing & Packing Co., in the same year built and operated a cold-storage and mild-curing plant.

Sacramento and San Joaquin Rivers.—These two rivers are the most important rivers in California. The Sacramento is quite crooked, the distance by river from Red Bluff to San Francisco being about 375 miles, while the distance by rail between these two places is only 225 miles. The river rises in several small lakes in the mountains about 20 miles west of Sisson, in Siskiyou County, and for nearly half its length flows through a narrow canyon. The upper portion is a typical mountain stream, with innumerable pools and rapids. A little above Redding the river emerges from the canyon and widens into a broad shallow stream. Below Sacramento it runs through a level country and is affected by tides. Sloughs are numerous in this stretch, some connecting it with the San Joaquin. The Sacramento and San Joaquin Rivers join as they empty into Suisun Bay.

The principal tributaries of the Sacramento which are frequented by salmon are the Pit and McCloud Rivers and Battle Creek. At one time salmon frequented the American and Feather Rivers, but mining and irrigation operations along these streams either killed them off or drove them away.

The San Joaquin River has its source in the Sierra Nevada Mountains. Flowing westerly and forming the boundary between Fresno and Madera Counties for a considerable distance, it then turns abruptly to the north just where it is joined by Fresno Slough, which drains Lake Tulare. From here its general course is northwesterly until it joins the Sacramento River, near the latter's mouth. The Chouchilla and Fresno Rivers are the principal tributaries of the San Joaquin.

The principal fishing grounds for salmon are Suisun Bay, the lower part of San Joaquin River, and the Sacramento River as high as the vicinity of Sacramento. Drift gill nets are used almost exclusively in this section. From Sacramento to Anderson there is considerable commercial fishing, more particularly with haul seines.

Owing to the early and excellent railroad facilities which the fisheries of the Sacramento River have enjoyed, they have not been handicapped so seriously as most of the other Pacific coast rivers in finding profitable outlets for the catch. Soon after the first transcontinental line was opened the shipping of fresh salmon to eastern points began, and it has been an important feature of the industry ever since.

The chief event in the history of the salmon fisheries of this river is the fact that the canning of salmon on the Pacific coast had its inception here in 1864. The circumstances leading up to this event and its consummation are interestingly told by R. D. Hume in the following words:

> The first salmon cannery of the United States was located at Washington, Yolo County, Calif. A part of the building was originally a cabin situated on the river bank outside of the levee just opposite the foot of K Street, Sacramento City. It was built in 1852 and occupied by James Booker, Percy Woodsom, and William Hume. William Hume came to California in the spring of 1852, bringing with him a salmon gill net which he had made before leaving his home at Augusta, Me. In company with James Booker and Percy Woodsom, Mr. Hume began fishing for salmon in the Sacramento River just in front of the city of Sacramento. William Hume had been salmon fishing in the Kennebec River in the State of Maine with his father, where his father and grandfather had been engaged in the same business since 1780, and their ancestors in Scotland had for pleasure pursued the sportive salmon on the Tweed and Tay for centuries before. In 1856 William Hume went back to Maine, and on his return to California the same year was accompanied by his brothers, John and G. W. Hume, who also engaged in salmon fishing in the Sacramento River. Among the schoolmates of G. W. Hume was one Andrew S. Hapgood, who had learned the tinsmith's trade, and who a short time after G. W. Hume left for California went to Boston and entered the employ of J. B. Hamblen, a pioneer in the canning business, and was sent by him to Fox Island on the coast of Maine to engage in canning lobsters. The canning of lobster was a new and growing industry, and Mr. Hamblen, to increase his business, a short time after sent Mr. Hapgood to the Bay of Chaleur, an arm of the sea which divides the Province of Quebec from that of New Brunswick, where, in addition to the canning of lobster, they also canned a few salmon. I believe this was the first salmon canned on the American Continent, and I am informed that the business in a small way is still carried on in that section of the country. In 1863 G. W. Hume went back to Maine, and while there visited Mr. Hapgood at Fox Island, to which place he had been again sent by J. B. Hamblen to take charge of the works at that place. During the visit of G. W. Hume to his friend Hapgood a talk about salmon was had, and it was agreed that if salmon on the Pacific coast were as plentiful as represented by Mr. Hume much money could be made in a salmon-cannery business. The plan decided on was that G. W. Hume, on his return to California, should try and induce his brother William to engage in the business with them, and, if he succeeded in so doing, Mr. Hapgood should purchase the necessary machinery and come out to California in time for the spring season of 1864. William Hume being agreeable to take part in the enterprise, Mr. Hapgood set out on the journey and arrived at San Francisco on March 23, 1864, and a few days later at the location where the operations were afterwards conducted.[a]
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[a] The description of the machinery used and the methods of canning have been quoted in full under "Canning" elsewhere in this report.

For a considerable time after the salmon-canning business was inaugurated the packers suspended operations in the early part of July of each year as at that time the market would take only goods which showed a rich oil and the best food values.[a]

The business languished after the firm established its cannery on the Columbia River, but in 1874 was renewed again by others and continued with varying success until 1905, when it ceased temporarily, owing to the smaller quantity of fish available and the difficulty of competing with the mild-cure packers and the fresh-fish dealers. Several times since small packs have been made when, for some reason, mild-curing was unprofitable.

Monterey Bay.—The first harbor south of San Francisco is Monterey Bay, a large indentation cutting into Santa Cruz and Monterey Counties. Only a portion of it is well sheltered, however. For a number of years it had been known that salmon frequented the waters of this bay for the purpose of feeding on the young fishes which swarmed there. Sportsmen frequently caught them with rod and reel, but it was not until the early eighties that the industry was established on a commercial basis. It has since grown very rapidly. The catch has either been mild cured at Monterey or shipped fresh. A few have been canned in recent years.

ALASKA.[b]

Alaska is the most favored salmon-fishing region. Many rivers, some of great length and draining enormous areas, intersect the district in every direction, while the number of small creeks is countless. Almost every one of these have runs of salmon of varying abundance. The principal streams entering Bering Sea are the Yukon, Kuskokwim, Togiak, Nushagak, Kvichak, Naknek, Ugaguk, and Ugashik; in central Alaska the Chignik, Karluk, Alitak, Susitna, and Copper Rivers are the main streams, while in southeast Alaska are found, among many others, the Anklow, Situk, Alsek, Chilkat, Chilkoot, Taku, Stikine, and Unuk Rivers. Most of the fishing in Alaska is carried on in the bays into which these rivers debouch. In southeast Alaska, which is composed largely of islands, the fishing is carried on mainly in the bays, sounds, and straits among these.

Even before the purchase of the district from Russia in 1867 our fishermen occasionally resorted to southeast Alaska and prepared salted salmon. The salmon fisheries did not become important, however, until canning was begun.

SOUTHEAST ALASKA.

One of the most favorable sections for carrying on fishing operations is southeast Alaska. Here a narrow strip of mainland, about 30 miles wide, separates British Columbia from salt water and forms the "panhandle" of Alaska. Outside this is a fringe of numerous islands, large and small, close to the coast line, conform-

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[a] The First Salmon Cannery. By R. D. Hume. Pacific Fisherman, Seattle, Wash., Vol. II, No. 1, January, 1904, pp. 19-21.

[b] The material for the history of the salmon fisheries of Alaska for the period from the inception of salmon canning to 1900 was obtained almost wholly from the following excellent and valuable reports by Capt. Jefferson F. Moser, to whom I am deeply indebted for this and other valuable data:

The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the United States Fish Commission Steamer *Albatross* for the Year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898, Vol. XVIII, pp. 1-178. Washington, 1899.

Alaska Salmon Investigations in 1900 and 1901. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1901, Vol. XXI, pp. 173-398. Washington, 1902.

ing to its irregularities and separated from it and from each other by deep straits and channels. These islands, about 1,100 in number, extend from the coast an average distance of about 75 miles and along the general contour for about 250 miles. Some of these islands are very large, indented with deep bays and sounds, and they in turn fringed with smaller islands.

The largest streams in this region are the Unuk, Stikine, Taku, and Chilkat, all of which take their source in the interior and drain considerable areas. The other rivers are usually streams, and the greater number are simply outlets to a lake or system of lakes.

All species of salmon are to be found in this region, but the humpback is by far the most abundant.

This region has been the favorite fishing ground for the smaller operators, although a few of the largest canneries in Alaska are located here. Of recent years transportation facilities have been exceedingly good and fairly cheap, while the nearness to the States and the considerable resident population which could be drawn upon for labor have been big factors in its development.

The Russians did considerable salting of salmon. Petroff, in his report in the Tenth Census on the "Population, industries, and resources of Alaska," writes as follows of the Redoubt near Sitka: "The once famous Redoubt or deep-lake salmon fishery on Baranof Island, which at one time during the Russian rule supplied this whole region, and whence 2,000 barrels of salmon were shipped in 1868, now lies idle."

Bancroft[a] in speaking of the king salmon of Alaska says: "So choice is its flavor, that during the régime of the Russian American Co. several barrels of the salted fish were shipped each season to St. Petersburg for the use of the friends of the company's officials."

One of the earliest operators in southeast Alaska was a Greek, or Slav, named Baronovich, who married the daughter of Skowl, one of the old-time chiefs of the Kasaans, and received from him the fishery on Karta Bay, a part of Kasaan Bay, and one of the best red salmon streams south of Wrangell Narrows. Baronovich built a saltery here, kept a store and traded with the Indians. He died some years ago, and for some time after his death his sons operated it. It finally collapsed a couple of years ago.

For a number of years a saltery was operated at Klawak, on the west coast of Prince of Wales Island. In 1878 the North Pacific Trading & Packing Co. purchased the saltery and erected the first cannery in Alaska here. A pack was made the same year, and the plant has operated every year since. In 1899 the cannery burned down, but it was immediately rebuilt on the opposite side of the bay. For some years this plant was operated almost exclusively with native labor, and at present the majority employed are natives.

The same year that the above cannery was established the Cutting Packing Co. built a cannery at old Sitka, and operated it in 1878 and 1879, then it was closed down. In 1882 the machinery was taken by another company to Cook Inlet.

In 1882 M. J. Kinney, of Astoria, under the name of the Chilkat Packing Co., built a cannery on the eastern shore of Chilkat inlet and made a pack the same year. The cannery changed hands several times

[a] History of Alaska, Vol. XXXIII, p. 661. By Hubert Howe Bancroft. San Francisco, 1886.

and finally was burned in 1892, and not rebuilt. The cannery packed every year from 1883 to 1891, both inclusive, except in 1888, when it was closed.

In 1883 the Northwest Trading Co. built a cannery on Pyramid Harbor, a little bay on the western side of Chilkat Inlet. It was operated by this company in 1883 and 1884, was idle in 1885, and in 1888 was sold to D. L. Beck & Sons, of San Francisco, and operated by that firm. In the spring of 1889 it was burned, but was rebuilt at once and a pack made that year. In 1893 it joined the Alaska Packers Association, which operated it, except in 1905, until the end of the season of 1908, when it was finally abandoned.

On the north shore of Boca de Quadra, about 8 miles from the entrance, a cannery was built in 1883 by M. J. Kinney, of Astoria, and operated under the name of the Cape Fox Packing Co. from 1883 to 1886. Late in the last-named year it was sold and moved to Ketchikan, operating there under the name of the Tongass Packing Co. during 1887, 1888, and until August, 1889, when it was burned and not rebuilt.

In 1886 Rhode & Johnson erected a saltery at Yes Bay. The following year the firm became Ford, Rhode & Johnson. In 1887 work was begun on a cannery which was finished in 1888. Packing was begun in 1889 under the name of the Boston Fishing & Trading Co. In 1901 it was included in the Pacific Packing & Navigation Co. consolidation, and when that concern failed was purchased in 1905 by the Northwestern Fisheries Co. In 1906 the cannery was purchased by C. A. Burckhardt & Co., who have operated it each year to date, either under that name or subsequent incorporations known as the Yes Bay Canning Co. and the Alaska Pacific Fisheries.

In 1887 the Aberdeen Packing Co. of Astoria, Oreg., built a cannery on the Stikine River, about 8 miles above the mouth. In 1889 the cannery was moved to Point Highfield, on the northern end of Wrangell Island, and operations commenced under the name of the Glacier Packing Co. In 1893 it joined the Alaska Packers Association, who have operated it continuously, except in 1905.

The Loring cannery of the Alaska Packers Association was built in 1888 by the Alaska Salmon Packing & Fur Co., of San Francisco, and operated by the Cutting Packing Co. The company was incorporated in 1883 and operated a saltery until the cannery was built. When the Alaska Packers Association was formed in 1893 it joined that organization. The cannery has operated every year since it was built, and in some seasons has made the largest pack of any in the Territory.

Shortly after William Duncan and his community of Tsimpsean Indians had settled, in 1887, on Annette Island, which island had been set aside by the Federal Government as a reserve for them, plans were under way for a salmon cannery, but funds came in so slowly that it was not until 1890 that any pack was attempted. In 1891 it was in full operation, and operated from then continuously until 1913, when the plant was shut down for that and the two succeeding years. Much dissatisfaction had been expressed by the natives over the operation of this and other industrial plants on the island, and finally the Federal authorities took possession of practically everything, as guardian of the natives, and early in 1916 leased the cannery to P. E. Harris & Co., of Seattle, the understanding being that they were to employ natives when available. Unfortunately the plant burned down on May 17, just before the fishing season began. In 1918 the Annette Island Packing Co. built and operated a cannery here.

For the purpose of assisting the natives of Annette Island in operating this cannery the President in 1916 issued a proclamation making a fishery reserve of the island and among other things provided that—

the waters within 3,000 feet from the shore lines at mean low tide of Annette Island, Ham Island, Walker Island, Lewis Island, Spire Island, Hemlock Island, and adjacent rocks and islets, located within the area segregated by the broken line upon the diagram hereto attached, and made a part of the proclamation, also the bays of said islands, rocks, and islets, are hereby reserved for the benefit of the Metlakahtlans and such other Alaskan natives as have joined them or may join them in residence on these islands, to be used by them under the general fisheries laws and regulations of the United States as administered by the Secretary of Commerce.

One white trap net owner refused to remove his trap from the waters in question, and when decision was rendered against him in the lower court, carried the case to the United States Supreme Court, which, in December, 1918, upheld the right of the President to grant exclusive fishing rights in public waters.

James Miller operated a saltery on Burroughs Bay, on Behm Canal, in 1886 and 1887. In 1888 Andrew and Benjamin Young, of Astoria, Oreg., built a cannery here and operated it under the name of the Cape Lees Packing Co. in 1888, 1889, and 1890. It was closed in 1891 and 1892. In 1893 it became a part of the Alaska Packers Association, and was dismantled the following year.

About 1888 a saltery was established on Thorne Bay, Prince of Wales Island. The following year it was sold to the Loring cannery. In 1892 it was sold to Robert Bell, who moved it to the upper end of the northwest arm, on the western shore. Salting was not carried on each season, as it was sometimes found to be more profitable to sell the fish fresh to the canneries. The plant was finally abandoned.

In 1889 Messrs. Sanborn and Ellmore, of Astoria, built a cannery in Pavlof Harbor, Freshwater Bay, on the eastern side of Chichagof Island, and operated it under the name of the Astoria & Alaska Packing Co. It made a pack that year and in the spring of 1890 was moved to Point Ellis, on the eastern side of Kuiu Island, packing that year and also in 1891. It was burned in May, 1892. Only one building was left standing, and it and the site were purchased by John H. Mantle, of Wrangell, who operated a saltery on each arm of the bay. Mr. Mantle began operations here in 1893.

In 1889 the Baranof Packing Co. built and first operated a cannery at the Redoubt, about 12 miles below Sitka. It was also operated in 1890 and then moved to Redfish Bay, on the western coast of Baranof Island. It made its first pack here in 1891 and was then operated every year until 1898, when it was sold to the Alaska Packers Association and dismantled.

In 1889 the Thlinket Packing Co., organized at Portland, Oreg., built a cannery at Point Gerard, on the mainland opposite Point Highfield, at the head of Wrangell Island. It was operated that and the subsequent year.

In 1901 this company built another cannery at Santa Anna, on the north side of Cleveland Peninsula, and made a pack the same year.

In 1901 both plants became part of the Pacific Packing & Navigation Co. In 1902 the Gerard Point plant was closed and was not opened again. In 1903, 1904, and 1905 the Santa Anna plant was closed also. Early in 1905 these plants were purchased by the Northwestern Fisheries Co. at the assignee's sale of the old corporation's properties. The Santa Anna plant was operated in 1906 and has been operated each year since.

The Chilkat Canning Co. put up a plant at Chilkat village, on Chilkat Inlet, in 1889. It was operated from 1889 to 1893, and then sold to the Alaska Packers Association. It was held in reserve for some years but was finally dismantled.

In 1889 D. Blauw, of Tacoma, Wash., built a saltery on Grouse Island, Boca de Quadra, and dry-salted dog salmon. He operated only one season.

In 1890 a cannery was built by the Bartlett Bay Packing Co. on Bartlett Bay, Icy Straits, and operated by Williams, Brown & Co., of San Francisco. A saltery was constructed here prior to that date, and in 1889 a pack of 4,300 cases was made in a crude way. In 1891 the ice piled up in Glacier Bay to such an extent that the cannery could do almost nothing. It was not operated after this date. In 1893 it became a part of the Alaska Packers Association and was dismantled in 1894.

About 1890 a saltery was established on the north shore of the mouth of Quadra Stream, on Boca de Quadra, by Clark & Martin. It was operated intermittently until about 1898, when it was abandoned. The same parties also established a saltery at Ketchikan shortly after the one on Quadra Stream was built, and operated this until about 1898, when the plant was turned into a steamer wharf and warehouse for the new town of Ketchikan which was building up around it.

In 1896 the Pacific Steam Whaling Co. built a cannery on the northern side of Hunter Bay, near the southern end of Prince of Wales Island, and made a pack the same year. Miller & Co. had a saltery at this place and it was purchased by the company and removed to make room for the cannery. Miller & Co. also had a saltery on Nutqua Inlet, which was built in 1896, and this also was sold to the canning company. In 1901 the cannery became a part of the Pacific Packing & Navigation Co. It was closed in 1904. Upon the dissolution of the company in 1905 this plant was purchased by the Northwestern Fisheries Co., which company, after keeping it closed in 1905 and 1906, has operated it each season since.

The Quadra Packing Co. built a cannery on Mink Arm, in Boca de Quadra, in the spring of 1896 and made its first pack that year. In 1901 the plant was purchased by the Pacific Packing & Navigation Co. It was closed in 1904, 1905, and 1906. Upon the dissolution of the company in 1905 the plant was purchased by the Northwestern Fisheries Co. It was reopened in 1907 and has been operated each season since.

In 1897 a saltery was built on Taku Point, near the head of Taku Inlet. In 1898 and 1899 it was operated by the Quadra Packing Co. In 1900 the Icy Straits Packing Co. operated it.

In 1897 a small saltery was in operation by Cyrus Orr at Point Barrie, Kupreanof Island. In the same year Walter Kosmikoff operated a small saltery at Shipley Bay, on Prince of Wales Island. In 1900 he sold it to the Icy Straits Packing Co.

Fred Brockman in 1897 built and operated a small saltery on Sarkar Stream, Prince of Wales Island. Mr. Brockman operated this saltery intermittently until his death in 1915.

In 1897 Banter & West were operating a saltery at Sukkwan, on Sukkwan Island. In the same year Miller & Co. started another saltery on Kassook Inlet, on Sukkwan Island, while Thomas McCauley was operating a saltery on Whale Passage.

In 1899 the Icy Straits Packing Co., consisting of stockholders of the Quadra Packing Co., built a cannery and sawmill at a point on the southeastern shore of Wrangell Narrows, about a mile south of the northern entrance to same, and named the town site Petersburg. The cannery was ready and operated in 1900. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1903, 1904, and 1905. In 1905 it was purchased at the sale of the company's properties by the Northwestern Fisheries Co. In 1906 the Pacific Coast & Norway Packing Co., which had been operating a cannery at Tonka, on Wrangell Narrows, purchased this plant and transferred its activities to the latter. In 1915 the plant was leased to the Petersburg Packing Co., composed of stockholders of the old company.

In 1900 the Western Fisheries Co., of Portland, built a cannery at the head of Dundas Bay, and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904. At the assignee's sale of the company's properties in 1905 this plant was purchased by the Northwestern Fisheries Co. and operated in 1905 and each subsequent year.

In 1900 the Fidalgo Island Packing Co. built a cannery on the southern side of Ketchikan Creek. A pack was made the same year. The plant was closed in 1903, only a little salting being done that year, was reopened in 1904, was closed again in 1905, and was reopened in 1906, since when it has been operated each season to date, except in 1909.

In 1900 the Pacific Coast & Norway Packing Co. operated a floating saltery while prospecting for a cannery location. In 1901 the company built a cannery at Tonka, about midway of Wrangell Narrows, on the western side, and made a pack in that and subsequent years until 1906. In that year the company purchased the Petersburg cannery and thenceforth operated from there. The Tonka plant was dismantled a few years later.

In 1900 the Royer-Warnock Packing Co., of San Francisco, built a small cannery on Beecher Pass, which connects Duncan Canal with Wrangell Narrows, using the old Buck saltery for the cannery proper. It operated only the one season. It was a hand-pack plant.

The Taku Fishing Co. in 1900 built a cannery on the southern side of the entrance to Port Snettisham, and made a pack in that year. In 1901 it became a part of the Pacific Packing & Navigation Co. The plant was closed in 1902 and not reopened again.

In 1900 the Taku Packing Co., organized in Astoria, Oreg., built a cannery on the western shore of Taku Inlet and made a pack the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again. In 1905 it became the property of the Northwestern Fisheries Co.

In 1900 the Chilkoot Packing Co., organized at Aberdeen, Wash., built a cannery at the head of Chilkoot Inlet, and operated the same year. In 1901 it became a part of the Pacific Packing & Navigation Co. It was closed in 1904 and not reopened again.

In 1900 the Great Northern Fish Co. operated a floating saltery. Its principal business was salting dog salmon for the Japanese trade, and it operated only one season. J. E. Rice, of Whatcom, Wash., in the same year packed dog salmon on Karta Bay for the same trade.

The Pacific Packing & Navigation Co. (an account of whose inception, operation, and failure appears under Puget Sound) was organized in 1901 and acquired the following canneries in Alaska: Canneries of Pacific Steam Whaling Co. at Nushagak, Bristol Bay; Chignik, Alaska Peninsula; Uyak, Kodiak Island; Kenai, Cook Inlet; Orca, Prince William Sound; Hunter Bay, southeast Alaska. Also the Hume Bros. & Hume canneries at Chignik and Uyak; the Thlinket Packing Co. with canneries at Gerard Point and Santa Anna; the Western Fisheries Co. cannery at Dundas Bay, Icy Straits; Chilkoot Packing Co. cannery at Chilkoot Inlet; the Taku Packing Co. cannery at Taku Inlet; the Taku Fishing Co. cannery at Port Snettisham; the Boston Fishing & Trading Co. cannery at Yes Bay; the Chatham Straits Packing Co. cannery on Sitkoh Bay; the Icy Straits Packing Co. cannery at Petersburg, Wrangell Narrows; and the Quadra Packing Co. cannery at Mink Arm, Boca de Quadra.

The company met with financial disaster in 1904, and at the resulting sale most of its properties were bought by the Northwestern Fisheries Co., a corporation formed for the purpose. Of the Alaska canneries the Sitkoh Bay plant was sold to George T. Myers & Co., while the Orca plant was leased to Capt. Omar J. Humphreys, from whom the Northwestern Fisheries Co. later on secured it.

The San Juan Fishing & Packing Co., of Seattle, established a cannery and cold-storage plant in 1901 at Taku Harbor, a small bay on the mainland a short distance south of Taku Inlet, and made a pack the same year. This plant was purchased in 1903 by the Pacific Cold Storage Co. and operated by it in 1903, 1904, and 1905. In 1906 it was leased and operated by the Taku-Alaska Packing Co. From 1907 to 1911 the plant was leased and operated by John L. Carlson & Co. In 1911 the plant was purchased by Mr. Carlson and the name changed to the Taku Canning & Cold Storage Co., under which name it has been operated each year since. In 1918 it was purchased by Libby, McNeill & Libby.

In 1901 the Chatham Straits Packing Co. built a cannery on Sitkoh Bay, Chichagof Island. The same year this cannery became a part of the Pacific Packing & Navigation Co. Upon the dissolution of the latter, early in 1905, this plant was purchased by George T. Myers & Co., which company has operated it to date without a break.

In 1901 F. C. Barnes, of Portland, Oreg., built a cannery at Lake Bay, on the east side of Prince of Wales Island, and made a pack that season. This cannery was operated in 1902, but was closed in 1903. It was reopened in 1904, and operated each season after that. In 1910 it was incorporated under the name of F. C. Barnes Co.

In 1901 the Union Packing Co., organized in Tacoma, Wash., built a cannery on Kell Bay, an arm of Affleck Canal, on the southern side of Kuiu Island. In 1904 this plant was moved to the Kvichak River in Bering Sea.

Buhring & Heckman operated a small saltery in Union Bay, on the north side of Cleveland Peninsula, in 1901. Packing was carried on aboard a barge.

In 1901 the Muir Glacier Packing Co. put up a saltery on Ideal Cove, Dry Pass, near Wrangell. It has operated mainly as a mild-cure station. It was closed down in 1903 but was opened in 1904. It was then closed in 1905, 1906, and 1907. It was opened in 1908 by K. J. Johansen and operated in 1908 and 1909.

In 1902 the Kasaan Bay Co. built a cannery on the north side of Kasaan Bay, Prince of Wales Island, and made a pack the same year. It was shut down in 1904 and 1905, but reopened in 1906 by Gorman & Co., of Seattle, who had purchased control of the company. Shortly after the closing of the packing season the plant burned down, but it was rebuilt in time to operate the following season. In 1909 the plant was closed, but was reopened in 1910. On September 12 of that year the plant was again destroyed by fire, but was rebuilt in time to operate the following season. On October 29, 1911, the plant was once more destroyed by fire, but was rebuilt in time to operate in 1912. In 1915 the plant was purchased and operated by the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co.

In 1902 the Alaska Fish & Lumber Co. built a cannery at Shakan, on Kosciusko Island, near the head of Prince of Wales Island, and made a pack the same year. It was shut down in 1904. In 1905 the property was taken over by the Shakan Salmon Co., a new company composed largely of members of the old corporation, who operated it that season. In 1906 Gorman & Co., of Seattle, obtained control of this cannery and operated it each season under the name of the Shakan Salmon Co. until 1915, when it was sold to the Anacortes Fisheries Co., a subsidiary of the Booth Fisheries Co.

In 1902 the Columbia Canning Co. built a cannery on the southern side of Chilkoot Inlet, and made a pack that year. In 1910 C. A. Burckhardt & Co., under the name of the Chilkoot Fisheries Co., purchased and operated this plant. In 1911 the name was changed to the Alaska Pacific Fisheries. Early in 1919 the plant was totally destroyed by fire.

The only cannery in this section lost to Alaska by action of the Federal Government was that of the Wales Island Packing Co., which was built on Wales Island, near Dixon Entrance, in 1902. When the Alaska Boundary Arbitration Commission declared Wales Island a part of Canada in 1903, this cannery automatically ceased to be an American one. After the change of government it lay idle for some time, but is now in use once more by Canadian parties.

In 1902 the Thlinket Packing Co. built a cannery on Funter Bay, on the west side of Admiralty Island, and made a pack that year and every subsequent year to date.

The same year the Pillar Bay Packing Co. built and operated a cannery near Point Ellis, on Kuiu Island, and operated it until 1918, when it was sold to the Fidalgo Island Packing Co.

In 1902 the Alaska Fisheries Union, organized in Seattle, built a cannery on the east side of Chilkat Inlet, and made a pack that year. After operating to 1905, the plant was in that year leased to and operated by the Lynn Canal Packing Co. The plant was purchased in 1906 by the Pacific American Fisheries. In 1908 it was moved to Excursion Inlet and has been operated each season to date.

The Tacoma Fishing Co. in 1902 established a saltery and halibut station at Tee Harbor, on Lynn Canal, and made a pack that year. Later it became the property of the International Fisheries Co. In 1910 the plant was purchased by the Tee Harbor Packing Co., which established a cannery and operated first in 1911. It has been operated each season since, being sold to the Alaska Pacific Fisheries Co. in 1920.

The Seattle-Scandinavian Fish Co. built a saltery on Snug Harbor, Tenakee Inlet, Chichagof Island, in 1902, and made a pack. It packed in 1903 also, but shut down in 1904. The plant was leased in 1905, and then shut down for good.

The Alaska Fish & Mining Co. built and operated a saltery at Revilla, on Tongass Narrows, during the single season of 1902, while the Rice Fisheries Co., in the same year, built and operated a saltery on Boca de Quadra.

The United Fish Co., of Seattle, salted at Tolstoi Bay, east side of Prince of Wales Island, 1903 and 1904.

In 1907 the Alsek Fisheries Co. did some salting on the Alsek River. Malcolm Campbell was interested in the above company and in subsequent years operated under his own name. In 1910 the St. Elias Packing Co. established a cannery near the saltery and made a pack the same year, and in 1911 and 1912. Since then the plant has been closed and was sold in 1916 to Libby, McNeill & Libby.

The Astoria & Puget Sound Packing Co., in 1908, built and operated a cannery on Excursion Inlet. It was closed the following year, but has been operated each year since. It was burned in 1917, but was rebuilt in time to operate the following season.

The year 1911 witnessed a considerable increase in the number of canneries. Among the new plants built and operated were the following: Hidden Inlet Canning Co., Hidden Inlet, Portland Canal; Hawk Fish Co. (later changed to P. E. Harris & Co.), Hawk Inlet, Admiralty Island; Lindenberger Packing Co., Roe Point, Behm Canal: Deep Sea Salmon Co., Cape Edwards, Chichagof Island; L. Gustave & Co., Skowl Arm, Prince of Wales Island (changed in 1912 to Skowl Arm Packing Co.), and M. E. Lane (a small hand-pack plant), Myers Chuck, Cleveland Peninsula.

An innovation in Alaska salmon canning this year was when the old ship *Glory of the Seas* was fitted out as a floating cannery by the Alaska Fish Co., and operated in Hawk Inlet, Admiralty Island, and at Ketchikan. Quarters for the crew were built over the cabins on the quarter deck, the latter being reserved for officials. The remainder of the upper deck was used for receiving, dressing, and cleaning the fish, which were brought on board by means of a portable elevator attached to the side of the ship. The "iron chink" and the sliming and cleaning tanks were also on this deck. The fish were carried in chutes to the second deck, where a line of sanitary machinery had been installed. The retorts were placed on the forward part of the second deck. The third deck was used for cooling and storing the pack. No lacquering or labeling was carried on aboard the vessel.

In 1912 this plant and the ship *William H. Smith*, the latter by the Weiding & Independent Fisheries Co., of Seattle, were operated. The *William H. Smith* also did some freezing of salmon.

In 1913 the *Glory of the Seas* was sold to the Glacier Fisheries Co., which operated it as a cold-storage plant. The floating cannery and cold-storage ship *William H. Smith* was not operated in Alaska during this season.

In 1912 still more canneries were built, among these being the following: Admiralty Trading Co., Gambier Bay, Admiralty Island; Alaska Sanitary Packing Co., Wrangell; Canoe Pass Packing Co., Canoe Pass; Herbert Hume Packing Co., Nakat Inlet, Portland Canal; Hoonah Packing Co., Hoonah, Icy Straits; Irving Packing Co., Karheen; Kake Packing Co., Kake; Kuiu Island Packing Co., Point Beauclaire, Kuiu Island; Lindenberger Packing Co., Craig, Fish Egg Island: Oceanic Packing Co., Waterfall; Point Warde Packing Co., Point Warde, Bradfield Canal; Pure Food Fish Co., Ketchikan; Revilla Fish Products Co., Ketchikan; Sanborn-Cram Co., Burnett Inlet; Starr-Collinson Packing Co., Moira Sound; Sunny Point Packing Co., Cholmondeley Sound; Swift, Arthur & Co., Heceta Island; Walsh-Moore Canning Co., Ward Cove, and Wiese Packing Co., Rose Inlet.

In 1913 the plant of Swift, Arthur & Co. was used as a mild-cure station alone, while the name was changed to the Swift-Arthur-Crosby Co. The Alaska Fish Co. absorbed the Oceanic Packing Co. and transferred its activities to the former company's cannery at Waterfall. The following other plants were shut down: Canoe Pass Packing Co., Herbert Hume Packing Co., Point Warde Packing Co., and the Revilla Fish Products Co.

In 1914 one new cannery was built. This was erected on George Inlet, Revillagigedo Island, by the George Inlet Packing Co. The canneries of the Point Warde Packing Co., located at Point Warde, and the G. W. Hume Packing Co. (formerly the Herbert Hume Packing Co.), at Nakat Inlet, which were not operated in 1913, were reopened in 1914. The cannery of the Swift-Arthur-Crosby Co. was also reopened. The Walsh-Moore Canning Co. changed its name to the Ward Cove Packing Co., while the Sanborn-Cutting Co. took over the cannery operated by the Kake Packing Co. The canneries of the Admiralty Trading Co. and the Skowl Arm Packing Co. were closed in 1914. The plant of the Kuiu Island Packing Co. burned down in the fall.

In 1915 the Admiralty Trading Co. did not operate. Late in the summer it was sold to the Hoonah Packing Co., which company operated it in 1916 and succeeding years. The new canneries in 1915 were the Doyhof Fish Products Co., at Doyhof, on Wrangell Narrows, and Edward Verney & Son (a hand plant), at Metlakahtla. The name of the Irving Packing Co. was changed to the Karheen Packing Co. The Straits Packing Co. purchased the Skowl Arm cannery of the Skowl Arm Packing Co. and operated it.

In 1916 the following new canneries were constructed and put into operation: Auk Bay Salmon Canning Co., Auk Bay; Beegle Packing Co., Northland Packing Co., and J. L. Smiley & Co., all at Ketchikan; Sanitary Packing Co., George Arm; Seattle Packing Co., floating plant in Idaho Inlet; Tenakee Fisheries Co., Tenakee; and Union Bay Fisheries Co., Union Bay.

The George W. Hume Co.'s plant at Nakat Inlet, formerly operated by the Herbert Hume Packing Co., burned down shortly after the season's operations had begun. It was rebuilt in time to operate in 1917.

Late in 1916 the Lindenberger Packing Co. sold its Roe Point plant to the Northwestern Fisheries Co. and its Craig plant to the Columbia Salmon Co. About the same time the Seattle Packing Co. disposed of its floating cannery *Amelia* to the Northland Fish Co., which operated it at Metlakahtla in 1917. The Sanitary Packing Co. changed to the Ketchikan Packing Co., while the Sunny Point Packing Co. took over all the interests of the Northland Packing Co., and in 1917 operated the cannery also located at Ketchikan.

In 1917 the heavy demand throughout the world for foodstuffs caused a considerable increase in the number of new canneries in Alaska. In the southeast Alaska section, nine were built and operated as follows: Alaska Herring & Sardine Co., Port Walter; Alaska Pacific Herring Co., Big Port Walter; Baranof Packing Co., Red Bluff Bay; R. L. Cole & Co., Tokeen; Haines Packing Co., Letinkof Cove; Lane & Williams, Moira Sound; Northland Fish Co. (floating plant *Amelia*), Metlakahtla; Sitka Packing Co., Sitka; and Robert Scott, a floating cannery at Craig. The two first named were built in 1916 but were not then engaged in canning salmon.

On September 13, 1917, the cannery of the Sunny Point Packing Co., at Sunny Point, was totally destroyed by fire, while on October 2 the same fate befell the cannery of the Astoria & Puget Sound Canning Co. at Excursion Inlet. Wilson Fisheries Co., of Chicago, took over the J. L. Smiley & Co. plant at Ketchikan.

In 1918 the following new canneries were put into operation: Alaska Clam Canning Co., Petersburg; Alaska Packing & Navigation Co., Pavlof Harbor; Columbia Salmon Co., Tenakee Inlet; Hidden Inlet Canning Co., Hood Bay; Hunter & Dickinson, Washington Bay; T. E. P. Keegan, Douglas; J. H. Long Packing Co. and Northern Packing Co., Juneau; Noyes Island Packing Co., Noyes Island; Pybus Bay Fish & Packing Co., Pybus Bay; Pyramid Packing Co. and Sitka Packing Co., Sitka; Southern Alaska Canning Co., Quadra; Todd Packing Co., Peril Strait; and H. Van Vlack & Co., Petersburg.

The name of the Sanborn-Cram Co. was changed to Burnett Inlet Packing Co. The Deep Sea Salmon Co. established a new plant at Port Althorp and used part of the equipment of its former Knik Arm cannery in equipping it. G. W. Hume Co. purchased the Doyhof Packing Co. cannery at Scow Bay. The Marathon Fishing and Packing Co. operated the barge *Amelia* at Petersburg. The Southern Alaska Canning Co. took over the Rose Inlet plant of the Wiese Packing Co.

The following new plants were constructed and operated in 1919: Alaska Salmon & Herring Co., Tyee; Alaska Sanitary Packing Co., an additional plant at Cape Fanshaw; Beauclaire Packing Co., Port Beauclaire; Cape Fanshaw Fishing & Packing Co., Cape Fanshaw; J. L. Carlson & Co., Auk Harbor; Douglas Island Packing Co., Douglas; Hood Bay Packing Co., Hood Bay; Olympic Fisheries Co., floating barge at Ketchikan, etc.; Petersburg Packing Corporation, Washington Bay.

The Southern Alaska Canning Co. took over the Alaska Pacific Herring Co., while the Alaska Clam Canning Co. changed its name to the Mountain Point Packing Co. The American Packing Co. took over the J. H. Long Packing Co.

In 1919 the Northwestern Fisheries Co. did not operate its Santa Ana, Hunter Bay, and Roe Point canneries, while the Anacortes Fisheries Co. shut down its Shakan cannery. Other canneries which did not operate were the following: Craig cannery, of Columbia Salmon Co.; T. E. P. Keegan, Douglas.

At one time salteries were of considerable importance in this section, but the establishment of canneries, with the consequent heavy demand for fresh salmon, induced most of the salteries to sell their high-grade fish to the canneries and pack only the cheaper grades. Many of them quit the business as a result of the competition, while others were forced out by the low prices prevailing at times for salted salmon. As many of the salters moved from place to place, and frequently changed their operating name, it has been difficult to keep track of them, and in this review only those are listed who attained to some prominence either through longevity or largeness of pack.

James Millar, one of the earliest whites to take up his residence here after the purchase of Alaska, and his sons were very active in starting and operating salteries, and it was an unusual thing during the period previous to 1910 when one of the family was not operating such a plant.

Jacob Louth established a saltery on the south arm of Moira Sound about 1900 and operated it for some years.

John C. Frey established a saltery on Etoline Island in the nineties and ran it until his death in 1904, when John H. Mantle purchased and operated it until about 1910.

Anderson & King built a saltery on Cholmondeley Sound, Prince of Wales Island, in the nineties. In 1904 it was operated under the name of A. E. King. After Mr. King's death his widow operated it from 1906 to 1909. In 1910 the saltery was purchased by C. A. Burckhardt & Co., who built a cannery on the site and began operations in 1911. In 1912 the name was changed to the Alaska Pacific Fisheries.

The Alaska Fish & Development Co. built a saltery on Pleasant Bay, Admiralty Island, in 1903, and operated it from 1903 to 1905. In 1907 it was operated by the Alaska-American Fish Co., but has been closed since.

Yakutat Bay is the only harbor available for vessels from Cape Spencer to Prince William Sound. In 1902 C. A. Fredericks & Co., of Seattle; Mulvey & Wilson, of Yakutat; Jewell Fish Co.; and Ankow Fish Co. all established salteries here. While their primary purpose was the salting of herring, considerable salmon was also salted. These plants operated only the one season.

In 1904 the Yakutat & Southern Railway Co. built a cannery here. This plant is noted for being the only one that hauls its fish by railway from the fishing streams to the cannery. The railroad is a little over 9 miles in length, and for some years an engine which had seen service on the elevated railroads of New York City and was discarded when the latter were electrified was used. A more modern engine is now in use. The fish are carried in open freight cars. Later this company was purchased by Gorman & Co., and now is the property of Libby, McNeill & Libbey, although operated under the original name.

PRINCE WILLIAM SOUND AND COPPER RIVER.

The great indentation known as Prince William Sound, and the Copper River delta, a short distance south of the sound, were not exploited as much as many other portions of Alaska until about 1915, due largely to the limited means of transportation and the consequent heavy expense of operation.

The principal source of salmon supply is the Copper River, a glacial stream about 300 miles long, which empties into the Gulf of Alaska through a delta nearly 40 miles in width and extending upstream about 25 miles.

Owing to the constantly shifting shoals in the delta, special knowledge is needed in navigating them, while special flat-bottomed vessels are required as run boats. The gill net and dip net are the only important apparatus in use in the river. In Prince William Sound traps and purse seines catch most of the salmon.

In 1889 a company known as the Central Alaska Co. built a cannery on Wingham, or Little Kayak Island, about 15 miles west from Cape Suckling. It made a pack that year, and the following spring was moved to Thin Point, on the southern side of the Alaska Peninsula.

The Peninsula Trading & Fishing Co. built a cannery on the same island in 1889. In 1891 it was moved to one of the sloughs of the Copper River delta, known as Coquenhena, and operated in 1891. It was closed in 1892 and 1893. The Pacific Steam Whaling Co. operated it until 1897, when it was abandoned.

In 1916 the Hoonah Packing Co. built and operated a cannery on Bering River.

Louis Sloss & Co., of San Francisco, built a cannery under the title of Pacific Packing Co. in 1889 at the extreme eastern end of the sound, close by the present site of Cordova, and called it Odiak. The cannery was closed in 1892. In 1893 it joined the Alaska Packers Association and was operated each season until 1905. In 1906 the buildings and site were sold to the Copper River & Northwestern Railroad Co., which was preparing to build a railroad from Odiak to the headwaters of the Copper River.

In 1889 the Pacific Steam Whaling Co. built a cannery close by the Odiak plant, but in the spring of 1895 it was moved to the spot now known as Orca, about 3 miles north of Cordova. It was closed in 1892, and has been operated ever since except in 1919 and 1920. In 1901 it was taken into the Pacific Packing & Navigation Co. combination. When the latter's assets were sold in 1904, this cannery was not included in the sale, as at the time the plant was under lease to Capt. Omar J. Humphrey. In 1905 it was sold to the Northwestern Fisheries Co., which had purchased most of the Alaska plants of the defunct company, and they have operated it since.

In 1915 the Copper River Packing Co. built a cannery on the Copper River at Mile 55, and made a pack the same year. The cannery uses no run boats, but has an arrangement with the Copper River & Northwestern Railroad Co. to haul the fish from the fishing stations to the cannery, and bring the finished product to Cordova for shipment by steamer. In 1918 the name was changed to the Abercrombie Packing Co.

The Canoe Pass Packing Co., which had built a cannery at Canoe Pass, southeast Alaska, in 1912, and had not operated it subsequently, in 1915 moved the machinery to Cordova and installed it in a rented building and made a pack. It built its own cannery at Shepard Point, near Cordova, in 1917.

In 1916 the Carlisle Packing Co. built a cannery at Cordova, while the Clark-Graham Co. built one at Eyak, a few miles away.

In 1917 the following new canneries were operated: Valdez Packing Co., Valdez; Copper River Packing Co., Port Nellie Juan; Lighthouse Canning Co. and Moore Packing Co., Cordova; and San Juan Fishing & Packing Co., Seward. The latter plant was also equipped for freezing salmon and other fishes. The Lighthouse Canning Co. was canning clams in 1916, the first year of its operation. The Alaska Sea Food Co. took over the Turner cannery, which had been built in 1916 and used in packing clams. The plant was destroyed by fire on April 4, but was rebuilt the same year, although not operated with salmon until 1918.

A number of salmon salteries were started in Prince William Sound after 1915. Charles Matthews in 1916 operated a salmon saltery at Seward; The Kenai Fishing & Trading Co. in 1916 acquired the J. Bettles saltery on Eshamy Bay. In 1918 the company expanded into a canning plant. A. C. Hoodenpyle operated a saltery at Port Wells in 1918.

In 1919 the following new canneries were started: Franklin Packing Co., Port Ashton; and Pioneer Packing Co., Cordova (this plant had been operating on clams for a couple of seasons). The Eyak River Packing Co. took over the Clark-Graham Co., while the Hillery-Scott Co. succeeded the Lighthouse Canning Co.

COOK INLET.

While this great inlet has an abundant supply of salmon, it is one of the most difficult sections in all Alaska in which to fish successfully. The tides and currents in the inlet are strong and treacherous, increasing in height and force as its head is approached, where the tide comes in with a bore which is extremely dangerous to small craft. Shoals make out a long distance from shore and are continually changing.

The first cannery to be built on the inlet was in 1882, when the Alaska Packing Co., of San Francisco, built one at Kasilof, on the right bank of the Kasilof River at the mouth, utilizing the available machinery from the cannery built by the Cutting Packing Co. at old Sitka in 1878. In 1885 this cannery was sold to the Arctic Fishing Co. In 1890 the loss of its cannery ship forced it to close that season. In 1893 it joined the Alaska Packers Association. At the height of the season of 1905 the plant was burned. It was rebuilt the next spring and has been operated each year since.

The cannery of the Northern Packing Co. was built in 1888 on the eastern side of Cook Inlet, at Kenai, at the mouth of the Kaknu River. It was operated up to and including 1891. In 1893 it joined the Alaska Packers Association, but has not been operated since 1891.

In 1897 the Pacific Steam Whaling Co. built a cannery at Kenai, but did not install the machinery and operate it until the next year. In 1901 this cannery was taken over by the Pacific Packing & Navigation Co. In 1903 the plant burned down. Upon the sale of it assets in 1905 the site passed to the Northwestern Fisheries Co. In 1910 the company put up a new plant here and has operated it continuously since. During the period when the site was unused a mild-curing establishment was operated here by the San Juan Fishing & Packing Co. in 1907 and 1908. This plant burned down just before the fishing season of 1916 began, but was rebuilt in time to operate in 1917.

In 1890 George W. Hume, of San Francisco, built a cannery at Kasilof, on the right bank of the river, about half a mile above its mouth. It was operated in 1890, 1891, and 1892. In 1893 it joined the Alaska Packers Association and was consolidated with the plant of the Arctic Fishing Co.

C. D. Ladd operated a saltery on the left bank and at the mouth of the Chulitna River, about 6 miles above Tyonek. This saltery was purchased by the Alaska Salmon Association in 1899. The following spring it erected a cannery here and made a small pack. It was operated also in 1901 and 1902, and then abandoned.

In 1907 J. A. Herbert & Co. established a saltery at English Bay and operated it until 1910.

In 1911 the Seldovia Salmon Co. built a cannery at Seldovia and operated it until late in 1915, when the company went into the hands of a receiver. In 1916 it was reopened by the Columbia Salmon Co. In 1917 it was bought by the Northwestern Fisheries Co. and operated in this and the succeeding year, but was closed in 1919.

In 1912 the Fidalgo Island Packing Co., which already operated a cannery at Ketchikan, in southeast Alaska, built a cannery at Port Graham, at the lower end of the Kenai Peninsula. A pack was made that year and each year since.

The same year Libby, McNeill & Libby built a cannery at Kenai and operated that year and each subsequent year.

In 1915 the Deep Sea Salmon Co., which operates a cannery in southeast Alaska, built a plant near Knik, on the west side of Cook Inlet, and made a small pack. This plant was abandoned at the end of 1917 and part of the equipment sold to a new plant in southeast Alaska.

Of recent years considerable salting of salmon has been carried on in Cook Inlet. In 1916 Dr. Knut A. Kyvig, of Anchorage, did some salting at Swanson Creek, Turnagin Arm, under the name of the Kyvig Packing Co. In 1917 the Beluga Whaling Co. salted salmon at Beluga. In 1918 Dr. Kyvig disposed of his interest in the Kachemak Bay plant to the Kachemak Canning Co.

AFOGNAK ISLAND.

Afognak Island lies to the northwest of Kodiak, and it is separated from it by a narrow strait.

In 1889 the Royal Packing Co. built a cannery at the head of Afognak Bay and operated it in 1889 and 1890. It became a member of the Alaska Packers Association in 1893. It has not been operated since 1892.

The Russian-American Packing Co. in 1889 built a cannery immediately above that of the Royal. It was operated in 1889 and 1890. In 1893 it became a member of the Alaska Packers Association. It has not been operated since 1890.

In accordance with an act of Congress approved March 3, 1891, the President, by proclamation of December 24, 1892, set aside the whole island and within 1 mile from the shores thereof as a fish-cultural reserve for the use of the United States Commission of Fish and Fisheries. As a result of this action both canneries were forced to move from the island entirely.

KODIAK ISLAND.

This island has been the scene of some of the best fishing in Alaska. The Russians early settled here, one of the most fertile spots in the usually sterile soil of Alaska, and undoubtedly they must have prosecuted the fisheries from an early date, although but little data are extant showing their operations in this line.

Karluk River and Lagoon.—One of the greatest salmon streams in the world is the Karluk River, and although its importance is much diminished now through long continued and heavy fishing, it still produces annually a large pack of canned-salmon, and has the distinction of having produced more salmon than any other river in Alaska.

It will doubtless surprise most readers to hear that the river which has yielded so many countless thousands of salmon is only 16½ miles in length. It has its source in two lakes, the larger of which is about 8, the smaller, 3 miles long. The mouth of the river is about 2 miles above the canneries, and spreads out here into a lagoon. This lagoon has at the head a width of about 300 yards, and gradually widens until it is nearly half a mile across as it approaches the spit. The lagoon has a general east and west direction, is about 2 miles in length, and, except for the shingle spit which is thrown across its mouth by the action of the sea, its shores are bluff, rising from about 50 to 100 feet. The spit is three-fourths of a mile long with an average width of about 200 feet. The outlet of the lagoon is only 90 feet wide at its mouth. The western side of the mouth of the lagoon is Karluk Head, a precipitous mountain mass about 1,600 feet high.

The outer side of the spit is where the fishing is carried on. Haul seines are used exclusively. As bowlders used to be common here it was necessary to remove a number of them in the early days when a seine shore was to be prepared. The red salmon run here is an exceptionally long one, the season extending from about the middle of June to about the middle of September. The other species of salmon also run here; sometimes humpbacks appear in large numbers. As the beach is open to Shelikof Strait, in which storms are frequent, seining is often interrupted.

As early as 1867 the salting of salmon was carried on at Karluk. In 1870 the Alaska Fur Trading Co. and the Alaska Commercial Co. began to salt salmon and continued this on a gradually expanding scale.

In 1882 Smith & Hirsch, who had been engaged in salting on Karluk Spit, built the first cannery on Kodiak Island. After operating it until 1884 it was organized under the title of the Karluk Packing Co., and packed under that name every year until 1911, when canning operations were transferred to the new cannery in Larsen Bay. In 1893 it joined the Alaska Packers Association.

The Kodiak Packing Co. in 1888 built a cannery on the eastern side of the spit and operated it in 1888, 1889, 1890, 1891, and 1893. It joined the Alaska Packers Association in 1893, but has not been operated since that season.

The Hume Packing Co. built a cannery on the spit about 400 yards westward of Kodiak cannery in 1889. In 1892 it was consolidated with the Aleutian Islands Fishing & Mining Co., which had built a cannery about 100 yards westward of the Hume cannery in 1888. In 1893 the consolidation became a member of the Alaska Packers Association. This plant was not operated in 1900.

In 1888 the Alaska Improvement Co. built a cannery on the left bank of the outlet, opposite the point of the spit and facing the Shelikof Strait. It was ready to pack in 1888, but was not operated on account of the loss of its cannery ship, the *Julia Ford*. In the spring of 1897 it was sold to the Alaska Packers Association and has since been operated by that company.

In 1893 the Hume Canning & Trading Co. built a cannery on the beach under Karluk Head, about three-fourths of a mile northward of the Alaska Improvement Co., in what is known locally as Tanglefoot Bay. It was operated in 1893 and 1894, and in 1895 it was sold to the Alaska Packers Association and operated by that company. It has been closed since.

The great increase in the number of canneries in Alaska in 1888 and 1889 caused such an enlargement of the pack that the markets became glutted, and it was soon apparent that steps would have to be taken to reduce the output if the operators were to avoid bankruptcy.

Capt. Moser in "Salmon and Salmon Fisheries of Alaska"[a] thus describes the attempts of the canners to find a working solution of this important problem and the final result of their endeavors:

In 1890 the three canneries at Chignik combined under an operating agreement known as the Chignik Bay Combination, under which the plant of the Chignik Bay Co. was operated, the three canneries sharing the expense and dividing the output equally. This arrangement remained in force during the seasons of 1890 and 1891. Its evident success in 1890 probably led to the local combinations on Kodiak Island in 1891, and then to the association which now exists.

The large packs during this period and the glutted market caused the cannery interests to devise some scheme to meet the conditions. The combination at Chignik in 1890 permitted the pack to be made there at a lower rate and, as previously stated, it was continued in 1891. The same year (1891) the canneries at Karluk, Uyak, and Afognak entered a combination, under the name of the Karluk River Fisheries, under which it was agreed that each cannery should have a quota of fish from the several localities, based upon the average packs of each cannery in 1889 and 1890. The estimated pack for the canneries interested was placed at 250,000 cases, and upon this estimate the apportionment of the work at each cannery was made. Under this agreement four of the eight canneries were closed, their quota being packed in the other four canneries as follows, viz, that of the Royal at the Karluk, of the Arctic at the Kodiak, of the Aleutian Islands at the Hume, and of the Russian-American at the Alaska Improvement.

In the summer of 1891 the Kodiak Packing Co. and the Arctic Packing Co., both at Alitak Bay, also had a mutual agreement under which only one cannery, the Arctic, was operated, the quota of fish of the Kodiak being packed in the Arctic cannery. By these combinations the full pack of the Karluk district was made in half the number of canneries and the expense of packing very considerably reduced.

In September, 1891, the Alaska Packers Association was formed to dispose of the unsold salmon of that season's pack (some 363,000 cases) and five trustees were ap-

[a] The Salmon and Salmon Fisheries of Alaska. Report of the Operations of the U. S. Fish Commission Steamer *Albatross* for the Year ended June 30, 1898. By Jefferson F. Moser. Bulletin, U. S. Fish Commission, 1898 Vol. XVIII, pp. 18–21. Washington, 1899.

pointed to manage the business. This association was not incorporated and expired after the salmon were sold.

The successful operation of these arrangements led, in 1892, to an arrangement in which nearly all (31) of the canneries joined, entering under the name of the Alaska Packing (not Packers) Association, for the purpose of leasing and operating and therefore controlling the canneries and reducing the Alaska pack for that year, it being found too great for the market's demands. All the canneries in operating condition in 1892 were members of this association except the following: Metlakahtla Industrial Co., at Metlakahtla; Boston Fishing & Trading Co., at Yes Bay; Baranoff Packing Co., at Redfish Bay; Chilkat Canning Co., at Pyramid Harbor; Alaska Improvement Co., at Karluk; and the Bering Sea Packing Co., at Ugashik.

The association was regularly incorporated on January 13, 1892, and shares were distributed on the basis of 1 for each 2,000 cases packed in 1891, and the profits were divided equally on all shares, regardless of the amount of profits derived at the different points. Of the 31 canneries, 9 were operated by the association, while the others were closed, the Alaska pack being reduced one-half.

The year 1893 found the Alaska Packers Association organized and incorporated February 9. This association was formed from the canneries that had joined the Alaska Packing Association of 1892, except the Pacific Steam Whaling Co., at Prince William Sound, and the Peninsula Trading & Fishing Co., the latter's cannery having been moved from Little Kayak Island to the Copper River delta in 1891.

The agreement of 1893 was similar to that of 1892, except that the amount of profit was taken into consideration in addition to the probable average quantity which could be packed at the different points. This was subject to adjustment for each district, and no arbitrary rule was followed. Each cannery entering the association was obliged to purchase an additional amount of stock, equaling two-thirds of the number of shares received by it for its plant; that is, a company which received 1,500 shares for its plant was required to purchase 1,000 shares additional. The money received from this sale of extra stock was used as working capital. No shares were sold to the general public, the owners of canneries subscribing for the full amount.

This association was then and is now (1920) the largest operator in Alaska, and, with its three canneries on Puget Sound, is also a factor in that region.

At a number of its canneries the association has always maintained physicians, whose services and supplies have been free to its own employees and to all natives applying for medical advice and medicines. This service has been of incalculable benefit to the latter, a large proportion of whom suffer from disease in some form or other.

No canning has been done at Karluk since 1911, when a new cannery was built at Larsen Bay, a branch of Uyak Bay, and the equipment remaining in the plants on the spit removed to it. This was done because frequent storms had caused havoc to vessels anchored in the open straits opposite the mouth of the lagoon. Since then fishing has been carried on as usual, the fish being carried to the canneries on Uyak Bay. The Alaska Packers Association and Northwestern Fisheries Co., the only operators now, have an agreement to divide the fish on the basis of seven to the former for every three given to the latter.

Alitak Bay.—Alitak Bay, or the "South End," as it is termed locally, is a deep indentation, with several arms, on the southwestern end of Kodiak Island, about 65 miles from Karluk. The seine is the principal apparatus used here.

In 1889 the Arctic Packing Co. built a cannery in the southwest bight of Olga Bay, which is a branch of Alitak Bay and is connected with it by a long, narrow passage. In 1893 it entered the Alaska Packers Association.

In 1889 the Kodiak Packing Co. built a cannery at Snug Harbor, a cove in the passage connecting Olga Bay with Alitak Bay, and operated it in 1889 and 1890. Its quota of fish was packed by the

Arctic Packing Co. in 1891. In 1893 it joined the Alaska Packers Association and the same year was dismantled.

In 1918 the Alitak Packing Co. built a cannery on Alitak Bay.

Uyak Bay.—Uyak Bay is on the northwestern side about the middle of Kodiak Island and is a considerable body of water with ramifying arms. On the western shore, near the entrance and about 18 miles from Karluk, is Uyak Anchorage. The harbor is formed by the main shore of the island and Bear and Harvester Islands, and is frequently used as an anchorage by cannery ships and the steamers from Karluk during bad weather. As there are no red salmon streams in Uyak, fishing is carried on elsewhere. Most of it is at Karluk Spit.

In the spring of 1897 the Pacific Steam Whaling Co. and Hume Bros. & Hume built canneries on the main shores at Uyak Anchorage. In 1901 both plants became a part of the Pacific Packing & Navigation Co. and were operated by it. In 1905 the Uyak plants were purchased by the Northwestern Fisheries Co., and the same year one of the plants was destroyed by fire and was not rebuilt. The remaining plant has been operated each year since.

Five miles southeast from Uyak Anchorage is a narrow arm called Larsen Bay. It is 4 miles long. Immediately within the entrance on the northern shore is the site of the cannery of the Arctic Packing Co., which was built in 1888, and operated in that year and 1889 and 1890, since which date it has been closed. In 1893 it became a part of the Alaska Packers Association and in 1896 it was dismantled.

As the association had lost several ships while loading at Karluk, it finally decided to move its plants from that place, and in 1911 a cannery was built at the old site on Larsen Bay, and from that time all cannery operations formerly carried on at Karluk have been performed at this plant.

Uganuk Bay.—This bay is next to the eastward of Uyak. For several years a saltery was operated here by Oliver Smith, who sold it to the Alaska Packers Association in 1896. The same year the latter built a cannery on the bay. It made a pack in 1896 and a partial pack in 1897. This cannery was abandoned in 1900.

Kodiak.—Salting operations have been carried on at this old Russian settlement for a number of years.

In order to furnish work for the natives, the Alaska Commercial Co. and Blodgett & Blinn salted the catches made by them in 1906 and subsequent years until 1912, when the Kodiak Fisheries built a cannery and has operated it each year since.

The Woman's American Baptist Home Missionary Society had carried on a home and school for native children on Wood Island, close to Kodiak, for some years. In 1902 the society established a salmon saltery here in order to furnish employment for the natives. No data are recorded in the official reports of further activities on the part of this plant.

CHIGNIK BAY.

Chignik Bay is on the southern side of the Alaska Peninsula and is the first important indentation after leaving Cook Inlet on the way to the westward. The bay is about 150 miles southwest of Karluk. On the westward side of the bay is a small deep bay known as Anchorage Bay. Several of the canneries are located here, and the transporting vessels of all the canneries make their anchorage at this point. In the extreme southwest corner of Chignik Bay is the entrance to Chignik Lagoon. At the head of this lagoon, from which all the canneries draw their supplies of red salmon, is the mouth of the stream up which go the schools.

Chignik River is about 6 miles long, with an average width of 100 yards, and its depth is such that a boat can ascend only at high water. It has its rise in two lakes, each about 10 miles long

Red salmon predominate in the runs, although all five species are to be found. A run of very small red salmon, weighing about 2 pounds, and known as Arctic salmon, appears here every year.

Practically all of the fishing here is with traps, although gill nets and seines have also been used at times.

This bay, next to Karluk Spit, has been the scene of more bitter fights for supremacy in canning than any other place in Alaska.

In 1888 the Fishermen's Packing Co., of Astoria, Oreg., sent a party to Chignik Bay to prospect for fish, and they returned in the fall with 2,160 barrels of salt salmon.

The next year, this company, operating under the name of the Chignik Bay Co., built a cannery on the eastern shore of the Lagoon, 2½ miles from the entrance.

The same year the Shumagin Packing Co., composed of capitalists from Portland, Oreg., and the Chignik Bay Packing Co., of San Francisco, built and operated canneries close to that of the Chignik Bay Co. All three of these companies soon arrived at a working agreement and finally combined into one organization. All were operated in 1889, 1890, and 1891. In 1892 they all joined the pool of the Alaska Packing Association, and the cannery of the Chignik Bay Co. alone operated. In 1893 they all became members of the Alaska Packers Association.

Since 1891 only the cannery of the Chignik Bay Co. has been operated. The Shumagin building has been moved alongside the former and the machinery consolidated, so as to form practically one large cannery.

In the spring of 1896 Hume Bros. & Hume built a cannery on the eastern side of Anchorage Bay and made a pack that year and in 1897.

The same spring the Pacific Steam Whaling Co. built a cannery one-fourth of a mile south of the Hume cannery, and made a pack that year and in 1897. In 1901 this plant, also that of Hume Bros. & Hume, became part of the Pacific Packing & Navigation Co. The failure of this company in 1904 threw its properties onto the market and most of them, including the two Chignik canneries, were purchased by the Northwestern Fisheries Co., which in 1905 shut down the Hume Bros. & Hume plant for good and has operated the other plant ever since.

In 1910 the Columbia River Packers Association built and operated a cannery on Anchorage Bay, and has operated it every year since.

The three companies operating here have an amicable agreement under which they each operate the same number of traps and divide equally the salmon caught.

ALASKA PENINSULA, SOUTH SIDE.

Ozernoy.—In 1889 a cannery, under the title of the Western Alaska Packing Co., was built at Ozernoy, on the western side of Stepovak Bay, south side of the Alaska Peninsula. It packed that year and in 1890, but the fish were so scarce that the cannery was dismantled in 1891 and the site abandoned.

Nothing was done with it for some years, but about 1905 Bostrop Omundsen located there and established a saltery. In the winter of 1912–13 August Lindquist purchased a half interest in the plant and it was operated under their joint names until the death of the senior partner in the fall of 1915; since then it has been operated by Lindquist alone.

Thin Point.—Thin Point is on the southern side of the Alaska Peninsula, near its extreme western end. A saltery was operated here for several years, until the Thin Point Packing Co. was organized by Louis Sloss & Co., of San Francisco, and the cannery was built in 1889. It was operated in 1889, 1890, and 1891, and was closed after that date. In 1890 the cannery ship *Oneida*, en route for this place, struck on the Sannaks in April and nearly all of the 77 Chinese on board were lost. In 1893 the plant became a member of the Alaska Packers Association. In 1894 the cannery was moved to the Naknek River, in Bering Sea, and became a part of the cannery of the Arctic Packing Co.

The Alaska Packers Association operated a saltery at Thin Point in 1894, 1895, and 1896, and then abandoned the place.

The cannery of the Central Alaska Co. was moved in 1890 from Little Kayak Island, near Katalla, to Thin Point. It operated during 1890 and 1891, was closed in 1892, and in 1893 joined the Alaska Packers Association, but was no longer operated. In 1895 the available machinery was moved to Koggiung, on the Kvichak River, in Bering Sea.

In 1908 Osmund & Andersen established a saltery at Thin Point and operated it in 1908, 1909, and 1910.

In 1911 the Pacific American Fisheries built a cannery at King Cove, on the south side of the Alaska Peninsula, a few miles east of Thin Point, and in the fall purchased the saltery. The cannery was operated in 1911 and each year since.

In 1917 the Pacific American Fisheries built and operated a new cannery at Ikatan, on Isanotski Strait, at the eastern end of Unimak Island. The Sockeye Salmon Co. built and operated in the same year a new cannery on Morzhovia Bay, a few miles from the strait, and on the Alaska Peninsula. In 1920 the latter was moved to the Unimak Island side of the strait.

SHUMAGIN AND SANNAK ISLANDS.

Small salteries have been operated at different places on the Shumagin and Sannak groups. The plants have usually been rude and primitive affairs and were operated whenever the price of salted salmon was high enough to justify same. As the ownership, and the location in many instances changed frequently, no attempt has been made even to list them.

In 1920 the Shumagin Packing Co. installed the necessary machinery in its saltery and put up a pack of canned salmon.

BERING SEA.

Bristol Bay.—The great redfish producing section of the world is in the Bristol Bay portion of Bering Sea. This bay lies in the eastern section of Bering Sea, inside of a line drawn from Port Moller to Cape Newenham, and a number of important rivers debouch into it, in all of which the annual runs of salmon, especially reds, are important.

Bristol Bay is considerably off the line of steamship travel, and as a result the companies operating here are compelled to have ships in which to bring up their employees and supplies in the spring and to take back the men and prepared products in the late summer or early fall when the season has ended.

Cannery ships belonging to the Nushagak plants are taken into the bay and anchored as near the canneries as possible. Owing to shoals this can not be done on Kvichak Bay and the Naknek and Ugaguk Rivers. In the early days of the fisheries the ships running to the latter canneries were brought as close to the plants as possible, unloaded by means of scows, and then taken to the Nushagak for shelter. When their numbers were too great to permit of this they were moored in the open about 5 miles off the point separating Kvichak Bay and Naknek River, where the anchorage is good and the vessels have very little trouble in riding out storms. Usually the captain and a boy are left aboard the ship.

NUSHAGAK RIVER AND BAY.

The Nushagak River, sometimes called the Tahlekuk, with its tributaries, and the Wood River, which enters the head of Nushagak Bay close by the mouth of the Nushagak, form a favorite resort of the red salmon, while all other species also ascend them.

But little is known of the upper courses of the Nushagak River, except that they drain the region between Lakes Clark and Iliamna on the east and the Kuskokwim on the west.

The river is said to be 200 miles long to the first lake, a large one. Beyond this lake there are three other smaller lakes, all connected by short stretches of river. The largest tributary of the river is the Malchatna, which enters it about 100 miles from the mouth. There are also several small tributaries, two of these being Tikchik River and Portage Creek. There are three or four Indian villages on the Nushagak, Kaknak being the largest. A launch drawing 3 to 3½ feet of water can navigate about 120 miles from the mouth. It is necessary to use a "bidarka" to go into the upper reaches. There are four rapids, around which a portage must be made in each case.

The river on its lower course is large, and flows a great quantity of water into the head of Nushagak Bay.

Wood River is about 24 miles long from its mouth to the first lake. Shoals and bars are frequent in the river, the depth on these at low water being 2½ feet and at high water 4 feet.

Aleknagik Lake, the first of the chain of three, is about 24 miles long, and has an average width of about 2 miles.

Wood River is noted especially for the interesting counting experiment the Bureau of Fisheries is carrying on here. This very important work was first taken up in 1908, as an indirect result of the order closing Wood and Nushagak Rivers to the commercial fishermen, as noted below, and has been continued, with the exception of 1914, to the present time. This work is made possible by the generosity of the Alaska Packers Association of San Francisco and the Alaska-Portland Packers Association of Portland, Oreg., who furnish the material and erect the barricade, also the labor needed throughout the season, while the Bureau of Fisheries furnishes the personnel required to carry on the direct work of counting the fish and making other observations.

A rack or trap is constructed across the foot of Lake Aleknagik, at a constriction in the lake contour something more than 200 yards wide, for the purpose of intercepting all salmon entering the lake and passing them through gates or tunnels at such a rate and in such a manner that an accurate estimate of their numbers can be obtained. The pot of the trap is located near the left bank, and this has three gates by which the salmon can be passed from the pot into the lake Each gate is 2 feet in width, and its bottom rests on a wooden platform covered with white oilcloth, so that the fish can readily be seen as they pass over it when the gate is raised. When fish are passing through a gate a small wooden frame with a glass center is arranged so it will float on the water, and in order to hold it in position it is fastened to the framework of the gate. This is for the purpose of making the water smooth so the fish can readily be seen even though the surface be disturbed by ripples, etc.

When the fish are coming rather slowly, every one is counted by means of a tally register as it passes out through the gates. When the large run comes the following method is employed: An actual tally of every salmon passing through is made for one minute, and this is repeated 15 minutes later, the number passing through for 1 minute being regarded as the average for 15 minutes. A sheet with the whole day divided into quarter hours is kept ready at the gate and the number for one minute as taken from the tally register is immediately entered thereon by the attendant who made the tally. From these figures the total for the day is obtained. During only a small part of the season has it been found necessary to resort to this method of estimating the run.

The following table shows for each year since 1908 the commercial catch of salmon made in Nushagak Bay, the number of fish passing from Wood River into Lake Aleknagik, the total of both and the percentage of salmon that escaped the fishermen:

Year.	Nushagak Bay catch.	Wood River tally.	Total.	Per cent of escape.
1908	6,140,031	2,603,655	8,740,686	30.0
1909	4,687,635	893,244	5,580,879	16.0
1910	4,384,755	670,104	5,054,859	13.2
1911	2,813,637	354,299	3,167,936	11.1
1912	3,866,950	325,264	4,192,214	7.7
1913	5,236,008	753,109	5,989,117	12.5
1914	6,174,097	(a)		
1915	5,676,457	259,341	5,935,798	4.3
1916	3,592,574	551,959	4,144,533	13.3
1917	5,679,818	1,081,508	6,761,326	15.9
1918	6,078,965	943,202	7,022,167	13.4
1919	1,452,931	145,114	1,598,045	9.0

[a] Work not carried on this year.

Snake River, a tributary of Nushagak Bay, is about 30 miles in length, very crooked, and has its rise in a single lake close by Aleknagik Lake. There is an Indian village on the river just below the lake. Red salmon are abundant in this stream.

Igushik River is about 50 miles in length and enters Nushagak Bay about 4 miles above Nichols Hills. So far as known it has its source in two lakes—Amanka and Ualik. A short distance below the first lake there are rapids and a small falls. The quite large Indian village of Yacherk is located here, and the natives do most of their fishing in the rapids. Peter M. Nelson established a saltery about 10 or 12 miles above its mouth in 1902, and operated it until he sold it to the Alaska Fishermen's Packing Co., who have operated it since. There is a small Indian village close by the saltery.

Nushagak Bay, in which practically all the fishing is carried on, is about 35 miles long and from 5 to 15 miles in width. Sand bars and mud flats, which are visible at low water, occupy the greater part of its area.

The drift gill net is the favorite apparatus in this bay, although a few traps are also used. The fish begin to run very early here. Kings usually appear about June 5, reds about June 5 to 8, cohos either late in June or early in July, dog salmon about the middle of June, and humpbacks about the same time. The reds do not run in large numbers until late in June.

Considerable fishing was carried on in both the Nushagak and Wood Rivers until in 1908, when, as a result of a hearing held by the Secretary of Commerce and Labor on December 16 and 17, 1907, it was decreed that beginning January 1, 1908, "it is hereby ordered that until further notice Wood River, a tributary of Nushagak Bay, in the district of Alaska, and the region within 500 yards of the mouth of said Wood River be closed to all commercial fishing, and that all commercial fishing be prohibited in Nushagak River proper."

The earliest fishing by whites in the Bristol Bay section was for salting purposes by the trading companies, more particularly the Alaska Commercial Co., which had an important station at Fort Alexander on Nushagak Bay. Petroff, in the census report of 1880, refers to exports from this section of "from 800 to 1,200 barrels of salted salmon per annum from the Nushagak River."

In 1883 the schooner *Neptune* visited the Nushagak on a salting trip. The next year the Arctic Packing Co. erected a cannery here and made a trial pack of 400 cases. This was the first cannery to operate in Bering Sea. It was located close to the Moravian mission. This cannery eventually became a member of the Alaska Packers Association, and has not been operated for several years.

The second cannery to be built was by an Astoria company, the Alaska Packing Co., and it was erected on the western side near the head of the bay and about 1½ miles below the junction of the Wood and Nushagak Rivers. It has been operated every year to date, being since 1893 a member of the Alaska Packers Association. It is popularly known as the "Scandinavian" cannery.

In 1886 the Bristol Bay Canning Co. was organized by San Francisco parties, and built a cannery on the western shore of Nushagak Bay in a bend about 2 miles below the cannery of the Alaska Packing Co., at a place called Dillingham. It became a member of the Alaska Packers Association in 1893 and was operated each year until 1907.

A couple of years later it was dismantled. This plant was popularly known as the "Bradford" cannery.

The Nushagak Canning Co. built a cannery on the eastern shore of Nushagak Bay in 1888, at a place known as Clark Point, 5½ miles below Fort Alexander. This cannery also became a member of the Alaska Packers Association in 1893, but from 1891 to 1901 was not operated, but held in reserve. In the last-named year a large double cannery was built here and put into operation and has been operated each year since.

This company also built and operated a saltery on the Igushik River in 1886. Three years later it was moved to the mouth of the Nushagak. In 1893 C. E. Whitney & Co. purchased an interest in it and by 1899 owned it all. In 1902 the saltery was sold to the Alaska Packers Association, which closed it down.

In 1899 the Pacific Steam Whaling Co. built a cannery and commenced canning on the eastern shore of Nushagak Bay at Fort Alexander, or Nushagak village. This cannery was purchased by the Pacific Packing & Navigation Co. in 1901, and upon the sale of its properties in 1904 became a part of the Northwestern Fisheries Co. It has been operated each year since the latter company acquired it.

The same year the Alaska Fishermen's Packing Co., of Astoria, built a cannery immediately below that of the Pacific Steam Whaling Co., and operated it every year to date, control of the company passing to Libby, McNeill & Libby in 1913.

In 1901 the Columbia River Packers Association, the Alaska-Portland Packers Association, and the Alaska Salmon Co. all built canneries on the Nushagak and have operated them to date, except the last named in 1909, when its supply ship was wrecked. The Alaska Fishermen's Packing Co. also built a saltery here. The latter plant was abandoned in 1904.

In 1903 the North Alaska Salmon Co. operated a new cannery on the Nushagak, a few miles below Clark Point.

In 1910, on August 10, shortly after the packing season had ended, the plant of the Alaska-Portland Packers Association was completely destroyed by fire. The plant was rebuilt in time to operate the next season.

KVICHAK RIVER AND BAY.

The Kvichak River is about 80 miles in length, varies from 100 yards to a mile in width, and discharges a vast quantity of water The influence of the tide is felt 30 miles from the mouth. The current is very swift, running in places as much as 7 miles an hour. The upper half of the river is filled with low, grassy islands, the channels in many places being quite narrow. A launch drawing 3 feet of water can reach Lake Iliamna with very little difficulty. In most sections there are over 2 fathoms of water in the channels. The river drains Iliamna Lake, the largest lake in Alaska, which is about 90 miles long and about 30 miles wide, and Lake Clark. There are a number of Indian villages along the shores of the river and lakes.

Practically all of the fishing here is carried on in Kvichak Bay, gill nets being the only form of apparatus in use. As it is not convenient for the fishermen to take the catch to the canneries, large house lighters and scows are moored in convenient places and the fishermen live aboard the former, while the fish are put aboard the latter and taken to the canneries by the run boats. The numerous shoals in the bay seriously impede both fishing and navigation.

The first fishing operations on the Kvichak were in 1894, when the Prosper Fishing & Trading Co. and the Alaska Packers Association each established a saltery and operated that year and in 1895; in 1896 the latter purchased the plant of the former and consolidated the two.

In 1895 the Point Roberts Packing Co., which was owned by the Alaska Packers Association, built a cannery at Koggiung, the site of the former saltery, and operated it the next year.

In 1900 there was a considerable development in this region. The Kvichak Packing Co., owned by the Alaska Packers Association, built a cannery on the northern point of entrance to Bear Slough, while the North Alaska Salmon Co. built two canneries about 1,000 feet apart on the left bank of the Kvichak, about 6 miles above Koggiung.

The latter company built a cannery at Hallerville on the Lockenuck River, a tributary of the Kvichak, in 1904. In 1913 a large new cannery to take the place of the Hallerville plant was built on the lower side of Pedersen Point, lower down on Kvichak Bay. In 1916 all the plants of this company were purchased by Libby, McNeill & Libby and have been operated by that company since.

The second plant of the Alaska Packers Association, known as the Coffee Creek plant, was burned down in 1906. It was rebuilt in 1908 and operated again in 1909, and has been operated continuously ever since.

In 1904 the Union Packing Co. established a cannery on the left bank a little distance above the canneries of the North Alaska Salmon Co., having moved this plant from its original location on Kell Bay, in southeast Alaska. It was operated until 1907, when it was abandoned.

About 1905 the Northwestern Packing Co. built a saltery on the east side of the bay. In 1908 it was sold to and operated by Nelson, Olsen & Co., who in 1910 sold it to the Alaska Fishermen's Packing Co., which the following year turned it into a cannery. In 1913 Libby, McNeill & Libby bought this and the Nushagak plant, and continued to operate them under the old name. This cannery was destroyed by fire in the spring of 1915. It was rebuilt and operated in 1916.

NAKNEK RIVER.

But little is known of the Naknek River for more than 10 or 15 miles from its mouth. It is said that the river is about 60 miles long, and has its rise in a lake which is of considerable size. With the exception of a short series of rapids, up which it is possible to haul a boat with a rope from the shore, the river is navigable for small craft. Shoals and banks, many of which uncover at low water, are abundant in the lower courses of the river.

Red salmon is the principal species entering this river, although all the other species are to be found here in lesser abundance. They appear here a little later than in the Nushagak Bay. Only gill nets are used in fishing.

The first commercial fishing on the Naknek River was in 1890, when the Arctic Packing Co. built and operated a saltery on the east bank about 4 miles from the mouth. This plant was sold to the Alaska

Packers Association in 1893. The next year the latter built a cannery here, made the first pack in 1895, and has operated the cannery every year since. Ultimately the saltery was merged with the cannery.

In 1901 the association built another cannery about a mile nearer the mouth, and in 1911 still another was built close to the mouth.

In 1890 L. A. Pedersen built and operated a small saltery on the right bank about 3 miles from the mouth. In 1894 the Naknek Packing Co. purchased the saltery and erected a cannery a short distance above. This saltery and another built on the shore of Kvichak Bay in 1897 were operated for some years. In 1907 the latter was turned into a cannery and operated by Mr. Pedersen under the name of the Bristol Bay Packing Co. The Naknek Packing Co. cannery has been operated to date.

In 1916 the Red Salmon Canning Co. built and operated a cannery on the river about 2 miles above the plant of the Naknek Packing Co.

In 1918 the Northwestern Fisheries Co. operated a new cannery on the river about 2 miles below the plant of the Naknek Packing Co.

In 1919 the Alaska-Portland Packers Association operated a new cannery on the river several miles above the upper cannery of the Alaska Packers Association.

UGAGUK RIVER.

According to the natives this river, which is frequently called the Egegak, or Igagik, is about 80 miles long from the mouth to Lake Becharof, at the head. The lake itself is about 45 miles long and 15 miles wide. The river is navigable for small boats to within 10 miles of the lake, whence there is a succession of rapids, around which it is necessary to portage. The lower part of the river has numerous shoals, some of which are exposed at low water. King Salmon River, the principal tributary, enters about 7½ miles from the mouth.

The red salmon is the principal species, although all the other species are found in much lesser abundance. Gill nets alone are used here.

In 1895 the Alaska Packers Association established a fishing station on the right bank about 5 miles from the mouth and operated as a saltery until 1900, when the apparatus was moved to the cannery site.

In 1899 the Alaska Packers Association, under the name of the Egegak Packing Co., commenced building a cannery on the left bank opposite and a little above the salting station. This plant was finished in 1900 and packs were made that year and each succeeding year except 1905 and 1906.

In 1903 the North Alaska Salmon Co. built and operated a cannery on the opposite shore from the Alaska Packers Association, and has operated it each year to date, of late years under the name of its new owners, Libby, McNeill & Libby.

UGASHIK RIVER.

This river has its rise in a chain of two lakes, but with the exception of that portion below the upper cannery, about 25 miles, it is very little known to the whites. The river is very tortuous in its course. It has two known tributaries—King Salmon River, which enters through the left bank about 17 miles from the bar at the mouth, and Dog Salmon River, which enters through the left bank about 37 miles from the bar. From Smoky Point to the capes at the mouth the river widens very greatly, being about 20 miles across at the mouth. Shoals are numerous, but there is a channel with about 9 feet at low water. Gill nets exclusively are used here.

This river is essentially a red salmon stream, but the other species are also taken in small numbers, although the humpback is very scarce. This river is noted for the great falling off in the run of red salmon of recent years, 769,002 red salmon being taken in 1901, 1,640,973 in 1902, 1,703,536 in 1903, 564,492 in 1904, 432,779 in 1905, and 152,140 in 1906. About 1916 the run showed signs of improvement and during 1917 and 1918 was excellent, but the run of 1919 was small, the same as elsewhere in Bristol Bay.

C. A. Johnson was the first man to operate commercially on this river, having erected a saltery on the left bank, about 23 miles above Smoky Point, in 1889, and operated it continuously from 1889 to 1898, both inclusive. This saltery was merged in the cannery of the Bering Sea Packing Co. In 1894 Mr. Johnson established and operated another saltery on the right bank of the river, about 12 miles from the bar, which he sold in 1899 to the Alaska Packers Association, who absorbed it in their cannery plant.

The Bering Sea Packing Co., a branch of the Alaska Improvement Association, in 1890 built the first cannery on the river, this being located on the left bank near the first Johnson saltery. A small pack was first made in 1891. The plant was closed in 1892 and 1893, and as the location had proven far from suitable, it was, in 1894, moved to a point on the left bank, about 15 miles above Smoky Point, where it was operated until 1896. The next year it was sold to the Alaska Packers Association. The machinery and equipment were utilized in the latter company's cannery, and the old location abandoned.

In 1893 Charles Nelson established a saltery on the left bank of the Ugashik, immediately above the last site of the Bering Sea Packing Co. It was operated in 1893 and 1894, and then sold to the Alaska Packers Association, who closed it down.

In 1893 the Alaska Packers Association also built a saltery on the left bank of the river about a mile below the last site of the Bering Sea Packing Co. It was operated each year until 1895, when it was merged into the association's cannery.

In 1895 the Alaska Packers Association built a cannery, known as the Ugashik Fishing Station, on the right bank of the river immediately above the pilot station, which is about 12 miles from the bar. It made the first pack in 1896 and packed every year until 1907, when it was closed. In 1906 its outfit was destroyed in the San Francisco fire, and it was decided to operate it as a saltery, but the burning down of the Coffee Creek cannery of the association on the Kvichak changed the plans, and a part of the saved outfit of the latter was sent to the Ugashik and the plant operated as a cannery.

The Bristol Packing Co. built a cannery on the left bank of the river about 25 miles from Smoky Point in 1900. A pack was made the same year and the plant operated continuously until 1906, when it was shut down, and a small salting crew operated a portion of the plant. Eventually the plant was dismantled without operating again as a cannery.

In 1901 the Alaska Packers Association built and put into operation another cannery about 15 miles up the river from the other one. In 1906 this plant was shut down and eventually it was dismantled.

In 1901 the Red Salmon Canning Co. also built and operated a cannery still farther up the river and has operated it continuously to date.

ALASKA PENINSULA, BERING SEA SIDE.

Of recent years canneries have been located on the Bering Sea side of the Alaska Peninsula, outside of Bristol Bay proper, but it is probable that their numbers will not be large in the future, as the fisheries tributary to them are not very extensive, and are also very much scattered, making transportation expensive.

Port Heiden.—This important indentation on the Bering Sea side of the Alaska Peninsula, about midway between the Ugashik River and Port Moller, has never figured to any considerable extent in fishing operations. In 1912 and 1913 Gorman & Co. had the schooner *Harriet G.* located here throughout the season, engaged in salting salmon. The Illnik Packing Co. operated a saltery here in 1918.

Port Moller.—This great indentation in the Alaska Peninsula, between Port Heiden and Nelson Lagoon, was neglected for many years for the more profitable Bristol Bay region.

About 1902 the Bering Sea Packing & Trading Co. (there seems to be some confusion between this name and that of the Peninsular Packing Co., the latter being the name the company was known by after the first year or two in the official records), established a saltery on Bear River, which debouches a little east of Port Moller, and operated it until 1906, after which operations were suspended and but little is now left of the plant.

In 1912 the Pacific American Fisheries erected a cannery on Port Moller, but it was not operated until 1913. This concern has been successful mainly because of its introduction of purse seines in fishing.

In 1916 the Bering Sea Packing Co. built and operated a cannery on Herendeen Bay, a branch of Port Moller. In 1917 two new canneries were built and operated here, that is, the Fidalgo Island Packing Co. and the Phoenix Packing Co. In 1918 the Bering Sea Packing Co. was taken over by the Everett Packing Co. In 1919 all three Herendeen Bay canneries, as a result of the exceedingly slight runs of the two previous seasons, combined forces for the season and put up all the fish caught at the plant of the Fidalgo Island Packing Co.

Nelson Lagoon.—Nelson Lagoon is on the Bering Sea side of the Alaska Peninsula, is about 6 miles in length and about 2 miles in width. At its western end debouches the Nelson River, which is about a mile wide at its mouth. About 18 miles from the mouth the river divides, both branches having their rise in lakes. There is an easy portage from the lakes to Pavlof Bay, on the Pacific side of the peninsula, and this route is used frequently by both white men and Indians. The run is mainly of red salmon, and gill nets and traps are utilized. During the last few years purse seines have been used in this region with considerable success.

In 1902 Charles Johnson, who had operated on the Ugashik River, established a saltery here and operated it under the name of the Lagoon Salmon Co., and made a pack that and the succeeding year. In 1904 and 1905 it was shut down. It was reopened in 1906 and continued to operate until it was sold in 1914. In 1915 the new owners, the Nelson Lagoon Packing Co., built a cannery here which was oparated until 1920, when it was shut down.

Unalaska Island.—In 1916 the Pacific American Fisheries, having obtained a permit from the Department of Commerce, built a cannery at Unalaska, on Unalaska Island. This cannery is located inside of the Aleutian Islands reserve, and permit was given for its building and operation so that it might be possible for the Indians of Unalaska and Dutch Harbor to obtain work at home and save them the long trip to the Bristol Bay plants. It ceased operations at the end of the 1917 season.

KUSKOKWIM RIVER.

This, one of the great rivers of Alaska, has been but little exploited as yet. Very little accurate data have been obtainable about the river until within the last couple of years, and this relates mainly to the bay and a few miles of the adjacent river, which the United States Coast and Geodetic Survey has charted.

We know that the river has considerable runs of salmon, but usually ice conditions have been such in the spring that a cannery crew frequently could not get in in time to prepare for the run. In 1906 a salting outfit was sent here by Seattle dealers, but arrived too late for the run of fish. The outfit was cached at Bethel.

During the last seven years some mild curing of king salmon has been carried on here, but the lack of cold storage, both ashore and on the vessels operating to and from the river, has prevented any considerable development of this industry.

YUKON RIVER.

The 1918 report of the Alaska agent of the United States Bureau of Fisheries [a] contains the following account of the development of the salmon fisheries of the Yukon River:

> The development of the Yukon salmon fisheries began in 1918 with the establishment of a floating cannery at Andreafski. The season's operations resulted in a pack of 13,463 cases of salmon, divided as follows: Cohos 2,661, chums 6,471, humpbacks 107, and kings 4,224 cases. In addition to this, 10,400 pounds of cohos and chums were dry-salted. The total catch of salmon for the cannery was 115,531, of which 26,144 were cohos, 73,921 chums, 3,227 humpbacks, and 12,239 kings. Fishing was carried on from the mouth of the Yukon to a point above the junction of Clear River, chiefly in that part of the Yukon delta known as Kwikluak Pass. The fishing seasons were as follows: Kings, June 26 to August 17; chums, June 28 to September 8; humpbacks, July 7 to July 29; and cohos, August 3 to September 8. Some of the cannerymen and others frequently refer to salmon of one kind by the name "Yukons" or "Yukon salmon." In so doing they mean bright or fresh-run chums.
>
> An investment of $48,000 was made in the plant. One stern-wheeler, the *Martha Clow* (65 tons net), one gas boat, the *Althea* (17 tons net), and three smaller power boats were operated in connection with the cannery. Salmon were taken with 124 gill nets aggregating 9,869 fathoms, and 6 wheels of the two-scoop pattern. Employment was given to 169 men, 55 being fishermen, 102 shoresmen, and 12 transporters. Of these 36 were natives, 13 of whom were listed as fishermen.

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[a] Alaska Fisheries and Fur Industries in 1918. By Ward T. Bower. Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 29-30. Washington, 1919.

Stokes & Stokes operated a small saltery on the lower Yukon, packing 15 barrels of chum salmon. Their plant was valued at $1,500. Equipment consisted of one power boat and 300 fathoms of gill nets. They report having located too far up the river, but before another season will move to a point lower down.

Warden C. F. Townsend reported that one Sepella operated a saltery on the Yukon about 12 miles from salt water and that a pack of 110 barrels of chums and cohos was made. Salmon were taken with gill nets and one wheel. Mr. Townsend also advised that the Delta Fishing Co. was in the field in a small way.

Statistics compiled at the close of the season of 1918 indicate that exclusive of gear operated by the cannery and salteries near the mouth of the river, the whites and natives on the Yukon and tributary waters used 393 fish wheels, valued at $19,650, and 130 gill nets aggregating 3,250 fathoms, valued at $6,500. The estimated catch for local requirements was 1,400,000 salmon, which when dried represented approximately 700 tons of fish, valued at $140,000.

The total population of the Yukon region of Alaska, dependent in some measure on the fisheries, was estimated late in 1918 as being 10,907, of which number 6,638 were whites and 4,269 were natives. The number of dogs in the region was estimated at 6,183.

Prior to the season of 1918 the size of the run of salmon in the Yukon was an almost unknown quantity. The belief was expressed in some quarters that a comparatively small run ascended its waters, but others who were interested in the commercial exploitation of its fisheries held the opinion that a run aggregating many millions of salmon annually ascended the river. The necessity of maintaining the fisheries is paramount at all times, and if it is reasonable to suppose that a serious depletion of the supply by unrestricted fishing seems imminent, limitations must necessarily be imposed. This was done on December 14, 1918, by the promulgation of regulations affecting commercial fishing for salmon in the Yukon River. The closing order which is published in full on page 11 in this report became effective January 1, 1919.

MISCELLANEOUS PLACES.

At times small quantities of salted salmon have been packed in Bering Sea in the neighborhood of Nome and St. Michael. In 1917 the Arctic Fish Co. operated on a large scow on Golovin Bay, near Nome.

ARCTIC OCEAN.

Although it is known that there are good runs of salmon in some of the rivers debouching into the Arctic, the ice and other conditions have deterred people from attempting to extend their operations into this region. In 1912, however, the Midnight Sun Packing Co. built and operated a small cannery on Kotzebue Sound, in the Arctic Ocean. A small pack, mostly of Dolly Varden trout, was made in that and subsequent years. The plant was not operated in 1919.

BRITISH COLUMBIA.[a]

Fraser River.—This, the largest river in British Columbia (over 1,000 miles in length), has been important from a fishery standpoint ever since salmon canning was taken up commercially.

The Hudson Bay Co., the first to prepare salmon for commercial purposes, bought the fish from the Indians and pickled them in barrels for export, mainly to the Hawaiian Islands and Asia.

Howay,[b] in his work on "British Columbia," after describing briefly the fishing operations carried on by the Hudson Bay Co. in the Fraser River, has the following to say with respect to the develop-

[a] The author is indebted to Henry Doyle, of Vancouver, British Columbia, for practically all of the historical data relating to the canning industry of British Columbia, and hereby expresses his deep appreciation for this and many other courtesies.

[b] British Columbia, from the earliest Times to the Present. By F. W. Howay. 4 vols., illus. Vancouver, 1914.

ment of the commercial salmon fisheries and the preparation of the catch by salting and canning on the part of the independents who succeeded the company:

SALMON CANNING INDUSTRY.

No sketch of our history could be called complete without containing some reference to the origin and development, during the early stages, at any rate, of the industry of salmon canning.

By its charter the Hudson Bay Co. was granted "the fishing of all sorts of fish, whales, sturgeons, and all other royal fishes in the seas, bays, inlets, and rivers, within the premises (that is within the undefined area surrounding Hudson Bay), and the fish taken therein." Though no similar grant was contained in the exclusive license of trade with the Indians west of the Rocky Mountains, which was the only title the company had in this region, yet it claimed and exercised a monopoly of the salmon fishing on the Fraser River.

Reference has already been made to the salmon fishery carried on by the company at San Juan Island. In August, 1829, at Fort Langley (the name of this place has since been changed to Derby) 7,544 salmon were obtained from the natives at a cost of £13 17s. 2d. in goods. The trade increased; in 1835 and for many years thereafter 3,000 or 4,000 barrels of salt salmon were exported, principally to the Hawaiian Islands. With the revocation of the license in 1858 this claim of monopoly fell.

Capt. William Spring, in 1863, began salting and curing salmon at Beechy Bay. In the following year Mr Annandale, with whom Mr. Alexander Ewen was associated, opened a salmon saltery on Fraser River. This venture was almost a complete failure owing to the attempt to use the Scotch trap nets instead of drift nets. The former were found utterly unsuited to the conditions on Fraser River. When this enterprise failed, Mr. Ewen introduced drift nets and carried on an extensive business in salted salmon with the Hawaiian Islands and Australia.

The first attempt, on the Fraser River, to preserve salmon in hermetically sealed cans was made in 1867 by James Symes. This was not a commercial effort, but a mere experimental test to ascertain the possibility. A few cases were prepared, filled, and cooked by boiling on an ordinary kitchen stove. The result was most encouraging. The product was shown at the agricultural exhibition held in New Westminster in October, 1867, and was pronounced excellent, the directors making special mention of it.

About the same year Donald McLean established another salmon-curing establishment at New Westminster. Besides salted salmon, he put up pickled salmon, salmon boiled and preserved in vinegar, and smoked and kippered salmon.

The canning of salmon as a business was first undertaken on the Fraser by Alexander Loggie & Co. The persons interested were Alexander Loggie, Alexander Ewen. James Wise, and David S. Hennessy. Mr. Wise was an experienced fisherman; Messrs. Loggie and Hennessy had had experience in the canneries of New Brunswick. In June, 1870, these persons built, in connection with a salmon saltery, the first salmon cannery in British Columbia. It was located at Annieville, about 3 miles below New Westminister. The cannery was a very primitive affair; the cylinders upon which the cans were shaped were of wood covered with sheet iron; the trays were small wooden contrivances holding about three dozen one-pound cans. There was practically no machinery; the operations were almost entirely by hand. The fish after being put into the cans was preserved by boiling in large wooden vats. Great difficulty was experienced in thoroughly cooking the fish, the boiling point of ordinary water not proving sufficient; to overcome this, salt was added to the water, and by this means the temperature was raised to 230°. The room in which the cooking was performed was, in temperature like a Turkish bathroom; no windows or doors were allowed to be opened, except of necessity, under the mistaken idea that the cold currents of air would injure the product.

Capt. Stamp, who has been frequently mentioned in the foregoing pages, also entered the business at the same time. His cannery was located at Sapperton, New Westminster. He did not attempt to manufacture his cans, but obtained his supply from Mr. Deas, a tinsmith of Victoria.

About 1873, Loggie & Co. removed their cannery to New Westminster, where in the meantime Messrs. Lane, Pike, and Nelson had established themselves in the same business. These latter persons conceived the plan of canning the salmon whole; the sockeyes, being of an almost uniform size, lent themselves readily to this attempt. It was, however, a failure, as owing to the great vacuum in the cans, they became much distorted.

In 1872 Holbrook & Co. purchased a small cannery which had been started at Sapperton by Capt. Stamp some time before, and operated it for a few years.

In 1876 there were three canneries running, consisting of Holbrook & Co., Ewen & Co., and the British Columbia Canning Co. (Deas Island).

The following year this was increased by English & Co. and Finlayson & Lane, the latter quitting after one season, being succeeded in 1878 by Lane, Pike & Nelson. King & Co., the British Columbia cannery (Annieville), and the Delta cannery also commenced operations the latter year.

In 1879 Holbrook & Co., and Lane, Pike & Nelson dropped out, and Haigh & Sons (succeeded in 1884 by the Bon Accord Packing Co.) commenced operations.

King & Co. were burned out in 1880, and Adair & Co., afterwards known as the Wellington Packing Co., commenced. A year later Laidlaw & Co. commenced operations.

In 1882 the British Union Packing Co., afterwards known as the Harlock Packing Co., commenced packing salmon. The British-American cannery and J. H. Todd & Sons (Richmond cannery) also began operations.

Joseph Spratt started a floating cannery, known as "Spratt's Ark," in 1883; he retired at the end of two years. E. A. Wadhams also began operations in 1883. In 1887 the Holly cannery was built on Lulu Island opposite Deas Island. The high water of June, 1894, partially destroyed it and the site was abandoned.

No more additional plants were built until Hobson & Co. started in 1889. The Canoe Pass Canning Co. also started the same year, as did J. H. Todd & Sons with their Beaver cannery.

The Anglo British Columbia Packing Co. was formed in 1891, taking over the canneries formerly operated by the British Columbia Packing Co. (old Annieville plant), E. A. Wadhams, British-American Packing Co., Canoe Pass Canning Co., Duncan & Batchelor (Britannia cannery), and English & Co. (Phoenix cannery).

In 1892 the Terra Nova Canning Co. began operations, and the next year the Lulu Island Canning Co., Steveston Canning Co., Pacific Coast Packing Co., Canadian Pacific Packing Co., Short & Squair, and Butimar & Dawson (at Steveston) all commenced operation.

In 1894 the Gulf of Georgia Canning Co., Dinsmore Island Canning Co., Sea Island Packing Co., and the Fishermen's Packing Co. all built and began to operate canneries.

The Alliance Canning Co., Atlas Canning Co., Boutiliar & Co., and the Star Canning Co. commenced operations in 1895.

There was considerable development in 1896, when the Anglo-American Canning Co., Fraser River Industrial Co., Hume & Co., Provincial Canning Co., Westham Island Packing Co., Westminster Packing Co., and the Vancouver Packing Co. all started canning.

In 1897 the Premier Canning Co., Sinclair Canning Co., Western Fisheries, Cleve Canning Co., Welsh Bros., Currie, McWilliams & Fowler, Butimar & Dawson (at Canoe Pass), Colonial Canning Co., and the Fraser Canning Co. all began operating.

The English Bay cannery was added to the list in 1898, but the Sinclair Canning Co. and Western Fisheries plants were both destroyed by fire at New Westminster and not rebuilt. The plant of the Steveston Canning Co. was absorbed that year by the Federation Brand Salmon Canning Co. and the cannery renamed the "Lighthouse" cannery.

In 1899 the Greenwood Canning Co., Scottish Canadian Canning Co., St. Mungo Canning Co., Wurzburg & Co., and Acme Canning Co. all began active operations, while in 1900 the Great Northern Canning Co. was the only addition to the list. In 1900 the United Canneries (Ltd.) was formed to take over the Gulf of Georgia, English Bay, and Scottish Canadian plants, and the Canadian Canning Co. this year also absorbed the Star, Fraser, and Vancouver canneries. In 1901 the National Packing Co. built at Eagle Harbor.

Like the other canning sections, British Columbia suffered in 1901 from an oversupply of canned salmon, due to the large number of plants which had been erected and which were producing more salmon than market could be found for. At this juncture the British Columbia Packers Association was formed. It embraced 29 out of the 48 plants on the Fraser River and 12 of those situated in Northern British Columbia waters, including the following plants: Ewen & Co., Delta, Harlock, Wellington, Lulu Island, Terra Nova, Pacific Coast, Canadian Pacific, Short & Squair (Imperial cannery), Brunswick canneries at Steveston and Canoe Pass, Dinsmore Island, Sea Island, Fisherman's Packing Co., Reliance cannery, Atlas cannery, Boutiliar & Co., Hume & Co., Anglo-American, Provincial, Westham Island, Westminster Packing Co., Premier, Cleve, Welsh Bros., Currie, McWilliams & Fowler, Colonial, Greenwood, Wurzburg & Co., and the Acme Canning Co. In 1914 the corporation style was changed to the British Columbia Fishing & Packing Co. (Ltd.).

In 1902 the Fraser River Industrial cannery was sold to C. S. Windsor; in 1905 this plant was sold by Mr. Windsor to Peter Birrell.

In 1905 the Burrard Canning Co., Steveston Canning Co., Butimar & Dawson, Unique cannery, and the Vancouver Fish & Canning Co. were all built and operated. The latter was burned in the middle of the season. The same year the Great Northern cannery was purchased by McPherson & Wilkinson.

In 1906 the Great West Packing Co. cannery was built at Steveston; the Nye Canning Co. operated for part of the season on False Creek in Vancouver, and the Capital City Canning Co. built a plant at Victoria. The same year the Lighthouse cannery was leased for the season by the Royal Packing Co.; while in the following year the Unique cannery was dismantled.

In 1909 the Gulf of Georgia cannery was sold to M. Desbrisay & Co.; Peter Birrell sold the Industrial cannery to the Glen Rosa Canning Co., who have since operated it; the Lighthouse cannery was leased for the season by Kildala Packing Co.; the Gosse-Millerd Packing Co. purchased the Steveston Canning Co.'s plant; while the following year the Lighthouse cannery was leased for the season by Lee Coy.

In 1912 the Lighthouse cannery was sold to C. S. Windsor and associates. The Scottish-Canadian cannery was also sold to C. S. Windsor and associates, by whom it was operated under the name of the Scottish-Canadian Canning Co. until 1914.

In 1913 the Great Northern cannery was leased for the season to the English Fisheries (Ltd.), while in the following year the Gosse-Millerd Packing Co. bought the Vancouver and Fraser canneries from the receiver of the Canadian Canning Co. The Jervis Inlet Canning Co. acquired the Lighthouse cannery the same year.

The Scottish-Canadian cannery was acquired in 1915 by the Graham Co., while the Great Northern cannery was sold to the Defiance Packing Co.

In 1916 a new cannery was built at Liverpool, South Westminster, by the Liverpool Canning Co.

In 1917 the Gosse-Millerd Packing Co. purchased the Star cannery which had been lying idle since 1913; the Booth Fisheries Co. leased the Scottish-Canadian cannery for the season. They held an option to purchase same, but did not exercise it, and the plant has since been closed down. The Cliff-Lowman Packing Co. acquired the Lighthouse cannery from the Jervis Inlet Canning Co.

In 1918 the Canadian Fishing Co. built at Vancouver, and while their plant is not on the Fraser River it is classed in that area, as its pack will be largely secured from Fraser River fish.

Early in the spring of 1919 fire destroyed the Star, Steveston, and Lighthouse canneries, none of which have been rebuilt.

Skeena River.—The first cannery to be built on the Skeena River was in 1877, when a man named Neill built one at Inverness. In 1878 the Windsor Canning Co., consisting of Henry Saunders, W. H. Dempster, and John Wilson, of Victoria, established a cannery at Aberdeen.

There were no additions until in 1883, when the Balmoral cannery the British-American, and Robert Cunningham canneries were started.

In 1889 the North Pacific was started and in 1890 the Standard. In 1891 the Anglo-British Columbia Packing Co. bought the British-American cannery and the North Pacific Canning Co. cannery. In 1892 the Claxton, and in 1895 the Carlisle, canneries were built. In 1899 the Claxton cannery was purchased by the Wallace Bros. Packing Co. The Peter Herman (afterwards the Skeena River Commercial Co.) and Turnbull canneries were built in 1900. The last named operated only four seasons.

In 1902 the British Columbia Packers Association acquired the Balmoral, Cunningham, and Standard canneries.

In 1903 the Cassiar cannery was built. The next year the Alexandria Packing Co. was started. It was later acquired by the British Columbia Packers Association, as was also the Dominion cannery, which was built in 1906.

The Carlisle cannery was sold in 1906 to the Kildala Packing Co.

In 1911 the Wallace Fisheries (Ltd.) purchased the Claxton cannery from the Wallace Bros. Packing Co., while in 1913 the Canadian Fish & Cold Storage Co. built a cannery at Tucks Inlet, where their supply of salmon is obtained from the Skeena fishermen.

In 1916 the Gosse-Millerd Packing Co. built their Sunnyside plant. In 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Skeena River Commercial Co.'s plant at Port Essington, and also erected a new cannery at Port Edward.

Rivers Inlet.—The first cannery to be built and operated on Rivers Inlet was in 1881 by Shotbolt & Draney, afterwards the British

Columbia Canning Co. The Wannuck cannery was built in 1884, the Good Hope in 1895, the Brunswick in 1896, the Wadhams and the Vancouver in 1897.

There were no changes until 1902, when the British Columbia Packers Association acquired the Wadhams, Brunswick, Wannuck, and Vancouver, the two latter being dismantled and the two former enlarged correspondingly.

In 1906 the Beaver cannery was built by J. H. Todd & Sons, the Kildalla cannery by the Kildalla Packing Co., and the Strathcona cannery by Bain & Wilson, the latter afterwards being acquired by the Wallace Fisheries (Ltd.).

In 1911 the Strathcona Packing Co.'s plant was purchased by Wallace Fisheries (Ltd.). In 1917 the Provincial Canning Co. built a plant, and in 1918 the McTavish Canning Co. also built one.

Nass River.—The first cannery to be built on the Nass River was by Henry Croasdale in 1881, and it operated for four years. The Douglas Packing Co. built a cannery here in 1882 and operated it for two years. Both were then shut down owing to the fact that the locations were too far up the river for steamers to move the packs. In 1888 the plants were dismantled and removed to Nass Harbor and Mill Bay, respectively. In 1889 the Cascade Packing Co. commenced operations, but the plant was dismantled in 1893.

In 1903 the Pacific Northern cannery was built near the mouth of Observatory Inlet, and in 1905 it was purchased by John Wallace, who moved it to Arrandale. In the latter year the Port Nelson Canning & Salting Co. started. In 1908 the Mill Bay cannery was purchased by the Kincolith Packing Co. In 1911 the Arrandale and Port Nelson canneries were bought by the Anglo British Columbia Packing Co., and in the following year the Nass Harbor cannery was bought by the British Columbia Packers Association.

The Wales Island cannery, which became Canadian property under the Alaska boundary award, was in 1911 purchased by M. Desbrisay & Co., by whom it has since been continuously operated.

In 1916 the Kincolith Packing Co.'s Mill Bay plant was purchased by the Kincolith Fisheries (Ltd.), while in 1918 the Northern British Columbia Fisheries (Ltd.) purchased the Mill Bay cannery from the Kincolith Fisheries (Ltd.) and built a new plant at Kumeon. The Western Salmon Packing Co. also built a new plant at Summerville the same year.

Queen Charlotte Islands.—In 1912 the British Columbia Fisheries (Ltd.), a concern promoted by Sir George Doughty, M. P., of Grimsby, England, built a cannery at Aliford Bay, Skidegate Inlet, and operated same for two seasons. The British Columbia Fisheries (Ltd.) then went into insolvency, and the plant remained idle until 1916, when it operated under lease to the Western Salmon Packing Co. In 1917 the cannery was purchased by the Maritime Fisheries (Ltd.), the present owners.

The Wallace Fisheries (Ltd.), built at Naden Harbor in 1912, and operated that and the following seasons. The cannery was not in commission during 1914 or 1915, but ran in the years 1916 to 1918, inclusive. It was found that Masset Inlet would be a more suitable location, and in 1919 the plant removed from Naden Harbor to a new site on the shores of the Inlet.

A cannery was built at Lockeport in 1918 by the Lockeport Canning Co. The same year the Western Salmon Packing Co. (Ltd.) built a plant at Lagoon Bay.

Miscellaneous places.—A cannery was built at Metlakatla in 1882 by Rev. John Duncan for the Metlakatla Indians, fish being obtained from Skeena River. The plant was dismantled in 1886.

John Rood built the first cannery on Smiths Inlet, in Quachela Lagoon, in 1883. It was closed in 1884, and the plant moved to Wannuck, Rivers Inlet, to which place also the Smiths Inlet fish were subsequently transported for packing purposes. In 1902 the Wm. Hickey Canning Co. built a new plant on Smiths Inlet, selling same in 1912 to the Wallace Fisheries (Ltd.). The Western Packers (Ltd.) also built at Marguerite Bay in 1917.

A cannery was built at Lowe Inlet in 1890 by the Lowe Inlet Canning Co. It was sold to the British Columbia Packers Association in 1902.

In 1890 a cannery was built at Gardiner Canal by a man named Price and his associates. It ran until 1893, when it was dismantled and closed.

Robert Draney built at Namu in 1893, selling out in 1912 to the Draney Fisheries (Ltd.), who in turn sold out to the Northern British Columbia Fisheries (Ltd.) in 1918.

Robert Draney built the Kimsquit cannery in 1901, and in 1907 the Kildalla Packing Co. built the Manitou cannery. The latter is still operating, but in 1912 the Draney Fisheries (Ltd.) purchased the Kimsquit cannery, and in 1918 sold it again to the Northern British Columbia Fisheries (Ltd.).

In 1900 the Bella Coola cannery was built by John Clayton and sold by him in 1902 to the British Columbia Packers Association, who have operated it ever since. In 1917 a new cannery was built by the Tallheo Fisheries (Ltd.) and sold by them in 1918 to the Northern British Columbia Fisheries (Ltd.).

Toms, Morris & Fraser built at China Hat in 1900 and sold to the British Columbia Packers Association in 1902. The latter dismantled and closed the plant in the fall of that year.

A cannery was built at Warke Island in 1911 by John Wallace, principally for packing Gardiner Canal fish. Plant was purchased in 1917 by the Western Packers (Ltd.), who have since operated it.

A cannery was built at Bella Bella in 1912 by the East Bella Bella Canning Co. It was sold in 1915 to the Gosse-Millerd Packing Co., who have since operated it.

The cannery built at Alert Bay in 1881 by S. A. Spencer was purchased in 1902 by the British Columbia Packers Association, who have since operated same.

Cannery was built at Clayoquot in 1895 by Earle & Magneson. It was purchased by the Clayoquot Sound Canning Co. in 1902, by whom it has since been operated.

A cannery was erected at Bute Inlet in 1890 by C. S. Windsor and George Hobson, but only operated the one season.

The West Coast Packing Co. was built and operated at Nootka Sound in 1896, but only secured 112 cases. The plant was dismantled and abandoned. In 1917 a new plant was erected by the Nootka Packing Co., who have since operated steadily.

Dawson & Buttimer built at Alberni Canal in 1903. They sold out to the Wallace Fisheries (Ltd.) in 1911, and the latter have operated steadily ever since.

Pidcock Bros. built a small cannery at Quathiaski Cove in 1904. They operated it that and the following year and then sold to T. E. Atkins in 1907. This plant was destroyed by fire in 1909, and the following year the Quathiaski Canning Co. built a new plant, which has operated steadily since.

A small cannery was built at Pender Harbor in 1906 by P. H. Alder. It operated for two seasons and was then closed down and dismantled.

J. H. Todd & Sons and the Capital City Canning Co. both built at Victoria in 1905 (the former at Esquimalt). Messrs. Todd & Son still operate, but the Capital City Canning Co. plant was closed and dismantled in 1914.

Capt. R. E. Gosse built at Knight Inlet in 1907 at Sargeants Passage, but moved the plant to Glendale Cove in 1910, and at the close of that season sold the cannery to the Anglo British Columbia Packing Co., who have since operated it.

The Wallace Fisheries (Ltd.) built a cannery at Quatsino Sound in 1911, but dismantled it in 1914.

The Goletas Fish Co. built at Shushartis Bay in 1914, and after operating for three seasons sold the plant in 1917 to the Western Packers (Ltd.), the present owners.

The Gilford Fish Co. built a cannery at Kingcombe Inlet in 1914. After operating it that season they sold to the Preston Packing Co., the present owners.

The Jervis Inlet Canning Co. built a cannery at Jervis Inlet in 1912, operating it that and the following season. In the fall of 1913 it was destroyed by fire. In 1917 the C. L. Packing Co. erected a new plant at Green Bay, Jervis Inlet.

The Nanaimo Canning Co. started at Nanaimo in 1913 and operated until 1916, in which year the plant was acquired by the Nanaimo Canners & Packers (Ltd.).

The Quathiaski Canning Co. was built at Blind Cove in 1916; the Gulf Island Fish Co., at Lasqueti Island, in 1916; and the Sidney Canning Co., at Sidney, in 1916.

The Redonda Island Canning & Cold Storage Co. built a cannery at Redonda Island in 1917, while the Lummi Bay Packing Co. built a cannery at Nitnat in 1917.

In 1918 the Defiance Packing Co. built a cannery at Port Renfrew, while in 1919 the Gosse-Millerd Packing Co. built one at San Mateo.

SALMON FISHING IN THE HEADWATERS.

Considerable salmon fishing is carried on in the headwaters of certain of the larger rivers of the coast, of which no account appears in the data of the commercial fisheries. This is due to the fact that the fishing is usually of a desultory character, the fisheries are few in number and scattered widely, and while the catch in the aggregate is considerable it does not amount to much in any one spot.

The Columbia River is a typical example of such a stream. Commercial fishing is usually considered as ending at Celilo, about 150 miles from the mouth. As a matter of fact, salmon fishing for market or for home use is carried on to a considerable extent along the main river and also on the Snake and the Yakima, tributaries of the Columbia. In nearly all cases hook and line and spears are used alone, but on the Snake River, near Lewiston, in Idaho, are several rather important haul-seine fisheries. Fishing is carried on at these places in the spring for steelhead trout and in the fall for chinook and silver salmon and steelhead trout. As many as 25 salmon have been taken at one time. While this may seem a small number to one habituated to the large catches farther down the river, in the aggregate it amounts to a considerable quantity.

Considerable local fishing is carried on along the various Oregon streams above the sections usually fished by commercial fishermen. Most of this is done by ranchers living along the streams, and while by far the greater part is for home consumption a small proportion is sold.

On the Yukon River and its tributaries considerable salmon fishing is prosecuted. Much of this is done by natives for the use of themselves and their dogs, but at places white fishermen operate for a portion of the year and sell their catches in near-by settlements or at the mining camps. No effort has ever been made to secure statistics of the extent of this fishery.

APPARATUS AND METHODS OF THE FISHERIES.

GILL NETS.

The gill net is the oldest and most popular form of apparatus in use in the salmon fisheries of the Pacific coast. There are two kinds, drift and set, these names clearly expressing the difference between them. Fine flax or linen twine is generally used in their manufacture, although in some places cotton twine is employed, and it has usually 12 threads and is laid slack. They are hung in the ordinary manner—to a rope with cork floats to support the upper portion of the gear, and to a line with lead sinkers attached, which keeps the net vertical in the water and all its meshes properly distended. The nets are tanned, usually several times each season.

Drift nets vary greatly in length and depth, depending upon the width of the fishing channels, the depth of water, etc. On the Sacramento River they average about 300 fathoms in length, are 45 meshes deep, and have a stretch mesh of from 7½ to 9½ inches. On the coastal rivers of Oregon these nets average about 125 fathoms in length, and are about 36 meshes in depth, the mesh varying with the species of salmon sought. On the Columbia River the nets average about 250 fathoms in length and have a stretch mesh for chinooks of 9 to 9½ inches. On the Willamette River, the principal tributary of the Columbia, they average about 75 fathoms in length, with meshes of 8 and 9½ inches. On Willapa Harbor drift gill nets run from 100 to 250 fathoms in length, are 30 meshes deep, with stretch meshes of 7 and 8½ inches. On Grays Harbor they average 100 fathoms in length, the chinook nets run from 24 to 45 meshes in depth, with a stretch mesh of 9 inches, while the silver or coho nets are 35 meshes in depth, with a stretch mesh of 7 inches. In northern British Columbia the nets average 150 fathoms in length with a stretch mesh of 5¾ inches. In the Puget Sound region the nets average 300 fathoms in length, with meshes suitable for the particular species sought. In Alaskan waters the nets vary greatly in length and depth, depending upon the places where fished.

Drift gill netting is prosecuted chiefly in the estuaries of the rivers in and near the channels. If the water is clear the nets are set only at night, but should the water be muddy or discolored with glacial silt, fishing can be carried on either night or day. Night fishing is most common in the States, while day fishing is most common in Alaska. When fishing in rivers, it is necessary to work in a straight stretch of water of fairly uniform depth and free from snags or sharp ledges, these being called "reaches."

In setting the net the boat puller rows slowly across the stream while the other man pays out the apparatus, to the first end of which a buoy has been attached. When about two-thirds of the gear is out, the boat is turned downstream at nearly right angles to her former course, so that the net, when set, approximates the shape of the letter L. The net is laid out at nearly right angles or diagonally to the river's course, so that it will intercept the salmon that are running in, and is usually put out about an hour before high-water slack and taken in about an hour after the turn of the tide. In Alaska the fishermen usually fish on both the high and low slack. The nets are allowed to drift for the time specified, the fishermen drifting along at one end, then the net is hauled into the boat over a wooden roller fixed in the stern, and the fish, which have become gilled in the meshes, are removed, stunned or killed by a blow on the head, and thrown into the bottom of the boat.

Set gill nets are made in the same way as drift nets, in many instances being fragments of the latter, and are usually operated in the upper reaches of the rivers. They vary in length from 10 to 100 fathoms, from 35 to 65 meshes in depth, and have the same sizes of meshes as the drift nets, the size varying, of course, with the species sought for. Sometimes these nets are staked, sometimes anchored, while occasionally only one end is tied to the shore or a stake set in the water.

On the flats off the mouth of the Stikine River, in southeast Alaska, a combination of the drift and set method is followed. A double set of stakes, about 6 feet apart, are set out from the shore for a distance of several hundred yards. An hour or two before slack water the fishermen pay out the net parallel to the line of stakes and about 50 feet from them. The tide drifts the net down until it is caught against the stakes, which retain it until slack water, when the fisherman takes it up and repeats from the opposite direction on the next turn of the tide.

HAUL SEINES.

On the Columbia River, where this form of apparatus plays a prominent part in the fisheries, the nets vary in length from 100 to 400 fathoms; the shallowest end is from 35 to 40 meshes deep, but it rapidly increases in width and is from 120 to 140 meshes deep at the other wing. The "bunt," or bag, in the central part of the net is about 50 fathoms long. These nets are usually hauled on the numerous sand bars which are a very noticeable feature of the river at low tide. Buildings are erected on piles on these sand flats, in which the

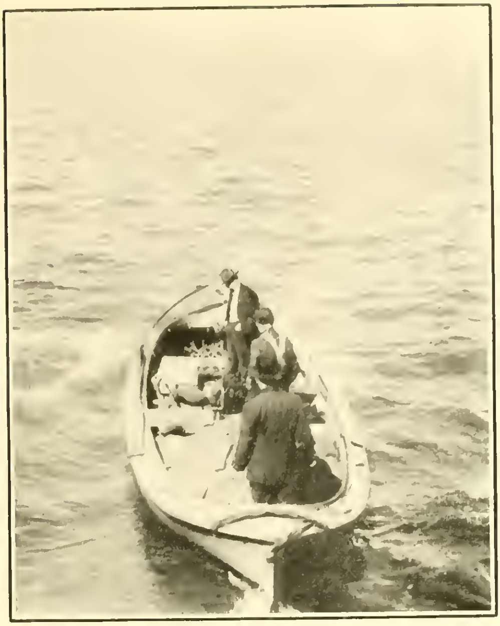

FIG. 8.—COLUMBIA RIVER POWER GILL NET BOAT.

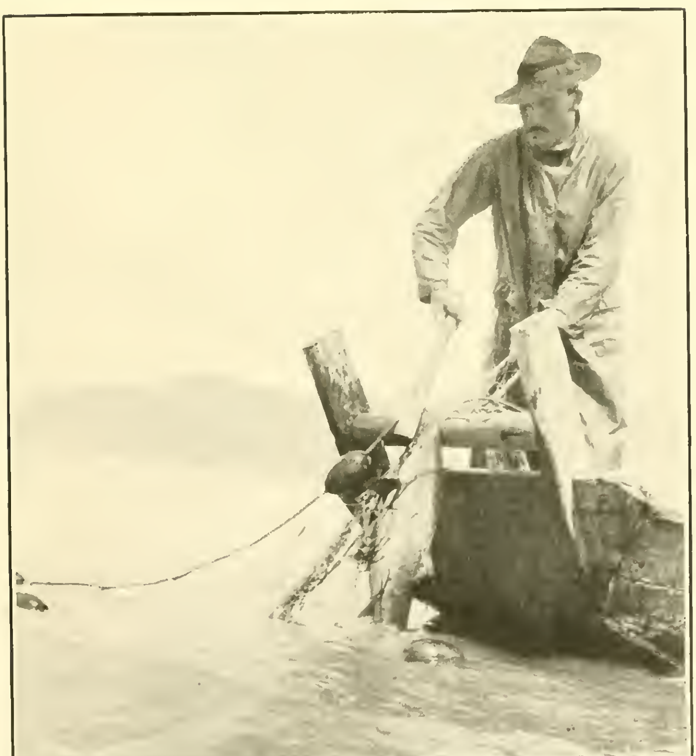

FIG. 9.—REMOVING THE SALMON FROM A GILL NET.

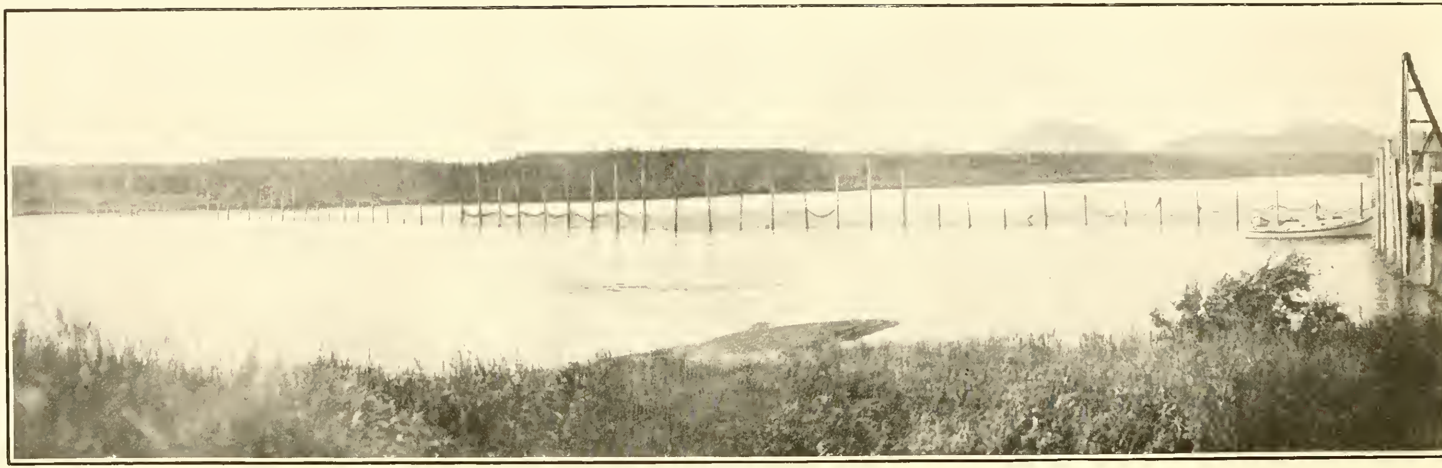

FIG. 10.—SALMON RACK ACROSS WOOD RIVER, ALASKA.

FIG. 11.—DIPPING SALMON FROM THE COPPER RIVER, ALASKA.

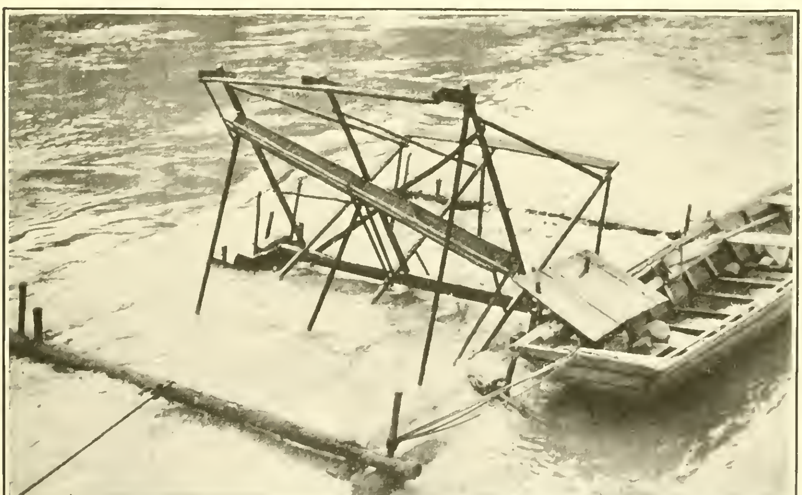

FIG. 12.—FISH WHEEL, YUKON RIVER, ALASKA.

FIG. 13.—A SCOW LOAD OF SALMON.

FIG. 14.—PURSE SEINE CREW DELIVERING FISH TO CANNERY TENDER.

men and horses take refuge at high tide, when the bars are covered with water. Operations begin as soon as the beach or bar uncovers, so that the men can wade about. The net is placed in a large seine boat, with the shore end attached to a dory. At the signal the seine boat is headed offshore, while the dory heads toward the bar. As the seine boat circles around against the current the net is paid out in the shape of a semicircle. The dory men hurry to the bar with the shore end of the net, the idea being to get that in as soon as possible in order to prevent the escape of the salmon in that direction. As soon as this has been accomplished, the outer shore line is brought to the bar, when several horses are hitched to the line and begin to haul in the net, care being taken by the men to work it against the current as much as practicable, and to get it in as speedily as they can in order to prevent the escape of salmon either by jumping over the cork line or finding some outlet below the footrope or lead line.

The only other place on the coast where haul seines are important is at Karluk, on Kodiak Island, in Alaska. Here the seines are hauled upon the narrow gravel spit dividing the lagoon from the strait, and practically the same method is followed as in the Columbia River.

DIVER NETS.

These are in use in the Columbia River, mainly throughout the middle and upper portions of the river. They vary from 100 to 200 fathoms in length and are used almost exclusively for chinook salmon. In construction they somewhat resemble a trammel net. Two nets are attached together side by side. The outer one, or the one toward the oncoming fish, has a larger mesh than the other, so that if the fish manages to pass through the first, it will be caught in the smaller meshes of the second.

DIP NETS.

These consist of an iron hoop secured to the end of a stout pole with a bag-shaped net fastened to the hoop. They are generally used at the cascades on the rivers, small platforms being erected upon which the operator stands while fishing. Indians formerly used them to a large extent, but, owing to the steady decline in the number of Indians, and the appropriation of favorable spots by the whites for other forms of apparatus, they are but little used now.

SQUAW NETS.

This type is virtually a set net. It consists of an oblong sheet of gill netting, about 12 feet long and 8 feet deep, its lower edge weighted to keep it down, and its upper edge attached to a pole that floats at the surface, and is held by a line or lines to another projecting pole which is securely fastened to the shore, so that it will not swing around with the strain of the swift current on the net. A single block is attached to the pole, and through this passes a rope, thus making a tackle for the more convenient manipulation of the net. The dip-net fishermen of the Columbia River use this net, which derives its name from the fact that it used to be commonly operated by Indian squaws for taking salmon. But few are now in use, for the same reasons as given for the decline in the use of dip nets.

PURSE SEINES.

This form of apparatus is in quite general use in Puget Sound and southeast Alaska, and has proved highly effective in these deep, swift waters. These seines are about 200 fathoms long, 25 fathoms in the bunt, and 20 fathoms in the wings, all with a $3\frac{3}{4}$-inch stretch mesh. The foot line is heavily leaded and the bridles are about 10 feet long. The purse line is made of $1\frac{1}{2}$-inch hemp. The rings through which the purse line is rove measure about 5 inches in diameter and are made of galvanized iron.

Purse seining for salmon in Puget Sound and waters north of same is one of the most important methods in use in the fisheries. In the type of vessel used in this fishery there has probably been greater improvement than in any other branch of the fisheries of the coast. In the early days row scows were in use, but now vessels with power are used.

In 1903 the first gasoline-powered purse seine boat appeared on the Pacific coast salmon fishing grounds in Puget Sound. The vessel was named the *Pioneer* and she was equipped with a 5-horsepower engine. The first season she easily demonstrated her vast superiority over the other purse seiners in the quickness with which she could reach a school of fish after it was sighted and in surrounding it with her seine. The next year there were a few more built or equipped, and the number has steadily increased until at the present time practically all except a few in southeast Alaska are equipped with motor engines.

The first power seine boats were only about 30 feet in length and had small power. As they were few in numbers, there was virtually no competition, and high power and speed were not a necessity. As the boats increased in numbers, however, competition became keener, and the first types of boats with their small power were quickly thrown into the shade by the newer types, which averaged between 45 and 55 feet in length, with 45 to 75 horsepower engines.

When motive power was introduced in the vessels, it was natural that the fishermen should soon introduce winches for the purpose of hauling in the nets, as the whole work could then be done by the one engine.

The purse seine vessels are built with rounded sterns. On an elevated section of the stern is set a movable platform on a pivot. The after end of this platform has a long roller. The purse seine is stowed on this platform, the head rope with corks on one side and the foot line on the other, so that there will be no tangling when the seine is paid out.

When the lookout sights a school of fish, the seiner is run down close to it and a rowboat launched. One man takes his place in this with the rope from one end of the seine and acts as a pivot, while the seiner circles around the school, the crew paying out the seine as she moves along. When it is all out, the vessel runs alongside the rowboat and takes aboard the other rope. Attaching this and the rope from the other end to the power winch, the circle around the fish is rapidly narrowed, and the slack of the seine as it comes in is stowed back on the platform. Around the bottom of the seine and through galvanized-iron rings about 5 inches in diameter runs the purse line. As this is hauled into the boat, the open space at

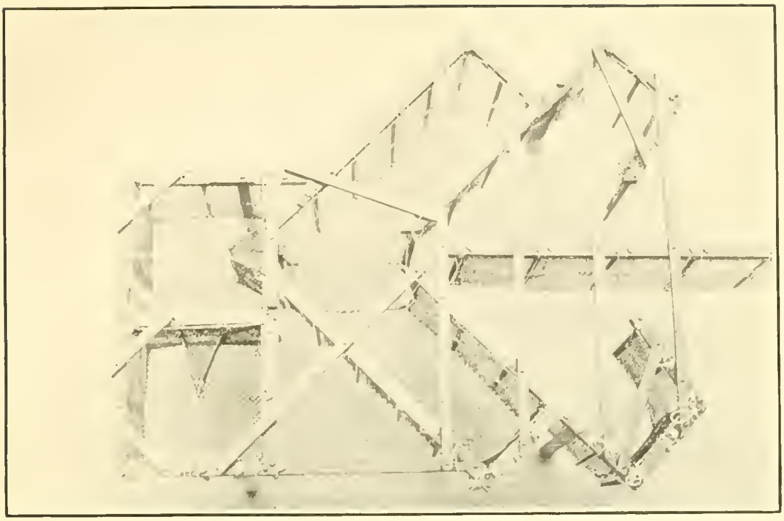

FIG. 15.—FLOATING TRAP.

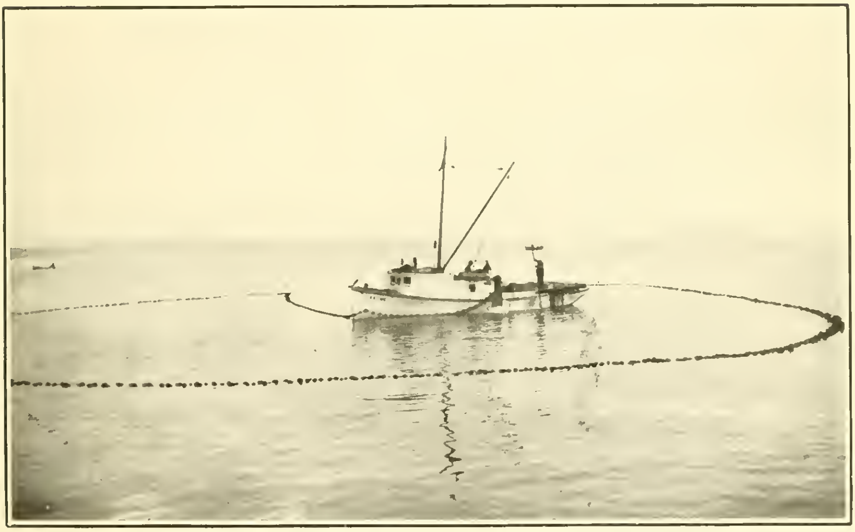

FIG. 16.—PURSE SEINER HAULING IN NET.

FIG. 17.—DIPPING SALMON FROM A PURSE SEINE.

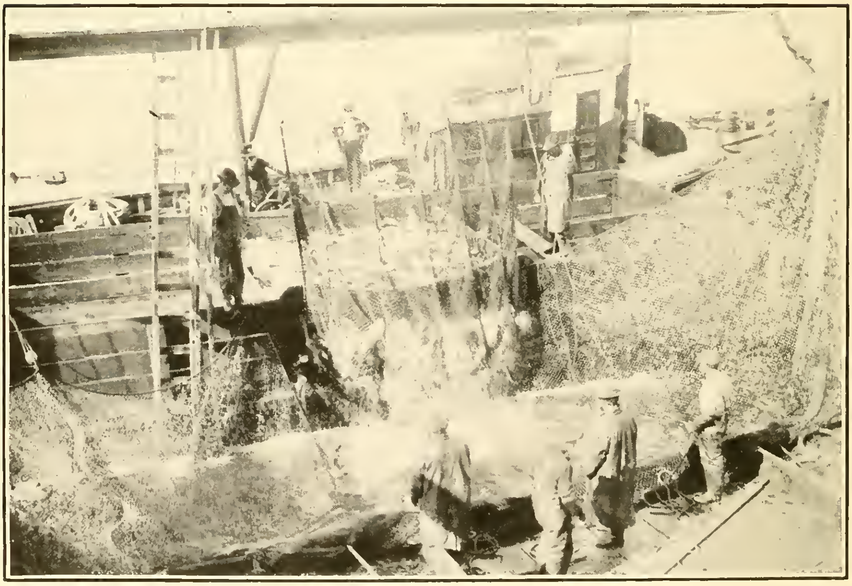

FIG. 18.—BRAILING SALMON FROM A TRAP.

the bottom is rapidly closed up just as a handbag would be through the drawing together of the pursing string at the top. During this operation the nonpower purse seiners have a man standing alongside the rail who throws a pole into the center in order to drive the fish away from the open section. He is so skillful in this work that almost invariably the pole comes back to his hand as the pressure of the waters forces it up again. When the bottom has been pursed up the fishermen hauling by hand can move more leisurely, but with the power winches in use the hauling in of the net is a comparatively easy matter, and the pole thrower is dispensed with.

When all the fish are in the bunt and the latter alongside, the fish are generally dipped out by means of a dip net balanced on the end of a tackle. A fisherman lowers it into the seine, scoops up a load of salmon, and as the net is hauled up guides it over the vessel, and then trips it and dumps the fish into the hold.

The Puget Sound purse seiners meet the salmon off the entrance to the Strait of San Juan de Fuca and follow the sockeyes till they have passed out of American waters, what are known as the Salmon Banks, off the lower end of San Juan Island, being the principal rendezvous during the run of sockeyes. After this run is over they go up the Sound and fish for dogs and cohos, and later go to the head of the Sound and fish for dogs, cohos, chinooks, and steelhead trout. In southeast Alaska they follow the fish all over the bays, straits, and sounds of that section. Purse seines are used in a few other places, but the fishery is secondary to those with other forms of apparatus.

This style of fishing is said to have been introduced on Puget Sound by the Chinese in 1886.

TRAPS OR POUND NETS.

A trap is stationary and consists of webbing, or part webbing and part wire netting, held in place and position by driven piles. This piling usually is held together above water by a continuous line of wood stringers, also used to fasten webbing to or to walk on if necessary.

In building, the "lead" is first constructed. This runs at right angles, or very nearly so, to the shore, and consists of a straight line of stakes, to which wire or net webbing is hung from top of high water, or a little higher, to the bottom, making a straight, solid wall.

At a little distance inshore of the outer end of the lead begin what are called the "hearts." These are V-shaped and turned toward the lead, beginning at a distance of 30 to 40 feet on either side of same and running in the same general direction, the "big heart" or outer heart first, the inner heart, supplementing the first, being smaller, and the end of the outer heart leading into it. Some traps have only one heart. The narrow end of the inner heart leads into the "pot" and forms what is known as the "tunnel." The tunnel ends in a long and narrow opening, running up and down the long way, and is held in position by ropes and rods. Below this is what is known as the "apron," a sheet of web stretched from the bottom of the heart upward to the pot, in order to lead the fish into the tunnel when swimming low in the water, and to obviate the necessity of building the pot clear to the bottom, which would be expensive, as the pots of the traps are usually in quite deep water. If the trap is intended to catch the fish coming from only one direction, the lead generally runs to and is attached to one side of the entrance to the outer heart on the side opposite to that from which the fish are expected.

Some traps have "jiggers" (a hook-shaped extension of the outer heart) on each side, and sometimes on only one side, which help to turn the fish in the required direction.

The "pot" is built out beyond the inner heart and immediately adjoining same. It is a square compartment, with web walls and bottom connected in the shape of a large square sack, fastened to piling on all sides. This pot is hauled up and down by means of ropes and tackles, either by hand or, as is most popular, by steam.

The "spiller" is another square compartment adjoining either end of the pot (sometimes there are two spillers, one at each end), and is simply a container for fish. A small tunnel leads the fish from the pot into the spiller, whence the fishermen lift them out. This is accomplished by closing the tunnel from the pot, after which the ropes holding the front of the spiller are loosened and the net wall allowed to drop almost to the level of the water. A steam or gasoline tug then pushes a scow alongside the spiller and takes position on the outside of this scow. From the deck of the tug a derrick is rigged with a running line from the steam capstan through the block at the top of the derrick. This line is attached to the far end of a net apron, called a "brailer," which is heavily weighted by having chains along each side and leaded crossways at several places. A small boat is run inside the spiller, and the men in this draw the brailer across the barge and let it sink in the spiller. The fish soon gather over it, when the steam capstan quickly reels it in, the net folding over as drawn in from its far side and spilling the fish out on the scow. Men on the scow pick out and throw overboard the undesirable fish. The apron is then drawn back across the pot and the operation repeated so long as any fish remain. In this manner a trap with many tons of salmon in it is quickly emptied.

Traps, like nearly all other fixed fishing appliances, are built on the theory that salmon, like most other fishes, have a tendency to follow a given course in the water, whether a natural shore line or an artificial obstruction resembling one; also that the fish very seldom turns in its own wake. The trap has taken advantage of these natural tendencies of the fish, and is arranged so that, although the salmon may turn, he will continually be led by the wall of net toward and into the trap.

If a trap is located in a place where fish play and where an eddy exists, and the fish run one way with the incoming tide and the opposite with the outgoing, it will fish from both directions; if located where the fish simply pass by, as for instance, on a point or reef, it will fish from one side only.

A variation of the trap, to be used in places where piles can not be driven, is the floating trap. An experimental trap of this variety was used at Uganuk, on Kodiak Island, Alaska, as early as 1896. Its use was abandoned in 1897, not to be resumed until some years later. A number of floating traps (of the type invented by J. R. Heckman, of Ketchikan, Alaska) have been and are being used in

FIG. 19.—RACKS AND RUNWAYS FROM WHICH INDIANS GAFF SALMON, CHILKOOT RIVER, ALASKA.

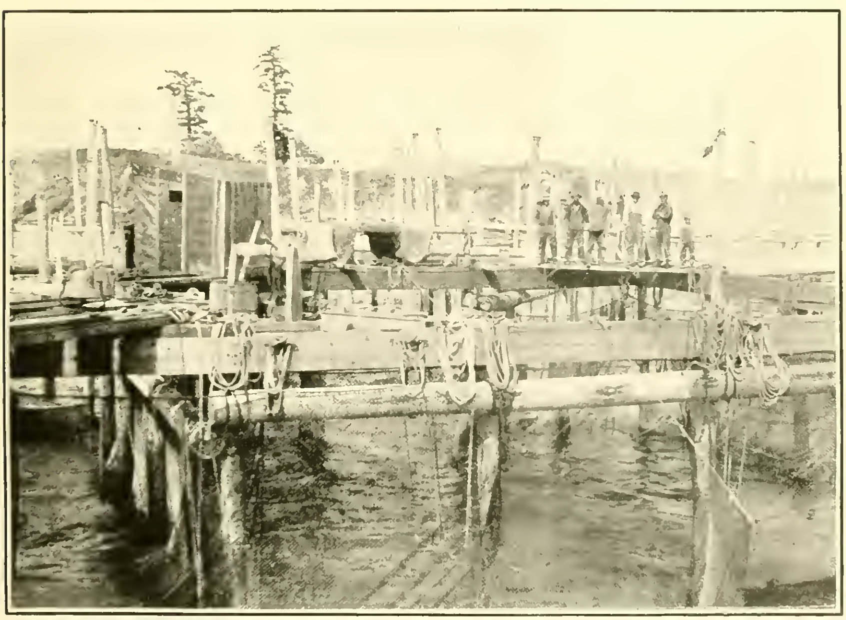

FIG. 20.—THE POT AND SPILLER OF A SALMON TRAP.

FIG. 21.—TROLLING FOR SALMON ON PUGET SOUND WITH POWER BOATS.

FIG. 22.—PUGET SOUND PURSE SEINE BOATS AT RICHARDSON, WASH.

southeast Alaska, the first having been installed in 1907. The design of this trap follows the shape of an ordinary Puget Sound driven trap. It is constructed of logs, 20 to 26 inches at the butt, bolted and braced together in one solid frame. Suspended from this frame through the logs are 2½-inch pipes extending down in the water 30 feet. Halfway down these pipes and also on the extreme lower ends are eyebolts, to which the web is drawn down and fastened. Thus the web is kept in place as well as if the pipes were driven piles. The lead is also a continuation of large piles or logs bolted firmly together with similarly suspended pipes and webbing.

The so-called wooden traps on the Columbia River are essentially weirs, being a modification of the brush weirs or traps used by the Indians for the capture of salmon long before the advent of the white men. They are built on shore, of piling and planks, the latter arranged like slats with spaces between. The bowl, or pot, is provided with a movable trapdoor that can be opened during the closed season and on Sundays, so that the fish can pass through and run upstream. These weirs, after being built, are launched into the river, placed in proper position near the shore, and then ballasted so that they sink to the bottom.

According to Collins,[a] "pound nets were introduced on the Columbia River in 1879. In May of that year O. P. Graham, formerly of Green Bay, Wis., built a pound net on the river similar to those used on the Great Lakes. The success of this venture led to the employment of more apparatus of this kind, and many fishermen went West to participate in the fishery."

The first trap on Puget Sound, it is said, was built by John Waller, about 1880, off Cannery Point, at the southeastern corner of Point Roberts.

According to Collins,[b] H. B. Kirby, who had previously fished on the Great Lakes, set a pound net in Puget Sound about 1883, but it was a complete failure. This was set off Point Roberts, near where the Waller trap was set. On March 15, 1888, he again set a pound net, which he had designed to meet the new conditions, at Birch Bay Head, in the Gulf of Georgia. It proved a complete success, and was the forerunner of the present large number which are set annually in these waters.

In Alaska the first trap was set in Cook Inlet about 1885. British Columbia refused to permit the use of pound nets in its waters until 1904, when their use was allowed within certain limited regions.

Some of these traps, especially on Puget Sound, have proved extremely valuable. The years 1898 and 1899 covered practically the high-water mark, as several desirable locations changed hands in those years at prices ranging from $20,000 to $90,000 for single traps, the original expense of which did not exceed $5,000. But few have brought such high prices since, however, owing to the decline in the run of salmon, and at the present time but few of them would fetch much at a sale.

The location of sites for these nets is regulated by law in Oregon, Washington, and British Columbia, but in Alaska the procedure is

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[a] Report on the Fisheries of the Pacific Coast of the United States. By J. W. Collins. Report, U. S. Commissioner of Fish and Fisheries, 1888–89, p. 210. Washington, 1892.
[b] Collins: Op. cit., p. 257.

not well defined and has proved rather confusing to strangers. Some acquire the shore line by mineral location or by the use of scrip, while still others have merely a squatter's right.

Under the existing fish-trap laws applicable to Alaska, a fish trap may be operated anywhere along the coast of Alaska, 300 yards from the mouth of any salmon stream, and along the shores of all rivers—excepting those emptying into Cook Inlet, the streams on Afognak Island, and in Wood River—where the same are at least 500 feet wide.

A clear water distance of 600 yards laterally and 100 yards endwise must be maintained between all traps. At the present time there is no law regulating the length of leads, the maximum depth of water in which the pot may be driven, or the use or occupancy of the trap sites.

It has been decided by the highest courts within the past year that title to the upland conveys no title to the trap owner who may be in front. The tidelands of Alaska are not of sufficient commercial importance as yet to enter into this controversy. At the present time there is no tideland law applicable to Alaska affecting the upland owners or the trap-site locators.

At the present time the canner who is on the ground first with piles and a driver can assert his right to any unoccupied trap site regardless of who fished it the previous season. This, however, is the exception rather than the rule. As a general proposition the canners respect the rights of rivals in the same fishing region, and a trap location once recognized as that of a certain individual or company is rarely jumped so long as the original locator cares to maintain a trap on it.

Within the bounds of the forest reserve no land can be acquired except by lease, which may be secured from the United States forestry agent, Ketchikan, Alaska.

INDIAN TRAPS.

The natives, especially in Alaska, have various ingenious methods of catching salmon. In the Bering Sea rivers they catch them by means of wickerwork traps, made somewhat after the general style of a fyke net. These are composed of a series of cylindrical and conical baskets, fitting into each other, with a small opening in the end connecting one with the other and the series terminating in a tube with a removable bottom, through which the captive fish are extracted. Some of the baskets are from 15 to 25 feet in length and are secured with stakes driven into the river bottom, while the leader, composed of square sections of wickerwork, is held in place by stakes.

During the summer of 1910 the author found and destroyed an ingenious native trap set in Tamgas stream, Annette Island, southeast Alaska. This stream is a short and narrow one, draining a lake, about midway of which are a succession of cascades. In the narrowest part of the latter, and in the part up which the fish swim, a rack had been constructed of poles driven into the bottom and covered with wire netting, so as almost wholly to prevent salmon from passing up. Just below, and running parallel to the rack and at right angles to the shore, was placed a box flume with a flaring mouth at the outer end. At the shore end the flume turned sharply

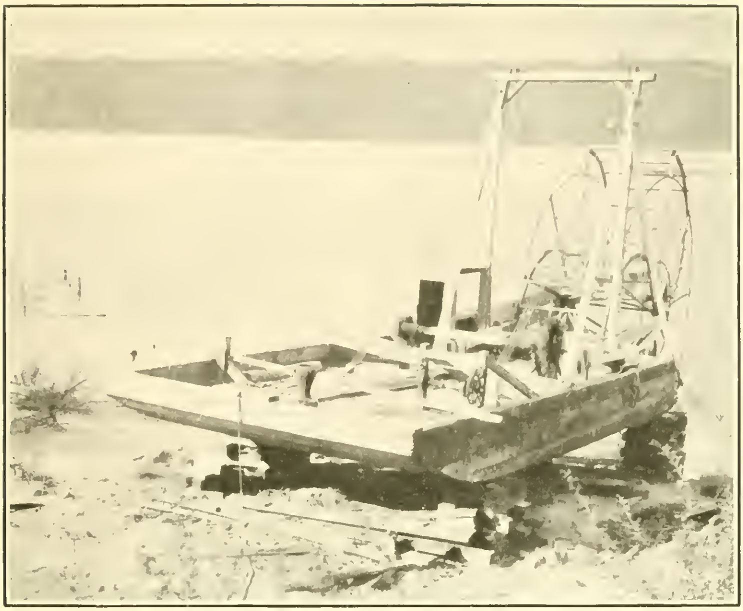

FIG. 23.—A COLUMBIA RIVER SCOW FISH WHEEL.

FIG. 24.—PUGET SOUND SALMON TRAP.

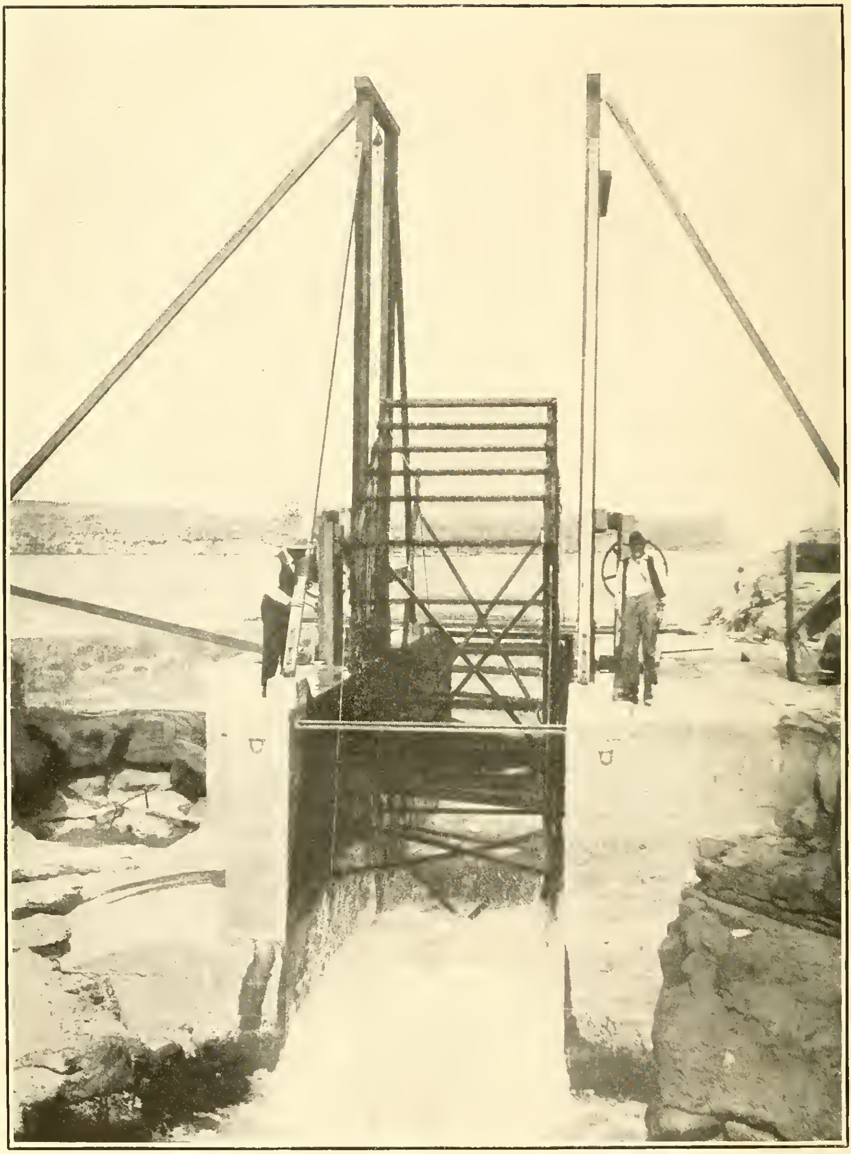

FIG. 25.—A COLUMBIA RIVER STATIONARY FISH WHEEL.

at right angles and discharged into a square box with slat bottom and covered over with boughs. The fish in ascending the stream would be stopped by the rack and in swimming around many of them would be carried by the current into and down the flume, eventually landing in the receiving box alongside the shore.

WHEELS.

Fish wheels are of two kinds, the floating or scow wheel, which can be moved from point to point if need be, and the shore wheel, which is a fixed apparatus. They operate in exactly the same manner, however. The stationary wheel is located along the shore in a place where experience has shown that the salmon pass. Here an abutment is built of wood and stone, high enough to protect it from an ordinary rise in the river. To this is attached the necessary framework for holding the wheel. The latter is composed of three large scoop-shaped dip nets made of galvanized-iron wire netting with a mesh of 3½ to 4 inches. These nets are the buckets of the wheel and they are so arranged on a horizontal axis that the wheel is kept in constant motion by the current, and thus picks up any fish which come within its sweep. The nets are fixed at such an angle that as they revolve their contents fall into a box chute through which the fish slide into a large bin on the shore. The wheels range in size from 9 to 32 feet in diameter and from 5 to 15 feet in width, and cost from $1,500 to $8,000, the average being about $4,000. A number of them have long leaders of piling running out into the river, which aid in leading the salmon into the range of the wheel.

The scow wheel consists of a large square-ended scow that is usually decked at one end and open at the other. Several stanchions, some 8 to 10 feet high, support a framework upon which an awning is spread to protect the fish from the sun's rays and the crew from the elements. To one end of the scow are fastened two upright posts, which are guyed by wooden supports, while projecting from the same end is the framework which supports the wheel, the latter being constructed in the same way as the stationary wheel, but on a smaller scale. In operation the scow is anchored with the wheel end pointing downstream, and as the wheel is revolved by the current, the fish caught fall from the net into a box chute, through which they slide into the scow. As stationary wheels can be used only at certain stages of water, the scow wheel is a necessary substitute to be used at such times as the former can not be operated, or in places where it is not feasible to build a stationary wheel.

The above forms of wheels are used exclusively on the Columbia River.

An ingenious device is used by some of the wheel operators on the Columbia River in getting their catch to the canneries, a few miles farther down the river. The salmon are tied together in bunches, which are attached to air-tight casks and sent down the stream. At the canneries small balconies have been constructed at the water end of the building. A man armed with a pair of field glasses is stationed here, and as soon as he sights one of these casks he notifies a boatman who goes out and tows in the cask and salmon. About 800 pounds of salmon are attached to a keg, and a tag showing the wheel from which shipped, is tied to the fish.

In 1908 the first fish wheel to be located in the coastal waters of Alaska was operated in the Taku River, in southeast Alaska. The wheel was set between two 4-foot scows, stationed parallel to each other, and each 40 feet in length. The wheel had two dips, each 22 feet in width and hung with netting. It could be moved from place to place, the same as the scow wheels on the Columbia River. It was operated throughout the king and red salmon runs, but caught almost no salmon, and was not set in the succeeding years.

For many years the natives of the interior of Alaska have been resorting to the banks of the Yukon and Kuskokwim Rivers and their tributaries in order to secure a sufficient supply of salmon to sustain them through the succeeding winter. The favorite apparatus of these natives at present is a type of fish wheel introduced by the whites about 1905. An oblong framework of timbers is constructed in the water and moored to the bank by ropes. A wheel, composed of two or three dips, is placed in this, the axle resting upon the framework. The current catches each dip in turn, thus causing the wheel to revolve, and the dip is of such shape that the salmon caught roll off it into a trough, down which they slide into a boat moored between the wheel and the shore or into a box fixed to the supporting framework on the side. Although crude in construction, these wheels are very effective and a large number of them are set each season.

The Columbia River fish wheel is a patented device. It was first used by the patentees, S. W. Williams & Bro., in 1879, and for several years they retained a monopoly in its use. A number are now operating on the river. The device was not new even when patented, as a similar "fishing machine," as it is called, had been in use prior to this time and is still used by white fishermen on the Roanoke River in North Carolina.

REEF NETS.

When the whites first visited the Northwest they found the natives employing a number of ingenious devices for catching salmon, and one of the most effective of these was the reef net. J. A. Kerr, Esq.,[a] who has been engaged in the salmon fisheries of Puget Sound for a number of years, has written the following very interesting account of this native fishery:

> The aborigines the world over have developed ingenuity solely along the lines of their necessities. The coast Indians of Alaska evolved the bidarky and the ingenious implements for taking the seal, the walrus, and the whale. The Siwash of Puget Sound developed a seaworthy dugout and appliances for taking salmon that marks the acme of Indian invention.
>
> When Vancouver explored the waters of the Sound he found over 500 Indians encamped at Chiltenum, now Point Roberts. He relates in his log of the voyage that these Indians were engaged "in fishing for salmon with crude nets made of the bark of young willow." He described the racks upon the contiguous upland used by the Indians in curing the fish.
>
> When Gov. Stevens negotiated the treaty with the Indians of the lower Sound at Point Elliott, now Mukilteo, in 1855, I was informed by Col. Shaw, the interpreter, that over 7,000 Indians attended, the session lasting for five days.
>
> The Government sought to have the Indians confined to reservations, and the disposition of their ancient fisheries was a matter of great solicitude on their part. Salmon was the principal article of their diet.
>
> After protracted discussion the sixth clause of the treaty was made to provide that "the right to take fish at their usual and accustomed fishing grounds, together with the right to erect and maintain racks upon the contiguous upland for curing and drying the same, is hereby forever guaranteed to said Indians."

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[a] The Siwash Reef Net. By J. A. Kerr. Pacific Fisherman Yearbook, 1917, p. 60.

There were two of those ancient fisheries on the lower Sound—Point Roberts Reef and Village Point.

The original reef net of the Indians, as described by the first white settlers and by the Indians themselves, was constructed as follows:

The natives peeled the bark from the willow and with it spun a twine and tied a net about 25 feet in width and 40 feet in length, with a mesh substantially of the dimensions and shape of that used in the now familiar pound net.

They then went into the swamps and cut cedar withes. After heating rocks and placing them in pools of water they steamed these withes, after which they twisted them into substantial ropes.

Their reef net operations were confined to the shoal waters over the reefs. The reef net locations were of great value to the Indians, and were considered as property and handed down from father to son. As a rule the Indian families controlling these locations owned an inner and outer location. The reef at Point Roberts is over 1 mile in length.

Reef net fishing was confined to the flood tide. At the beginning of the flood the outer location was used, after the middle of the flood the nets were shifted to the inner locations.

The Indians assembled at the reefs in advance of the salmon run and prepared their appliances.

They first secured heavy boulders or blocks of sandstone from Chuckanut to be used as anchors. They then procured for each net two logs about the length of their canoes. To each end of these logs they tied one of their ropes, about 100 feet in length, the other end of which was fastened to the stone anchor. These logs were anchored over the top of the reef and about 20 feet apart. From the forward end of these logs there was run out at an angle of 45° other ropes to a distance of 50 feet, the outward end fastened to a buoy. To these ropes were fastened stalks of kelp, the ends weighted to the bottom with stones. Thus was constructed a lead operating to concentrate the approaching school of fish between the logs. Then from the front end of these logs there was dropped forward and to the bottom two ropes, from one of these ropes to the other, at intervals of 2 or 3 feet, were fastened cords of willow twine. This appliance was called by the Indians a ladder.

Now in operating the net itself two canoes were lashed on the inside of the logs. Three Indians occupied one canoe and four the other. The net was then suspended between the canoes. The Indians in the forward end of the canoes held the ropes fastened to the bottom of the net, those in the back end held the ropes fastened to the top of the net. The tide running against the net caused it to bag, or purse. The fourth Indian in one of the canoes was generally an elderly man and was called the watcher. He discovered the school of salmon as they were carried into the net and at his signal the Indians at the front of the canoes pulled the lower edge of the net, which was kept within 4 feet of the surface, above the water. The Indians at the middle of the canoe reached down and caught the sides of the net, lifting the sides above the surface. These Indians pulled against each other, the long ropes by which the logs were moored giving enough to allow the canoes to be pulled alongside each other. The fish were then dumped into one of the canoes, after which the net was loosened and lowered, and the boats fell back to their original position again. With these appliances the Indians would take up to 3,000 salmon on a single run of the tide.

This Indian appliance affords not only an interesting illustration of native ingenuity, but as a matter of fact was the forerunner of the pound net. John Waller, a Welshman, was one of the earliest settlers at Point Roberts. He observed the operations of the reef net and in the early 60's constructed at Point Roberts the first pound net ever driven on the Pacific coast. The leads duplicated that of the Indians, while he impounded the salmon by means of the tunnel leading into a web pot, instead of lifting them as impounded.

The reef net marks the humble Siwash as an inventor of some skill, and as a benefactor of some importance, and the apparatus would be in use to-day were it not for the large number of people required to operate it.

At one time this was a favorite device of the Puget Sound natives for catching sockeye salmon. Owing to the large number of men required to work them, and the fact that they can be worked only at certain stages of tide and in favorable weather, these nets gradually have been supplanted by other devices. In 1909 but five were used, and these were operated off the shores of San Juan, Henry, Steuart, and Lummi Islands, and in the vicinity of Point Roberts. Practically none are used at present.

TROLLING.

Each year the catching of salmon by trolling becomes of increasing importance commercially. Although begun a number of years ago the industry never attained prominence until the mild curers created such a persistent and profitable demand for king, or chinook, salmon that the fishermen, who had previously restricted their operations mainly to the use of nets during the annual spawning runs, which last but a small portion of the year, began to follow up the fish both before and after the spawning run and soon discovered that they were to be found in certain regions throughout nearly every month in the year.

Trolling has several advantages from the fisherman's point of view over seine, gill net, and trap fishing. To engage in it, one does not need any very expensive gear, a boat, hooks, and lines being all that are required. Then, there are no licenses to pay and no seasons to observe in many sections, as the fishing is done in many instances beyond the jurisdiction of State waters.

The fishermen comprise all nationalities. While the majority of them are professionals, men of all walks of life are to be found engaging in the business, some on account of their health, others because of reverses in business or lack of work, while still others engage in it from pure love of the outdoor life.

The Monterey Bay (Calif.) trollers use 48 cotton line generally. A few inches below the main lead an additional line is added, with a small sinker on it. This gives two lines and hooks, and as the main line has but the one lead, and that above the junction with the branch line, it floats somewhat above the latter, which is weighted down with a sinker. The main stem is about 20 fathoms in length, while the branch lines are about 5 fathoms each. These lines cost about $3.50 each. No spoon is used, but bait almost invariably. A few fishermen use a spread of stout steel wire, 4 feet long, with 5 or 6 feet of line on each end of the spread, two lines and hooks.

On the upper Sacramento River (mainly at Redding and Keswick) some fishing is done with hand lines. A small catch was made here in 1908, but none were so caught in 1909.

Even as early as 1895 trolling was carried on in the Siuslaw River, Oreg., for chinook and silver salmon.

About 1912 the fishermen living along the lower Columbia River discovered that salmon could be taken by trolling off the bar. A number of them went into the business regularly, while their numbers were greatly swelled by the addition of many of the net fishermen during the regular closed seasons on the river, these not applying to trollers. Some idea of the growth of this fishery off the Columbia River bar may be gained when it is stated that in September, 1915, about 500 boats were engaged in it. It is reported that in 1919 over 1,000 boats were engaged in trolling here.

At Oregon City and other places on the Willamette River a number of chinook salmon are caught by means of trolling each year, mainly by sportsmen. A spoon is quite generally employed in place of bait. The fishermen claim that the salmon are not feeding at this time, as their stomachs are shriveled up.

For a number of years the Indians living at the reservation on Neah Bay, Wash., have annually caught large numbers of silver and chinook salmon in the Strait of Juan de Fuca. A large number of white fishermen also engage in this fishery at the present time in the same waters, while others troll for the same species, but more particularly silvers, in parts of Puget Sound proper. The ordinary trolling line, with a spoon instead of bait, is used.

Many of the trollers use power boats, and in this event four and sometimes six lines are used. One and sometimes two short poles are run out from each side of the boat (when two are used on a side, one is shorter than the other), the butt being dropped into a chock. Two lines are generally trailed from the stern. At the end of each pole is a very short line with a small tin can attached. A few pebbles are in the can, and as the launch moves slowly through the water with all her lines set, the troller knows when he has a bite by the rattling of the pebbles in the can. Each of the lines attached to a pole is also connected with the boat by a short line from the side to a point on the line about 20 feet from the tip of the latter. When a fish is hooked, the fisherman merely pulls in the line by means of the short piece and then can haul the fish in hand over hand.

The most remarkable trolling region is in southeast Alaska. For some years the Indians here had been catching king salmon for their own use during the spring months, and about the middle of January, 1905, king salmon were noticed in large numbers in the vicinity of Ketchikan. Observing the Indians catching these, several white fishermen decided to engage in the pursuit, shipping the product fresh to Puget Sound ports. They met with such success that 271,644 pounds, valued at $15,600, were shipped. The next year several of the mild-cure dealers established plants in this region, thus furnishing a convenient and profitable market for the catch, and as a result the fishery has grown until in 1915 2,170,400 pounds of king salmon and 54,400 pounds of coho salmon were caught and marketed. The length of the fishing season has also lengthened until now the business is prosecuted vigorously during about seven months in the year, and in a desultory manner for two or three months more, only the severe winter weather preventing operations the rest of the year.

In southeast Alaska the fishermen generally use either the Hendryx Seattle trout-bait spoon No. 5 or the Hendryx Puget Sound No. 8. The former comes in nickel or brass or nickel and brass, the full nickel preferred. The Siwash hook No. 9/0, known as the Victoria hook in British Columbia, is in quite general use. As a rule, but one hook is used, and this hangs from a ring attached to a swivel just above the spoon, while the point of the hook comes a little below the bottom of the spoon. Occasionally double or treble hooks are used. Some fishermen use bait, and when this is done the herring, the bait almost universally employed, is so hooked through the body as, when placed in the water, to stretch out almost straight and face forward as in life.

There are a large number of power-boat trollers in this region. These trollers generally use one pole on a side and one at the stern. The rowboat trollers use but one line, which is attached to a thwart in the boat, handy to their reach when rowing, and trailing out from the stern of the boat.

The trollers usually have temporary camps where they congregate while the fish are to be found in that section, moving on to some more favorable spot when the fish begin to get scarce.

Reports from the trollers of southeast Alaska prove that all species of salmon will take the hook at some time or other in the salt waters of this region, an examination of their stomachs generally showing that they are either feeding or in a condition to feed.

A small commercial fishery is carried on in this region for coho salmon, mainly in August and September, in the neighborhood of Turnabout Island, in Frederick Sound. A Stewart spoon with two hooks on one ring is used, baited with herring in such a way that the fish is straightened out and faced toward the spoon. The sportsmen of Ketchikan also fish with rod and reel for this species in the neighborhood of Gravina Island, using a Hendryx spoon (kidney bait No. 6), which is silvery in color on one side and red on the other. Although much smaller than the king, the coho salmon is more gamey.

During the latter part of March the Gulf of Georgia, in British Columbia, is invaded by large schools of young coho salmon, locally called "bluebacks." They evidently come in from the sea by way of the Straits of Fuca, as their presence is at first apparent in the lower gulf, especially among the reefs and islands off Gabriola Pass. On their arrival these fish are only about a couple of pounds weight, but increase in size very rapidly, with correspondingly voracious appetites. They are to be found in the gulf throughout the spring and summer. By May the fish generally average close to three pounds each when dressed, while in July they are between four and six pounds in weight.

A number of fishermen with power and row boats engage in this fishery, the fish being either sold to the fresh markets or to the canneries.

Trolling lines and spoon baits of one form or another are used. In fishing from power boats the outer lines are attached to fish poles 15 to 18 feet long, rigged out on either side. Those poles are usually hinged at the foot of a short mast and lowered outboard by a halyard running through a block at the masthead, with the additional brace of a forward guy, which, with the drag of the lines aft, holds them in position. It has been customary to use from five to seven lines from each launch, the two outer lines leading from the ends of the poles; the next pair are attached to intermediate tips fastened halfway out on the main pole, while inboard lines are attached to smaller upright rods on either quarter.

The outer trolls are brought within reach (the poles being practically fixtures) by means of a short piece attached to each fishing line 15 or 20 feet from the point where it is fastened to the pole and leading inboard.

Recently, however, the Dominion authorities have decreed that a troller shall not use more than three lines from a boat when trolling for salmon. Should a man be alone in the boat three lines will keep him very busy if the fish are biting at all well.

Spoons are generally used. All shapes are employed, from the ordinary Siwash patterns to wobblers; brass or silver wobblers, of Nos. 4 and 5 sizes, are largely used by the fishermen. Spinners of 2 to 3 inches long are also popular. Copper, copper and silver, and brass spinners of the Siwash and Victoria patterns are very effective, while red beads, feathered hooks, or a piece of silvery salmon skin placed on the hook as an additional bait often add to the attraction of a spoon.

Quite generally the fishermen use single hooks on their spoons. Various lengths of line are used, but on the average about 60 feet for outside lines and 40 for inside are used. As fish can be landed much quicker with a short line, the fishermen generally shorten their lines to 20 or 30 feet when the fish are biting rapidly. Quite heavy lines are used from the pole to the sinker; from there extends a length of light line, and then a piece of wire, to which the spoon is attached. The sinker, which is usually between 2 and 3 pounds in weight when fishing from a power boat and about 1 pound when a rowboat is employed, is attached to the line about 18 feet from the spoon.

The best fishing times are in the early morning and evening, without regard to tidal conditions. The low slack water is always favorable to good fishing.

These fish are delicate flavored, but do not keep well, it being necessary to rush them to market if they are to be sold in a first-class condition.

Considerable numbers of these fish are taken by both American and Canadian fishermen on Swiftsure Banks, off Cape Flattery. As complaint had been made in 1914 that these fish were immature and were unfit for canning because of their appearance after being out of the water some hours, H. T. Graves, acting commissioner of agriculture for the State of Washington, which department is concerned with the wholesomeness of food products, made a thorough investigation of their fitness for food. In a letter to the Pacific Fisherman, Seattle, Wash., and published in that journal under date of August, 1914, he states, among other things, the following:

> The question, therefore, for us to determine was to ascertain their value as a food product. The condition of these fish arriving at the various canneries was carefully noted; samples were selected for bacteriological analysis.
>
> The fish when first taken from the water are very soft when compared with the other salmon. After they have been out of the water 12 hours the fish easily separates from the bony structures, and in the course of ordinary handling in the time which elapses between the hour of taking from the water until they are offered for packing at Sound canneries, which is anywhere from 12 to 48 hours, they become badly broken up and present a rather ugly and distasteful appearance, to say the least.
>
> We found that many different methods of handling were being experimented with by the fisherman and by Puget Sound canneries, but without any noticeable effect. While from a physical observation one would imagine these fish as received at the Sound canneries to be unwholesome, a bacteriological examination by Dr. E. P. Fick, State bacteriologist, indicated that putrefaction was not present, although some of the specimens did contain a rather high bacteria count.

BOW AND ARROW.

On the Tanana River, a tributary of the Yukon River, in Alaska, the Indians hunt salmon in birch-bark canoes with bow and arrow. As the canoe is paddled along and the Indian sees the dorsal fin of the salmon cutting the surface of the muddy water he shoots it. The tip of the arrow fits into a socket, and when struck the tip, which when loose is attached to the stock by a long string, comes out of the socket and the arrow floats, easily locating the fish for the fisherman.

SPEAR AND GAFF.

Spears of varying shapes and styles have been in use by the Indians from time immemorial and are still employed on many rivers in which salmon run. With the exception of the Chilkoot and Chilkat Rivers of Alaska, practically all of the catch secured in this manner is consumed by the fishermen and their families. In the Chilkoot River the Indians have built numerous racks in the stream and on the banks, upon which they stand and hook the fish out with a gaff attached to a pole. The catch is sold to the cannery located on Chilkoot Inlet.

SPORT FISHING FOR SALMON.

The number of sportsmen who improve the opportunity presented by the appearance of feeding springs and cohos is increasing yearly, and in time this promises to far excel the sport salmon fishing of the Atlantic coast.

On Puget Sound and lower British Columbia waters the anglers generally use ordinary trout fishing rods and tackle, with preferably a short trolling tip on the rod when out for coho. Small spinners of silver or copper, of about an inch in length, or else the small double Tacoma spoons, are very good. A strong gut leader or trace of fine piano wire is frequently used, as the fish's teeth would cut through an ordinary line. Where iron wire is used the salt water rusts it rapidly, and unless the precaution is taken to dry off the wire and oil it after using it can not be used for more than a couple of days. Sinkers of an ounce or two in weight are generally employed with fine line.

Many of the small spoons on the market have very cheap hooks, and these are apt to straighten out or break with the strain of a large fish. Hooks of the best steel will, however, stand up to this strain.

One of the favorite spots for anglers is at the falls on the Willamette River at Oregon City, Oreg. Another is on the Clackamas, a tributary which debouches into the Willamette near here. When the spring run of salmon appears in April, hundreds of anglers, many of them from far distant points, appear to participate in the sport during this month and in May. Many noted sportsmen have fished for salmon at these spots. Among them was Rudyard Kipling,[a] and his experiences were woven into a classic short story.

The fishing ground is spread over a mile's length of the river, from Clackamas rapids to the deadline at the falls. It is not an uncommon sight to see 500 boats, each containing from one to six fishermen and fisherwomen, dotting the river on favorable days during the season.

Two methods of fishing are followed. The most popular is to anchor at the head of the Clackamas rapids or in swift water near the falls and allow the rush of water to spin the trolling hook. In the longer lengths of quieter water the sportsmen troll in slow motor boats or rowboats.

An inexperienced boatman is apt to find fishing in the rapids or near the falls somewhat dangerous, as the swift water may overturn his craft and carry him to his death before help can reach him.

There is a fishway in the dam, so that the fish can pass up this and into the river above the dam. No fishing is allowed closer than 100

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[a] It was in 1889 that Kipling fished here, and his story was reprinted in The American Angler, Vol. II, No. 2, December, 1917, pp. 415-420.

feet of the mouth of this ladder. Up to 1915 there was a second deadline, 600 feet from the falls, beyond which no commercial fisherman could operate nets, but the Oregon Legislature in that year closed the Willamette to all net fishermen from the Clackamas rapids to the falls.

The salmon in the spring run on the Willamette will average about 25 pounds each, but examples weighing 50 pounds and over are not uncommon.

In 1914 the Salmon Club of Oregon was formed of anglers who desired to encourage the use of light tackle in the taking of large game fish, in place of the extremely heavy tackle heretofore used. The following rules were adopted:

The rods used may be made of any material except solid bamboo cane. They must not be less than 5 feet in length and weigh not over 6 ounces.

The line must not be heavier than the standard nine-thread linen line.

Any style of reel or spoon may be used and the wire leader must not exceed 3 feet in length.

The angler must reel in his fish, bring it to gaff unaided, and must do the gaffing himself. If a rod is broken at any time during the struggle with the fish it will disqualify the catch.

As a reward of merit the club awards bronze buttons to all anglers taking, on light tackle, salmon weighing 20 pounds or over; for a fish weighing over 30 pounds a silver button is given, and for any salmon over 40 pounds the lucky angler receives a gold button. Numerous additional prizes are also given by public-spirited citizens.

The season for light tackle on the Willamette River and all other inland streams of Oregon has been fixed by the club from January 1 to July 1.

In 1915 the first angler to win a gold button on the Willamette River did so on April 18, when he took a 42½-pound salmon. On the same day this same angler also won a silver button for a 32½-pound fish and a bronze button for a 26-pound fish.

DANGERS TO THE INDUSTRY.

Man is undoubtedly the greatest present menace to the perpetuation of the great salmon fisheries of the Pacific coast. When the enormous number of fishermen engaged and the immense quantity of gear employed is considered, one sometimes wonders how any of the fish, in certain streams at least, escape. High water or low water, either of which will prevent certain forms of apparatus from fishing to any extent while such conditions prevail, storms which impede fishing, and the hundred and one small things which in the aggregate are of considerable importance, however, all aid in assisting the salmon in dodging the apparatus and reaching the spawning beds in safety, while, unless the stream is completely blocked by a tight barricade, an indeterminate number of salmon will escape all the pitfalls man and animals may set for them.

In some sections an almost idolatrous faith in the efficacy of artificial culture of fish for replenishing the ravages of man and animals is manifested, and nothing has done more harm than the prevalence of such an idea.

While it is an exceedingly difficult thing to prove, the concensus of opinion is that artificial culture does considerable good, yet the very fact that this can not be conclusively proven ought to be a warning to all concerned not to put blind faith in it alone.

When salmon are stripped by man, the eggs fertilized and retained in hatcheries until the young are born, and then planted as soon as the yolk sac has been absorbed, it is manifest that the only saving over the natural method is in reducing the loss in the egg stage. We know that many eggs, after being deposited naturally on the spawning beds, are devoured by other fishes, while sudden freshets and occasional droughts also claim their toll of eggs. It is highly probable, although we have no positive data on this point, that these losses far exceed those experienced in artificial salmon culture, and whatever this difference is it represents the extent to which salmon hatcheries should be credited as preservers of the industry.

In the opinion of the author, the best way in which to conserve the fisheries of the coast is by enacting and enforcing laws under which a certain proportion of the runs will be enabled to reach the spawning beds and perform the final and most important function of their lives unmolested. If this is done, there can be no question of the perpetuation of the industry, and if it is then supplemented by the work of hatcheries, which would reduce the loss in the egg stage, assurance on this point would be made doubly sure.

If unrestricted fishing is to prevail, however, with a dependence upon hatcheries alone to repair the ravages of man, the industry will suffer seriously, for, from the very nature of things, less and less fish will annually escape through the fishing zone, resulting in a continually lessening quantity of eggs being obtained at the hatcheries, and finally the latter will have to close down from sheer lack of material upon which to work.

Should eggs be brought to the hatchery from other streams, it would merely be "robbing Peter to pay Paul," and in the end the same result would follow in those streams.

Fortunately these matters are becoming increasingly plain to the people of the various States, provinces, and territories concerned, and, while a few selfish persons in each are seeking solely their own enrichment by any means possible, the greater number of those interested in fishing operations want to see the industry perpetuated and are willing to do almost anything that will work to this end.

The rapid increase, during recent years, of salmon trolling and purse seining on the feeding banks off the mouth of the Columbia River and outside the Strait of Juan de Fuca and elsewhere on the coast has resulted in the taking of large quantities of small and immature salmon, and alarm is now felt lest the runs of chinooks and cohos be seriously depleted. Several thousands of large and small boats are being operated on these grounds from five to eight months of the year, and while, when prices were comparatively low, but few of these immature fish were marketed, the high prices which have prevailed during the last four years have caused such an intensity of fishing that many thousands are now caught each season.

Investigations [a] by experts off the mouth of the Columbia in 1918 show that a large proportion of the chinook salmon caught by trolling are 2 and 3 years old. These are generally sold to the canners, who separate them into two groups, those under 5 pounds and those over. Those under 5 pounds are called "graylings" by the fishermen, but a mere glance at them is sufficient to establish their real identity. The

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[a] The Taking of Immature Salmon in the Waters of the State of Washington. By E Victor Smith State of Washington, Dept. of Fisheries. 44 pp., 8 pls. 1920.

reports of one cannery during the period from May 11 to May 29 showed there had been received 4,061 pounds of these fish, none of which weighed 5 pounds. From May 30 to June 12 this same cannery received 548 of these fish having a total weight of 1,483 pounds. As the owner of this cannery was decidedly opposed to the purchase of these fish, and only bought them because his regular fishermen would have gone to other cannerymen with their full-sized fish had he not taken the immature ones, it is probable that the cannerymen who were not opposed to the practice received a greater proportion of immature fish than he.

An idea of the smallness of these immature salmon may be gained when it is stated that the average weight of sexually mature chinook salmon running into the Columbia River is about 22 pounds.

These small chinooks are said to produce a very inferior quality of canned goods, being rated as second and third grade. The meat is of an ashy color, poor in fat content, and insipid in taste.

Off the Strait of Juan de Fuca the same condition of affairs existed as off the Columbia River, with the added complication that many immature cohos were also captured.

The immature feeding coho deteriorates when taken from the water even more rapidly than does the immature feeding chinook. Within 24 hours of being taken from the water the abdomens may be broken open, the ribs protrude freely, and the flesh begins to deteriorate. It was early found that it was impossible, except through the exercise of extraordinary precautions, to get these fish to the upsound canneries before it was too late, so that of recent years only canneries situated adjacent to the banks were enabled to use them.

The sale of young salmon in the fresh fish markets of Seattle and other Puget Sound cities has been common for years. They are marketed usually as "salmon trout."

It is an economic crime to catch and kill these immature salmon, as but little money is obtained for them, while if they were allowed to attain maturity they would increase in weight, in the case of the chinook nearly 1,000 per cent on the average and in the case of the coho about 100 per cent in four or five months time.

Another bad feature of trolling operations off the mouth of the Columbia River is that trollers, because they operated outside the 3-mile limit, were exempted from the observance of the regular closed season, operative in the river from August 25 to September 10. As a result of this, fishing was carried on continuously throughout the run; most of the gill netters who had to stop fishing in the river put their nets ashore and went outside and engaged in trolling, while canneries on the river bought and canned all the fish brought in. In 1917 the Washington Legislature enacted a law prohibiting possession within the State during the closed season, except for personal use, of salmon caught beyond the 3-mile limit outside the Columbia River. The State court, on trial, held this to be unconstitutional as being an interference with interstate and foreign commerce.

Oregon also adopted the same law as Washington, and on trial this was upheld as constitutional on October 3, 1919, by the Oregon circuit court. However, the law will be of no value if valid in only one State, as if enforced there the fishermen will sell their catches in the other State.

It is quite plain that the salmon runs entering the Columbia River and the Strait of Juan de Fuca can not long continue to exist under this terrific drain upon the immature and mature fish. In the latter section the sockeyes and humpbacks are rapidly being exterminated, and it is probable that the chinooks and cohos, the especial victims in this attack, will soon show signs of exhaustion.

The State authorities appear to be helpless in these matters, but an enactment by the Federal Government could be maintained, as the principle has been applied to fishery matters elsewhere, notably the spring mackerel closed season for five years and the sponge law relating to the landing of undersized sponges taken from the grounds off the Florida coast.

Next to the fishing operations of man, the gravest danger to the salmon fisheries of the Pacific coast lies in the pollution of the rivers which the salmon ascend for spawning purposes. The salmon, both old and young, require pure cold water, and the immense runs which have annually ascended the streams for many years are doubtless due to the fact that such conditions have prevailed in them. The large increase in the population of the coast States within recent years, with the resulting increase of mills and factories, has greatly increased the amount of sewage from cities and towns and the waste of the manufacturing plants. Many of the latter have also constructed dams without adequate fishways, and these also wreak great havoc to the industry by cutting the fish off from the upper reaches of the rivers upon which constructed.

The emptying of sewage into streams ought to be made a crime. It is an exceedingly crude method of dealing with it, and, instead of disposing of the filth, merely transfers it from one place to another, making the water unfit for use at points farther downstream and spreading diseases and death amongst not only the finny but also human users of it.

In the present condition of sanitary science it is a comparatively easy matter to dispose of this filth by modern septic devices, and a number of cities are now disposing of their sewage in this manner.

The irrigation ditch, a comparatively new product on this coast, while of great benefit in developing the arid lands in certain sections, as at present operated is a considerable menace to the salmon fisheries. But few ditches have screens at their head, and as a result many thousands of young salmon slowly making their way to the ocean home pass into and down these to an early doom. Every owner of such a ditch should be compelled to place at its head a screen with fine enough mesh to prevent absolutely the passage through the same of even the tiniest baby salmon.

Next to man and his methods the trout is undoubtedly one of the greatest enemies of the salmon. The Dolly Varden follow the salmon from the sea to the spawning beds, and when the eggs are extruded devour countless thousands of them. Many and many a time the writer has seen on the spawning beds female red salmon swimming around with a cloud of trout spread out behind like a fan, following her every movement, eagerly waiting for the moment when the eggs shall appear.

In the summer, when the young are heading for the sea, the trout are lying in wait for them and again take their toll of countless thousands.

Much is said by certain people of the ravages amongst the salmon of certain animals, as the seal, sea lion, bear, eagle, kingfisher, crane, duck, loon, and hawk. While in the aggregate the ravages of these animals are considerable, they are not a drop in the bucket as compared with the direct or indirect ravages of man and his agencies.

FISHING SEASON IN ALASKA.

There is much interest manifested in the beginning and end of the salmon-fishing season for the more important waters of the various regions of Alaska. The following table, extracted from United States Bureau of Fisheries Document No. 838, "Alaska Fisheries and Fur Industries in 1916," pages 48 and 49, gives dates taken from the statistical reports made by the canning companies. The earliest one reported by any company doing much fishing has been accepted as an opening date, while the closing date was determined by taking the day nearest to which major operations ceased.

Fishing Season in the Canning Industry for Salmon Caught in Certain Important Waters in Alaska in 1916.

Locality.	Coho.		Chum.	
	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—
Southeast Alaska:				
Chatham Strait	June 1	Sept. 27	June 1	Sept. 30
Prince of Wales Island, west side	June 15	Sept. 23	July 1	...do....
Cordova Bay	...do....	...do....	...do....	...do....
Clarence Strait—				
Southern section	June 10	Sept. 29	June 27	Sept. 29
Northern section	July 20	Sept. 30	Aug. 13	Oct. 17
Behm Canal	June 15	Oct. 20	June 15	Oct. 20
Revillagigedo Channel	June 27	Sept. 29	June 27	Sept. 29
Stephens Passage	July 4	Oct. 4	June 22	Oct. 3
Peril and Sumner Straits	June 24	Sept. 27	July 1	Sept. 30
Frederick Sound	June 22	Sept. 21	Sept. 14	Sept. 23
Icy Strait and Cross Sound	June 15	Sept. 20	May 29	Sept. 27
Lynn Canal	July 7	Oct. 1	July 7	Oct. 1
Baranof Island, west side	July 4	Sept. 20	June 20	Sept. 20
Chichagof Island, west side	Aug. 15	Sept. 15	Aug. 5	Sept. 15
Portland Canal	Aug. 16	Sept. 9	July 8	Sept. 3
Iphigenia Bay	June 8	...do....		
Yakutat Bay and vicinity	Aug. 25	Sept. 28		
Central Alaska:				
Bering River				
Martin River				
Copper River Delta	May 12	Sept. 24	May 12	Sept. 21
Copper River, lake and canyon	May 31	Sept. 16	May 31	Sept. 16
Controller Bay	Aug. 24	Sept. 25		
Cook Inlet	July 2	Aug. 27	June 24	Aug. 23
Prince William Sound—				
Eastern section	July 1	Sept. 30	June 23	Sept. 24
Western section			July 7	Aug. 4
Afognak streams—				
Western part				
Eastern part	Aug. 15	Oct. 20		
Karluk	June 3	Oct. 2	June 3	Oct. 2
Red River			June 8	July 21
Uganik	Aug. 15	Oct. 10		
Olga Bay	June 8	Sept. 1	June 8	Sept. 1
Chignik Bay	June 28	Sept. 9	June 12	Sept. 8
Ikatan Bay	May 22	July 25	May 22	July 25
Cold Bay, Thin Point, and King Cove	June 28	Aug. 15	June 28	Aug. 15
Morzhovoi Bay	June 9	Aug. 11	June 9	Aug. 11
Pavlof Bay				
Western Alaska:				
Kvichak Bay	June 11	Aug. 1	June 11	Aug. 1
Naknek, Ugaguk, and Ugashik Rivers			June 21	July 31
Nushagak Bay	June 11	Aug. 4	June 11	Aug. 4
Nushagak River	June 21	Aug. 6	June 23	Aug. 6
Port Moller	June 7	Aug. 9	June 7	Aug. 9
Nelson Lagoon			July 1	Aug. 7
Kotzebue Sound	July 20	Sept. 1		

FISHING SEASON IN THE CANNING INDUSTRY FOR SALMON CAUGHT IN CERTAIN IMPORTANT WATERS IN ALASKA IN 1916—Continued.

Locality.	Humpback.		King.		Red.	
	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—	Fishing began—	Fishing ended—
Southeast Alaska:						
Chatham Strait	June 1	Sept. 30	June 1	Sept. 22	June 1	Sept. 12
Prince of Wales Island, west side	July 1	...do...			June 15	Sept. 23
Cordova Bay	June 15	...do...			...do...	Do.
Clarence Strait—						
Southern section	June 27	Aug. 16			June 8	Sept. 29
Northern section	Aug. 13	Oct. 17	June 27	Aug. 30	July 13	Sept. 7
Behm Canal	June 15	Oct. 20			June 15	Oct. 16
Revillagigedo Channel	June 27	Sept. 29	June 16	July 16	June 27	Sept. 29
Stephens Passage	June 22	Sept. 21	May 9	July 12	June 21	Oct. 3
Peril and Sumner Straits	June 21	Sept. 30			June 27	Sept. 9
Frederick Sound					June 22	Sept. 21
Icy Strait and Cross Sound	June 1	Sept. 27	May 21	July 15	May 21	Sept. 15
Lynn Canal	July 7	Aug. 24			June 24	Oct. 1
Baranof Island, west side	June 20	Sept. 20			June 8	Sept. 20
Chichagof Island, west side	Aug. 1	Sept. 15			Aug. 1	Sept. 1
Portland Canal	July 8	Sept. 3			July 8	Aug. 18
Iphigenia Bay	June 8	Sept. 9			June 8	Sept. 9
Yakutat Bay and vicinity	July 15	Aug. 10	June 2	Aug. 4	June 2	Aug. 4
Central Alaska:						
Bering River			June 22	June 28	June 6	Aug. 7
Martin River			May 12	July 9	June 12	July 9
Copper River Delta	May 12	Sept. 24	...do...	...do...	May 12	Aug. 15
Copper River, lake and canyon	May 31	Sept. 16	May 31	Sept. 16	May 31	Sept. 16
Controller Bay	July 23	Aug. 8			May 27	Aug. 15
Cook Inlet	June 27	Aug. 27	May 27	Aug. 27	May 30	Aug. 27
Prince William Sound—						
Eastern section	June 28	Sept. 24			June 20	Sept. 24
Western section	July 9	Aug. 1			June 17	July 23
Afognak streams—						
Western part	June 20	Aug. 15			May 15	July 31
Eastern part	July 15	Sept. 16			June 1	Oct. 20
Karluk	June 3	Oct. 2	June 3	Oct. 2	June 3	Oct. 2
Red River	June 8	July 21			June 8	July 21
Uganik	June 5	Oct. 10			June 5	July 27
Olga Bay	June 8	Sept. 1	June 8	Sept. 1	June 8	Sept. 1
Chignik Bay	June 12	Aug. 31	June 12	Aug. 31	June 12	Sept. 9
Ikatan Bay	May 22	July 25	May 22	July 25	May 22	July 25
Cold Bay, Thin Point, and King Cove	June 28	Aug. 15			June 28	Aug. 15
Morzhovoi Bay	June 9	Aug. 11	June 9	Aug. 11	June 9	Aug. 11
Pavlof Bay	Aug. 7	Aug. 15				
Western Alaska:						
Kvichak Bay	June 11	Aug. 1	June 11	Aug. 1	June 11	Aug. 1
Naknek, Ugaguk, and Ugashik Rivers			June 21	July 31	June 21	July 31
Nushagak Bay	June 11	Aug. 4	June 11	Aug. 4	June 11	Aug. 4
Nushagak River	June 17	Aug. 6	June 8	July 28	June 13	Aug. 6
Port Moller	June 7	Aug. 9	June 7	Aug. 9	June 7	Aug. 9
Nelson Lagoon			...do...	July 21	...do...	Aug. 7
Kotzebue Sound						

FISHERMEN AND OTHER EMPLOYEES.

FISHERMEN.

White men do the greater part of the fishing for salmon, many nationalities being represented, but Scandinavians and Italians predominate almost everywhere. A number of Greeks are to be found fishing in the Sacramento, while Slavonians do most of the purse seining on Puget Sound. The native-born American is not often found actually engaged in fishing, but frequently is the owner of the gear or has a responsible position in the packing plants.

A number of Indians participate in the fisheries of Alaska and a few fish in Washington. The only Chinese engaged in fishing are in Monterey Bay. A number of Japanese also fish in this bay, which is the only place in American territory where they fish for salmon. A considerable number of Japanese engage in fishing in Canadian waters.

In many places on the coast, particularly in Alaska, fishing is a hazardous occupation. In Alaska most of it is done in the bays, sounds, and straits, where storms are frequent, and the annual loss of life is heavy. The records of the Alaska Fishermen's Union show for its members the following losses of life by drowning: 1905, 10 men; 1906, 5 men; 1907, 10 men; 1908, 17 men; and 1909, 17 men.

The fishermen early saw the advantages of organization, and nearly every river now has a union which is subordinate to the general organization. One of the most typical of these is the Alaska Fishermen's Union, which has active jurisdiction over all sections of Alaska except a portion of southeast Alaska. This organization enters into contracts with the salmon canneries and salteries, by which the rates of wages, duties, etc., of the fishermen are fixed in advance for a certain period—three years—up until 1918, when an agreement was made for only one year. The same was true in 1919. As a result of this mutual agreement upon terms but little trouble is experienced with the fishermen, who generally conform scrupulously to the terms of the contract, and strikes and bickerings, which were very common some years ago, are now almost entirely absent.

CANNERY LABOR.

NATIONALITIES.

In the early days canning was a haphazard business and workmen came and went as common laborers do in the wheat fields of the West. As the business increased in importance and the need of skilled labor became imperative, men were put to certain work and kept at it from season to season, with the result that in a few years a corps of highly skilled workers had been evolved, and this had much to do with the rapid extension of the industry.

For many years Chinese formed the greater part of the cannery employees, the superintendent, foreman, clerks, machinists, and watchmen alone being white. No other laborers have ever been found to do the work as well or with as little trouble as the Chinese. In times of heavy runs, when the cannery would have to operate almost day and night in order to take advantage of what might be the last run for the season of the sometimes erratic salmon, the Chinese were always willing, even eager, to do their utmost to fill the cans, and, if fed with the especial food they insisted upon having and due regard was had to certain racial susceptibilities, the cannery man could almost invariably depend upon the Chinese doing their utmost.

The Chinese-exclusion law cut off the supply of Chinese, and as the years went by and their ranks became decimated by death, disease, and the return of many to China, the contractors were compelled to fill up the rapidly depleting crews with Japanese, Filipinos, Mexicans, Porto Ricans, etc., with the result that to-day in many canneries special quarters have to be provided for certain of the races—more particularly the Chinese and Japanese—in order to prevent racial hatred from engendering brawls and disturbances.

In Alaska the Japanese now compose about one-half of the cannery employees. While a few cannery men express themselves as well pleased with this class of labor, the majority find it troublesome.

In Alaska and at a few places in the States Indians are employed in the canneries. In Alaska more would be employed if they could be secured. They make fair work people, but are rather unreliable about remaining through the season.

CHINESE CONTRACT SYSTEM.

Cannery labor is supplied largely through the contract system In the large cities along the coast are agencies, mainly owned by Chinese, which make a specialty of furnishing labor for canning. In the agreement between the canning company and the contractor the company guarantees to pack a certain number of cases during the coming season, and the latter agrees to do all the work from the time the fish are delivered on the wharf until they are ready to ship at the end of the season for a certain fixed sum per case. Should the cannery pack more than the guaranteed number, which it usually does if possible, the excess has to be paid for at the rate per case already agreed upon, while if the pack for any reason should fall below the contract amount, the company must pay for the shortage the same as though they had been packed. The company transports the Chinese to the field of work and carries them to the home port at the end of the season. It provides them with a bunk house and furnishes fuel, water, and salt. The contractor sends along with each crew a "boss," who has charge of the crew and furnishes their food, the company transporting this free.

While this contract system met with favor from some of the cannery men because it relieved them from the annoyance and trouble involved in hiring, working, and feeding their cannery gangs, others, and these the most farsighted, from the early days of the industry viewed it with suspicion and distrust and in a few instances refused to have anything to do with it. While the plan apparently met with no objection from the Chinese when they were the only ones engaged in the work, as soon as other races began to be employed disputes became common, and it is probable that to-day it is the most unpopular feature of the industry from the common workers' standpoint, and mainly because of the abuses which have grown up in connection with it.

Since the beginning of the present century there has been a steady expansion of the salmon-canning industry, with a consequent heavy demand for cannery labor. As a result of the operation of the Chinese-exclusion act during this period the number of Chinese available has been steadily declining; in fact, most of the Chinese now employed are mainly men well along in life, as the few comprised in the rising generation do not wish to follow in their fathers' footsteps. As a result the oriental gang now comprises many nationalities.

The great increase in the number of canneries during the period noted, with the resulting demand for labor, led to the introduction of other nationalities, more notably the Japanese, into the ranks of the Chinese contractors. Many of these operated with very little or no capital and when a bad season occurred they usually passed their losses, in whole or in part, onto their workers, usually by absconding, and when the latter attempted to come back onto the owner of the plant the latter successfully pleaded the fact that he had made a contract with the contractor to do the work at a certain fixed sum per case, that the stipulated price had been paid him, and if he failed to settle with the men it was no concern of the canner.

The contractor, under his agreement with the canner, has the right to feed his employees from the ime they leave the home port until they return, and this is a most prolific source of profit and graft to him and of trouble to the canner. When the workers comprise orientals alone, the food question rarely troubles as then rice, which is the staple food and is also as a rule quite cheap, meets with the approval of all. But since the gangs now comprise almost as many nonorientals as there are orientals, and the former find it impossible to exist, let alone thrive, on rice, much trouble results when the contractor furnishes them with an undue proportion of the latter in the dail menu. As a result of this condition of affairs, some of the more far-seeing companies now compel the contractor to furnish each nationality with food to which they are accustomed and in sufficient quantities. Eternal vigilance is required in this matter, however, as the wily oriental is always seeking an opportunity to increase his profits by cutting the quantity of food to the minimum and by forcing as much rice as possible upon the employees Innumerable strikes in the canneries can be traced directly to dissatisfaction with the quantity, kind, and quality of food furnished to the men by the contractor's agent; and the resulting losses, which are sometimes very large, as the strikes generally occur when the cannery has plenty of fish, fall upon the cannery men.

Nearly all of the workers are ignorant men; in most cases they have but little knowledge of English, the language in which the contract is printed, and as no paternal Government watches over them to see that they understand thoroughly the terms of the contract and that it is fulfilled on the part of the employer, as is done in the case of the sailors and fishermen, some of them discover at the end of the season that their pay does not come up to the glowing promises of the agent who recruited them and also frequently discover that there are various fines provided for in the contract, which, while they do not work an injustice when the contractor is honest, yet in the hands of an unscrupulous and grasping contractor, frequently operate to the financial disadvantage of the worker.

Some of the dishonest contractors have developed other methods for fleecing their employees. Sometimes they will furnish to their contract workers, either directly or through some concern in which they have financial interests or which will pay them a commission, an outfit comprising clothing, blankets, shoes, etc., at a price two or three hundred times its real value. The worst feature of many of these outfits is that they are woefully inadequate for use in the climate to which the cannery ship is bound. Some unscrupulous contractors also sell goods to the workers at extortionate prices while at the cannery The latter is usually not permitted by the canners, who generally operate a store of their own where the men can as a rule obtain goods as cheap as they can be bought in either San Francisco or Seattle.

Orientals are inveterate gamblers, and there are usually several sharpers with each cannery gang, generally with the connivance of the contractor's agent—although it is usually an impossibility to prove this legally—and they inveigle the green hands into all sorts of gambling games, and in this manner frequently succeed in winning all or part of their season's wages. That those in charge of the gang are well aware of what is going on is patent when it is stated that the men are not paid off until they return to the home port at the end of the season, and that no considerable claim on the wages due a worker can be paid unless the contractor or his agent knows what it is for. Sometimes when dealing with a canner who is insistent upon seeing justice done to the members of the oriental gang, and the number of these is increasing rapidly, an effort is made to camouflage these gambling debts by charging them up on the books as clothing or goods furnished the worker.

As a result of these evils, a number of the cannerymen have discontinued the practice of making Chinese contracts and deal directly with their men. When this is done, it is but rare to hear of a strike due to food supplied, as the cannerymen, when the matter is put directly up to them, realize that the only way in which they can expect adequate work from their employees is by seeing that they are given the proper kind and quantity of food and that they operate under decent working and living conditions.

A few of the cannerymen who still retain the old system endeavor to eradicate so far as possible the evils of it by a close supervision over the food supplied the men and by having a representative present at the season's pay-off in order to see that no attempt is made to cheat the men out of their wages. Unfortunately, however, some of them feel that they have done their full duty when they have made a contract with someone, no matter what his financial responsibility may be, and have paid him the agreed upon sum at the end of the season, doubtless feeling that the rest is the concern alone of the men.

In a very few instances the members of the oriental gang are still shoved into inadequate and insanitary quarters aboard ships, and at the canneries are housed in quarters which are a disgrace to any modern packing plant, but, fortunately, these conditions, as stated, prevail now with but comparatively few of the companies. The old "China" house, in which was housed the whole oriental gang like rabbits in a warren, has been largely superseded by cottages, each housing from 8 to 16 men, and these are numerous enough to permit of the various nationalities flocking by themselves. Bathing facilities, with hot and cold water, are fairly common, and opportunities for washing clothing are frequent.

FISHERIES OF BOUNDARY WATERS.

Waters which form the boundaries between States or between nations, and in which fishing is carried on by the citizens of both, have almost always proved bones of contention, and the Pacific coast has been no exception to the rule.

WASHINGTON AND OREGON.

The Columbia River, which forms the boundary between Oregon and Washington, affords a typical example of the evils which can result from a division of responsibility between two States. For many years each State enacted laws regulating the fisheries of the river with very slight regard usually to laws already in force in the other State. As a result of this the fishermen transferred their residence for license purposes from State to State as the laws of one or the other best suited their particular purposes.

The fishermen and packers also were in apparently irreconcilable conflict as to the proper means to be taken to conserve the fisheries, and each session of the legislatures saw strong lobbies present to work for certain selfish ends, while the few earnest men who had the real welfare of the fisheries of the river at heart had difficulty in making the slightest headway against the influence of these lobbies.

To further complicate the matter, in 1894 Oregon claimed that, under the provisions of the enabling act admitting it as a State, it had jurisdiction to the Washington shore, and proceeded to arrest Washington men who were fishing in what was the open season according to Washington law but the closed season under Oregon law.

In June, 1908, the voters of the State of Oregon had presented for their consideration two bills radically affecting the waters of Columbia River. One proposed closing the river east of the mouth of the Sandy River against all fishing of any kind except with hook and line, and was originated by gill-net fishermen of the lower river for the purpose of eliminating fish wheels in the upper waters. This bill was the first presented to the people, and when it appeared the upriver men retaliated by presenting a bill affecting the lower river to such an extent that it practically prohibited the net fishermen from operating.

Very much to the surprise of all concerned both bills were passed and became laws on July 1, to take effect, as provided, on August 25 and September 10, respectively. The Oregon master fish warden proceeded to enforce both laws, arresting all violators on both sides of the river, irrespective of whether or not they were operating under a Washington or Oregon license, and incidentally did the fisheries a great service by bringing prominently before the public the anomalous condition of affairs which was occasioned by the archaic system under which the fisheries of the Columbia were governed. The State of Washington appealed to the United States courts, which, after argument, issued an injunction preventing the warden from enforcing the laws so far as the Washington fishermen were concerned.

In the meantime the attention of the General Government had been drawn to the apparently irreconcilable conflict between the two States, and fearing that in the mêlée the interests of the fisheries would be lost sight of, President Roosevelt, in a message to Congress, after reciting briefly the lack of harmony in jurisdiction by the States, recommended that the General Government take over the control of the fisheries of the Columbia, as well as other interstate rivers.

This had the effect of bringing matters to a head, and negotiations were soon in progress looking to the preparation of a treaty between the two States by which uniform laws would be adopted, and thus each State have concurrent jurisdiction to the opposite shore of the river. The legislatures each appointed a committee of eight members to confer and frame joint legislation. The two committees met in Seattle, Wash., early in 1909, and agreed upon the following recommendations:

First. A spring closed season from March 1 to May 1.
Second. A fall closed season from August 25 to September 10.
Third. A Sunday closed season from 8 p. m. Saturday of each week to 6 p. m. the Sunday following between the 1st day of May and the 25th day of August.

Fourth. We suggest the mutual recognition by each State of the licenses issued to floating gear by the other State.

Fifth. That the State of Oregon repeal chapter 89 of the session laws of Oregon for the year 1907, relative to the operation of purse seines and other like gear on the Columbia River.

Sixth. We recommend the enactment of similar laws in both States carrying an appropriation of at least $2,500 in each State and providing for the destruction of seals and sea lions and the granting of a bounty on the same, to be $2.50 for seals and $5 for sea lions.

Seventh. We recommend the repeal of both the fish bills passed under the provisions of the initiative and referendum in June, 1907, by the people of the State of Oregon, said bills being designated on the ballot as 318, 319 and 332, 333.

The recommendations were enacted into law by both States, and at the same time the State of Washington in its bill also prohibited fishing for salmon within 3 miles of the mouth of the Columbia between March 1 and May 1 and between August 25 and September 10, or salmon fishing on tributaries of the Columbia, except the Snake, between June 1 and September 15; and also prohibited fishing for salmon by any means save by hook and line in the Kalama, Lewis, Wind, Little White Salmon, Wenatchee, Methow, and Spokane Rivers and in the Columbia River 1 mile below the mouth of any of the rivers named. The agreement was subjected to a rather severe strain, however, when it was discovered that the Oregon Legislature had failed to provide the same closed periods for the tributaries that were enacted for the Columbia, thus leaving the Willamette, Clackamas, Lewis and Clark, and Youngs Rivers and Spikanon Creek open to fishing for 15 days in March and 15 days in April, while the Columbia was closed. The cry of bad faith was at once raised by the Washington fishermen, and for a short time it appeared that the agreement would be broken at the very beginning. The Oregon Board of Fish Commissioners took the matter up, however, and by order closed these streams to all fishing during the times of closed season on the Columbia, and thus restored peace once more.

This agreement continued in force until 1915, when the legislature of each State prepared for a thorough revision of its fishery code. In order to make this revision more effective, committees from both legislatures were appointed and held joint meetings in Portland, where they mutually agreed upon laws covering the fisheries of the Columbia River, and in order to make this agreement more binding the following chapter was inserted in the codes finally adopted:

All laws and regulations now existing, or which may be necessary for regulating, protecting, or preserving fish in the waters of the Columbia River, over which the States of Oregon and Washington have concurrent jurisdiction, or any other waters within either of said States, which would affect said concurrent jurisdiction, shall be made, changed, altered, and amended in whole or in part only with the mutual consent and approbation of both States.

As such an agreement between two States requires the approval of Congress, a bill ratifying the same was introduced in Congress on December 16, 1915, but was not finally ratified until April 1, 1918.

While the compact was pending in Congress, the Washington legislature at its 1917 session made several changes in the existing fisheries law and contended they were effective because the compact agreement was not ratified by Congress until 1918, which then did not take recognition of the new regulations. When the matter came officially before the superior court of Pacific County, Wash., in 1919, the court held that the compact was valid, thus nullifying laws passed by the State of Washington affecting the Columbia River since 1915, and if this decision stands in the higher courts of both States all laws passed by either legislature since 1915, affecting the Columbia River fisheries, will fail unless they happen to be the same in both States.

WASHINGTON AND BRITISH COLUMBIA.

The conditions which prevail in Puget Sound adjacent to the boundary between Washington and British Columbia have also been the cause of serious anxiety to those interested in the perpetuation of the salmon fisheries. The great schools of sockeye salmon which are on their way from the ocean to the spawning beds in the Fraser River pass through this section, and it is here that the greater part of the fishing is done. The Province of British Columbia and the State of Washington are vitally interested in the preservation of these fish, but, unfortunately, they seem unable to agree upon any definite policy with regard to their conservation, although it would appear to the unprejudiced observer that it ought to be possible to find some common ground upon which they could agree.

This condition of affairs on Puget Sound and similar conditions in other boundary waters led the General Government to take up the matter, and on April 11, 1908, a convention was concluded between this country and Great Britain for the protection and preservation o the food fishes in international boundary waters of the United States and Canada. Both Governments appointed international commissioners—Dr. David Starr Jordan for the United States and S. T. Bastedo (who was succeeded later by Prof. Edward Ernest Prince) for Canada—whose duty it was to investigate conditions prevailing in these waters and to recommend a system of uniform and common international regulations. After an exhaustive investigation the commissioners submitted recommendations, which included the following affecting the boundary waters dividing the State of Washington and the Province of British Columbia, these waters being defined as the Strait of Juan de Fuca, and those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10′ and 49° 20′:

GENERAL REGULATIONS.

3. *Disposition of prohibited catch.*—In case any fish is unintentionally captured contrary to the prohibitions or restrictions contained in any of the following regulations, such fish shall, if possible, be immediately returned alive and uninjured to the water.

4. *Dynamite, poisonous substances, etc.*—No person shall place or use quicklime, dynamite, explosive, or poisonous substances, or electric device in treaty waters for the purpose of capturing or killing fish.

5. *Pollution of waters.*—No person shall place or pass, or allow to pass, into treaty waters any substance offensive to fishers, injurious to fish life, or destructive to fish fry or to the food of fish fry, unless permitted so to do under any law passed by the legislative authority having jurisdiction.

No person shall deposit dead fish, fish offal, or gurry in treaty waters, or on ice formed thereon, except in gurry grounds established by the duly constituted authorities.

6. *Capture of fishes for propagation or for scientific purposes.*—Nothing contained in these regulations shall prohibit or interfere with the taking of any fishes at any time for propagation or hatchery purposes, and obtaining at any time or by any method specimens of fishes for scientific purposes under authority granted for Canadian treaty waters by the duly constituted authorities in Canada and for United States treaty waters by the duly constituted authorities in the United States.

3

12. Capture of immature salmon prohibited.—No salmon or steelhead of less than pounds in weight shall be fished for, killed, or captured in treaty waters.

13. Salmon weirs, etc., above tidal limits prohibited.—No salmon and no steelhead shall be fished for, killed, or captured by means of a net of any sort, any weir or any fish wheel, above tidal limits in any river in treaty waters.

14. Close season for sturgeon.—During the term of four years next following the date of the promulgation of these regulations no sturgeon shall be fished for, killed, or captured in treaty waters.

15. Capture of fish for fertilizer or oil prohibited.—Fishes useful for human food shall not be fished for, killed, or captured in treaty waters for use in the manufacture of fertilizer, or of oil other than oil for food or medicinal purposes.

16. Naked hooks and spears prohibited.—No spear, grappling hook, or naked hook, and no artificial bait with more than three hooks, or more than one burr of three hooks attached thereto, shall be used for the capture of fish in treaty waters. This regulation shall not prohibit the use of a gaff in hook-and-line fishing.

17. Torching prohibited.—No torch, flambeau, or other artificial light shall be used as a lure for fish in treaty waters.

The following regulations relate specifically to the waters named:

STRAIT OF JUAN DE FUCA AND ADJACENT WATERS.

The following regulations (62 to 66, inclusive) shall apply to the Strait of Juan de Fuca, those parts of Washington Sound, the Gulf of Georgia, and Puget Sound lying between the parallels of 48° 10′ and 49° 20′ north latitude:

62. Close season for salmon.—From August 25 to September 15 in each year, both days inclusive, no salmon or steelhead shall be fished for, killed, or captured for commercial purposes in these treaty waters; provided, however, that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington silver salmon, or coho salmon, may be fished for, killed, or captured from September 1 to September 15 in each year, both days inclusive.

63. Weekly close season for salmon and steelhead.—From 6 o'clock Saturday morning to 6 o'clock on the Monday morning next succeeding, no salmon or steelhead shall be fished for, killed, or captured in these treaty waters.

It is, however, provided that in the waters to the westward of a line drawn southward from Gonzales Point to the shore of the State of Washington the weekly close season shall begin 12 hours earlier, and shall end 12 hours earlier.

64. Construction of pound nets.—All pound nets or other stationary appliances for the capture of salmon or steelhead shall be so constructed that no fish whatever shall be taken during the weekly close season. The erection or addition to the pound net of a jigger is prohibited.

65. Location of pound nets.—All pound nets shall be limited to a length of 2,500 feet, with an end passageway of at least 600 feet between one pound net and the next in a linear series, such distance being measured in continuation of the line of direction of the leader of such net, and a lateral passageway of at least 2,400 feet between one pound net and the next.

On and after January 1, 1911, the mesh in pound nets shall be 4 inches in extension in the leader and not less than 3 inches in other parts of the net.

66. Nets other than pound nets.—No purse net shall be used within 3 miles of the mouth of any river and no seine within 1 mile of the mouth of any river in these treaty waters.

No gill net of more than 900 feet in length or of a greater depth than 60 meshes shall be used in these treaty waters.

The effort to enact these regulations into law by our Congress met with decided objections not only on the part of the Puget Sound operators, but also from operators in other waters affected, with the result that the bill was shelved and never acted upon finally. After waiting a while to see if any action would be taken by our Government, Canada finally repealed the act in which it had accepted the regulations.

DECREASE IN SOCKEYE SALMON RUN.

In 1913 the matter of the Frazer River-Puget Sound sockeye salmon run came prominently to the fore through a rock slide in Hell Gate

Canyon, on the Fraser River, caused by blasting operations of a construction gang building a railroad through there. This slide, it was asserted, cut off the greater part of the run to the upper river, and, it was feared, would have a very serious effect on future runs. By the time the run of 1914 arrived the greater part of the débris had been removed from the canyon, and the fish, it was alleged, could once more pass up. Reports of persons who visited these spawning grounds in 1913 and subsequent years were to the effect that but few spawners, as compared with earlier years, were to be found on them.

That the subsequent decrease in the runs was not to be attributed solely to the rock slide in Hell Gate canyon is plainly evident by a glance at the pack figures in this area before and subsequent to 1913. The following statement shows the combined sockeye packs of the American and Canadian packers operating on the run going to the Fraser River:

	Cases.		Cases.
1909	[a] 1,590,555	1915	155,714
1910	384,869	1916	105,870
1911	189,767	1917	[a] 559,732
1912	307,775	1918	70,420
1913	[a] 2,401,488	1919	98,409
1914	534,434		

Aside from the damage caused to the "big year" run by the rock slide, there can be only one explanation of such a progressive decline in the pack, and that is excessive fishing. The fishermen of both countries are to blame for this. On the American side traps, purse seines, and, in a slight degree, gill nets, have taken a heavy toll of the fish as they passed through our waters. After some had safely run this gantlet they met thousands of gill nets operted by Canadian fishermen in and around the mouth of the Fraser River and in the lower reaches of same, and it is a wonder that any of the schools ever got to the spawning beds. Several abortive attempts have been made by the authorities of Canada and British Columbia on the one side and the State of Washington on the other to arrive at some equitable method for protecting this sockeye run. The former especially have professed an earnest desire to do something along this line, and there is no reason to doubt their sincerity. On the American side a few people, and among these a few of the more intelligent canners, pleaded for the enactment of laws that would adequately protect the salmon, but they were overborne by the great bulk of the packers and fishermen who, disregarding all the warnings and teachings of experience, insisted upon going ruthlessly forward with the slaughter, and when reproached with their shortsightedness clamored for the establishment of more salmon hatcheries, as though the latter could accomplish the miracle of increasing the supply of fry from a steadily decreasing supply of eggs.

That this wanton destruction of one of our greatest natural resources should have been permitted to continue unchecked by the people of Washington and British Columbia is a most surprising thing, and indicates either a most remarkable ignorance of the condition, which should have been patent to everybody, or a criminal apathy.

[a] The big year, which comes every fourth year.

AMERICAN-CANADIAN FISHERIES CONFERENCE.

In 1917 a joint commission, known as the American-Canadian Fisheries Conference, was appointed to take evidence and see if it were possible to compose the fishery disputes which had affected the good relations of the two countries for over 150 years. The commission was composed, for America, of William C. Redfield, Secretary of Commerce; Edwin F. Sweet, assistant Secretary of Commerce; and Dr. Hugh M. Smith, Commissioner of Fisheries; and for Canada, of J. Douglas Hazen, Chief Justice of New Brunswick, who had been for six years Minister of Marine and Fisheries for Canada; George G. Desbarats, deputy Minister Naval Service; and William A. Found, Superintendent of Fisheries.

Hearings were held on the Atlantic coast in 1917 and on the Pacific coast in 1918, and in 1919 the commission agreed upon and presented to their respective Governments several treaties concerning these matters, the only one of special interest here being the treaty covering the sockeye fisheries of the Fraser River-Puget Sound, which was signed on September 2, 1919. Owing to its importance this treaty is reproduced entire below:

CONVENTION FOR THE PROTECTION, PRESERVATION, AND PROPAGATION OF SALMON.

The United States of America, and His Majesty George V, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, Emperor of India, equally recognizing the desirability of uniform and effective measures for the protection, preservation, and propagation of the salmon fisheries in the waters contiguous to the United States and the Dominion of Canada, and in the Fraser River System, have resolved to conclude a convention for this purpose, and have named as their Plenipotentiaries:

The President of the United States of America, the Honorable Robert Lansing, Secretary of State of the United States of America, and

His Britannic Majesty, the Honorable Ronald Lindsay, his charge d'affaires at Washington, and the Honorable Sir John Douglas Hazen, a Knight Commander of the Most Distinguished Order of St. Michael and St. George, Chief Justice of New Brunswick, and a member of his Privy Council for Canada.

Who, having exhibited their full powers, found to be in due form, have agreed to and signed the following articles:

Article I.

The times, seasons, and methods of sockeye-salmon fishing in the waters specified in Article III of this Convention, and the nets, engines, gear, apparatus, and appliances which may be used therein, shall be limited to those which are specified in the regulations appended hereto, and/or which may be specified in revised, modified, or substituted regulations provided for in Article VI and promulgated in accordance with the terms of Article II.

Article II.

The High Contracting Parties engage to put into operation and enforce by legislative and executive action, with as little delay as possible, the provisions of this convention and said regulations, and the date when the said regulations shall be put into operation, shall be fixed by concurrent proclamations of the President of the United States and of the Governor General of the Dominion of Canada in Council. Each of the High Contracting Parties may, by appropriate legislation, provide for the trial, conviction, and punishment within its jurisdiction of any person found there who has contravened any of the provisions of this convention, and/or said regulations within the jurisdiction of the other High Contracting Party, and who has not been punished for such offence within the latter jurisdiction.

Article III.

It is agreed that the provisions of this convention and of said regulations shall apply to the waters included within the following boundaries:

Beginning at Carmanagh Lighthouse on the southwest coast of Vancouver Island, thence in a straight line to a point three marine miles due west astronomic from Tatoosh Lighthouse, Washington, thence to said Tatoosh Lighthouse, thence to the nearest point of Cape Flattery, thence following the southerly shore of Juan de Fuca Strait to Point Wilson, on Quimper Peninsula, thence in a straight line to Point Partridge on Whidbey Island, thence following the western shore of the said Whidbey Island, to the entrance to Deception Pass, thence across said entrance to the southern side of Reservation Bay, on Fidalgo Island, thence following the western and northern shore line of the said Fidalgo Island to Swinomish Slough, crossing the said Swinomish Slough in line with the track of the Great Northern Railway, thence northerly following the shore line of the mainland to Point Grey at the southern entrance to Burrard Inlet, British Columbia, thence in a straight line to the southern end of Gabriola Island, thence to the southern side of the entrance to Boat Harbor, Vancouver Island, thence following the eastern and southern shores of the said Vancouver Island to the starting point at Carmanagh Lighthouse, as shown on the United States Coast and Geodetic Survey Chart No. 6300, as corrected to July 20, 1918, and also the Fraser River and its tributaries.

The High Contracting Parties engage to have prepared, as soon as practicable, charts of the waters described in this article, with the international boundary line indicated thereon; and to establish such buoys and marks for the purposes of this convention as may be recommended by the commission referred to in Article IV.

Article IV.

The High Contracting Parties agree to appoint, within two months after the exchange of ratifications of this convention, a commission to be known as the International Fisheries Commission, consisting of four persons, two to be named by each party. This commission shall continue to exist so long as this convention shall be in force. Each party shall have the power to fill, and shall fill, from time to time, any vacancy which may occur in its representation on the commission. Each party shall pay its own commissioners, and any joint expenses shall be paid by the two High Contracting Parties in equal moieties.

Article V.

The International Fisheries Commission shall conduct investigations into the life history of the salmon, hatchery methods, spawning-ground conditions, and other related matters, and shall observe the operation of the said regulations appended hereto, and shall recommend to their respective Governments any modifications of, additions to, or substitutions for the appended regulations which may be found desirable.

Article VI.

The regulations appended to this convention shall remain in force for a period of eight years from the date of their promulgation, as provided in Article II, and thereafter until one year from the date when either of the High Contracting Parties shall give notice to the other of its desire for their revision, or until the termination of this convention, whichever shall first occur. Immediately upon such notice being given, the International Fisheries Commission shall proceed to make a revision of said regulations, which revised regulations shall be incorporated in a special agreement between the High Contracting Parties. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof, and shall remain in force for a period of five years and thereafter until one year from the date when a further notice of revision is given as above provided in this article, or until the termination of this convention, whichever shall first occur.

It shall, however, at any time, be in the power of the High Contracting Parties by special agreement upon the recommendation of the International Fisheries Commission, to make modifications of, additions to, or substitutions for any of the regulations in force, and (or) to make the provisions of this convention, and any regulations promulgated in accordance with the terms thereof, operative in the waters specified in Article III of this convention, as to any or all of the other species of salmon, including steelhead. It is understood that such special agreement shall on the part of the United States be made by the President of the United States, by and with the advice and consent of the Senate thereof. Such special agreement shall be binding only when confirmed by the two Governments by an exchange of notes. Such special agreement shall be promulgated as provided in Article II hereof.

Article VII.

This convention shall remain in force for a period of fifteen years, and thereafter until two years from the date when either of the High Contracting Parties shall give notice to the other of its desire to terminate this convention.

Article VIII.

The present convention shall be duly ratified by the President of the United States, by and with the advice and consent of the Senate thereof, and by His Britannic Majesty, and the ratifications shall be exchanged at Washington as soon as practicable.

IN FAITH WHEREOF, the respective plenipotentiaries have signed the present convention in duplicate and thereunto affixed their seals.

Done at the City of Washington this second day of September, in the year one thousand nine hundred and nineteen.

ROBERT LANSING, (Seal)
R. C. LINDSAY, (Seal)
J. D. HAZEN. (Seal)

APPENDIX.

INTERNATIONAL REGULATIONS FOR THE PROTECTION AND PRESERVATION OF THE SOCKEYE SALMON FISHERIES OF THE FRASER RIVER SYSTEM.

Section 1.

The following regulations shall apply to the waters described in Article III of the convention of September 2, 1919, between the United States and Great Britain, to which these regulations are appended, to-wit:

(Here is inserted the description of the waters affected, as already set forth in Article III above.)

Section 2.

DEFINITIONS.

"Drift net" shall mean a floating gill net that is neither anchored nor staked, but that floats freely with the tide or current.

"Trap net" shall include a pound net.

"Commission" shall mean the International Fisheries Commission appointed under the convention to which these regulations are appended.

"Treaty waters" shall mean all waters described in Article III of the convention to which these regulations are appended.

Section 3.

(*a*) Fishing for sockeye salmon in the treaty waters within the territorial limits of the State of Washington, shall not be permissible except under license from such state, and in the treaty waters of Canada except under license under the provisions of the fisheries act of Canada.

(*b*) No greater number of licenses for any class of fishing appliance shall be authorized in any year in the treaty waters within the territorial limits of the State of Washington than were issued for such class for the season of 1918, up to August 31st, inclusive thereof, and in the treaty waters of Canada the number of gill nets that may be licensed in any year shall not exceed 1,800.

(*c*) No license shall be granted to any person or partnership in the State of Washington unless such person or each member of such partnership shall be an American citizen, resident in said State, and no license shall be granted to any joint-stock company or corporation in said State, unless the officers, directors and the holders of a majority of the stock thereof, are American citizens, or unless it is authorized to do business in the said State; and no license shall be granted to any person, company or firm in the Province of British Columbia unless such person is a British subject resident in the said Province, or unless such company or firm is a Canadian company or firm, or is authorized by the Provincial Government to do business in the said Province of British Columbia.

(*d*) No one other than a British subject who owns or leases land on either side of the Fraser River above New Westminster Bridge, and who actually permanently resides on, and is cultivating such land, shall be eligible for a license to fish for sockeye salmon between New Westminster Bridge and Mission Bridge, but fishing under such license shall not be carried on below New Westminster Bridge.

SECTION 4.

The use of nets other than drift nets, purse seines, and trap nets shall not be permitted in treaty waters for the capture of sockeye salmon.

SECTION 5.

No net fishing or fishing of any kind, other than with hook and line, except for hatchery purposes, or scientific purposes, shall be permissible in the Fraser River above the down river side of Mission Bridge.

SECTION 6.

During the years 1920 to 1927, both years inclusive, no one shall fish for, catch or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time, no nets or appliances of any kind that will capture salmon may be used in these treaty waters; *Provided, however*, That salmon fishing for hatchery or scientific purposes may be authorized during this period.

SECTION 7.

The weekly close time for salmon fishing shall be from six o'clock a. m. Saturday, to six o'clock p. m. Sunday, in Canadian waters, excepting in that portion of the Fraser River between New Westminster Bridge and Mission Bridge, where the weekly close time shall be from six o'clock a. m. Saturday to six o'clock p. m. on the following Monday, and in the treaty waters of the United States from Friday at four o'clock p. m. to Sunday at four o'clock a. m. and during this close time no salmon fishing of any kind other than for hatchery or scientific purposes shall be permissible, and during the full period of each weekly close time or annual close season, each trap net shall be closed by an apron across the outer entrance to the heart of the trap, which apron shall extend from the surface to the bottom of the water and shall be securely connected to the piles on either side of the heart of the trap net, fastened by rings not more than two feet apart on taut wires stretched from the top to the bottom of the piles, and such apron, or the appliance by which it is raised and lowered, shall be provided with a signal or flag, which shall disclose whether the trap net is closed, and which shall be of the form and character approved by the commission: Provided, that in addition to the foregoing requirement, such trap net shall be equipped with a V-shaped opening, to the satisfaction of the commission, and in the lead of such trap net next to the entrance to the heart and immediately adjacent to the apron, of at least ten feet in width at the top and extending below the surface at least four feet below low water, which V-shaped opening shall remain open and unobstructed during the full period of each weekly close time or annual close season. For the purposes of assuring full compliance with this regulation, the owner or operator of each trap net shall constantly maintain during the weekly and annual close time a watchman, whose duty it shall be to cause each trap net to be kept closed and the lead to be kept open, as above provided.

SECTION 8.

All salmon trap nets shall be limited to a total length of twenty-five hundred feet, with an end passageway of at least six hundred feet between one trap net and the next in linear series, such distances being measured in continuation of the line of direction of the leader of such trap net, but in no instance shall more than two-thirds of the width of any passageway at any point be closed by trap nets. There shall also be a lateral distance of at least twenty-four hundred feet between one trap net and the next.

SECTION 9.

A salmon purse seine shall not exceed nineteen hundred linear feet in length, including the lead and attachment, measured on the cork line when wet.

SECTION 10.

(a) No purse seine shall be cast or placed in the water for fishing purposes within twenty-four hundred feet of any trap net.

(b) The use of purse seines for the capture of sockeye salmon shall be confined to the treaty waters southward and westward of a straight line drawn from the lighthouse on Trial Island, British Columbia, to the northwest point of Whidbey Island, State of Washington.

SECTION 11.

A salmon drift net shall not exceed nine hundred linear feet in length, and the vertical breadth thereof shall not exceed sixty meshes, and the size of the mesh shall not be less than five and three-fourths inches, extension measure, when in use.

Had such a treaty been adopted and rigidly enforced 10 or 12 years ago, it might have had a beneficial effect on the Fraser River-Puget Sound sockeye run, but the destruction of the run has progressed to such an alarming extent during the past 7 years that only a total cessation of all fishing for sockeyes in this section for a term of years could have the slightest beneficial effect. The proposed regulations provide that "during the years 1920 to 1927, both years inclusive, no one shall fish for, catch, or kill any salmon from the 20th day of July to the 31st day of July in each year, both days inclusive; and during this close time no nets or appliances of any kind that will capture salmon may be used in these treaty waters * * *." This closed period runs concurrently on both sides of the line, and while it would have but a very slight effect if the salmon were able to reach the spawning grounds in this short period, it certainly can have none if the Canadian gill netters are enabled to start fishing just about the time the salmon have reached the mouth of the Fraser.

The only hope of rehabilitating the sockeye run—and some well-informed observers have grave doubts whether anything will ever accomplish this desirable result—is to close the waters of Puget Sound through which the sockeyes pass and the Fraser River during the months of July and August or such other period as may be necessary to protect the sockeyes from the time they appear off the capes until they have passed beyond the fishermen on the Fraser River to all salmon fishing for a period of 8 or 12 years. As the sockeyes are 4-year fish—i. e., are born and live in fresh water for about a year, then go to sea, and are not observed again until they return in the fourth year after birth (a small proportion live to 5 years, and a vastly smaller proportion to 6 years), spawn on the breeding grounds of the Fraser and then die—a closed period of less than 4 years could have no appreciable effect, as it would not be a complete cycle in the animal's life, while 8 or 12 years, representing two or three cycles of their life, might possibly have a beneficial effect, although the experiences of the past show clearly that it is much easier to destroy a school of fish than it is to restore a much depleted one.

DECREASE IN HUMPBACK SALMON CATCH.

Another unfortunate condition has developed as a result of excessive fishing in Puget Sound of recent years, and that is the heavy decline in the catch of humpback salmon. These fish are caught in the same apparatus as used for sockeyes.

For many years the humpbacks came in countless numbers, and the fishermen were able to sell but a small part of the catch. Despite this, they persisted in catching them and many thousands were killed and thrown away during the years when the run appeared in the sound. This ruthless and senseless slaughter finally had its natural result, and about four years ago a heavy decline was observed in the catch of that year, and this decline has steadily increased since, with the result that to-day there are grave doubts as to whether the run can be preserved even in its impaired condition. The only hope is that the prohibition of all salmon fishing during the months of July and August may be adopted, which would prevent fishing for either sockeyes or humpbacks, both of which run during these months.

PACKS BY CANADIAN AND AMERICAN CANNERS.

Many people on both sides of the boundary line have been under the impression that the American fishermen on Puget Sound have been by far the greatest offenders in so far as the quantity of sockeye salmon taken has been concerned, but a table [a] prepared by Mr. J. P. Babcock, assistant to the Commissioner of Fisheries of British Columbia, does not bear this out. Previous to 1891 most of the fishing was done by British Columbia fishermen. The table follows:

Year.	Canadian waters.	American waters.	Total.	Year.	Canadian waters.	American waters.	Total.
	Cases.	*Cases.*	*Cases.*		*Cases.*	*Cases.*	*Cases.*
1891	176,954	5,538	182,492	1907	62,617	96,974	159,591
1892	79,715	2,954	82,669	1908	74,574	155,218	229,792
1893	457,797	47,852	505,649	1909	585,435	1,005,120	1,590,555
1894	363,967	41,791	405,758	1910	150,432	234,437	384,869
1895	395,984	65,143	461,127	1911	62,817	126,950	189,767
1896	356,984	72,979	429,963	1912	123,879	183,896	307,775
1897	860,459	312,048	1,172,507	1913	736,661	1,664,827	2,401,488
1898	256,101	252,000	508,101	1914	198,183	336,251	534,434
1899	480,485	499,646	980,131	1915	91,130	64,584	155,714
1900	229,800	228,704	458,504	1916	27,394	78,476	105,870
1901	928,669	1,105,096	2,033,765	1917	148,164	411,538	559,702
1902	293,477	339,556	633,033	1918	19,697	50,723	70,420
1903	204,809	167,211	372,020	1919	34,063	64,346	98,409
1904	72,688	123,419	196,107				
1905	837,489	847,122	1,684,611	Total	8,493,431	8,766,640	17,260,071
1906	183,007	182,241	365,248				

METHODS OF PREPARING SALMON.

CANNING.

EARLY DAYS OF THE INDUSTRY.

In the salmon industry canning is and has been almost from the time of the discovery of a feasible method of so preserving the fish, the principal branch. The first canning of salmon on the Pacific coast was on the Sacramento River in 1864, when G. W. and William Hume and Andrew S. Hapgood, operating under the firm name of Hapgood, Hume & Co., started the work on a scow at Washington, Yolo County, Calif. The Hume brothers, who came from Maine originally, had been fishing for salmon in the Sacramento River for some years before the idea of canning the fish had entered their minds, while Mr. Hapgood had previously been engaged in canning lobsters in Maine, and was induced by the Humes to participate in

[a] Fraser River Salmon Situation: A Reclamation Project. By John Pease Babcock. Appendix V, Report, British Columbia Commissioner of Fisheries for the year ending Dec. 31, 1919, p. 3. Victoria, British Columbia, 1920.

order that they might have the benefit of his knowledge of canning methods. The late R. D. Hume, who worked in the original cannery and later became one of the best-known canners on the coast, thus describes the plant and the methods employed:[a]

Before the arrival of Mr. Hapgood (from Maine) the Hume brothers had purchased a large scow, on which they proposed to do the canning of salmon, and had added an extension to the cabin 18 by 24 feet in area, to be used as a can-making shop. This had a shed on the side next to the river for holding any cans that might be made in advance of the packing season. A few days after the arrival of Mr. Hapgood (Mar. 23, 1864), the tools and machinery were packed and put in position. Mr. Hapgood made some stovepipe and two or three sheet-iron fire pots, and in a short time was ready for can making. The following list of tools and machinery will show how primitive our facilities were as compared with present methods: 1 screw hand press, 1 set cast-iron top dies, 1 set cast-iron bottom dies, 1 pair squaring shears, 1 pair rotary shears, 1 pair bench shears, 1 pair hand shears or snips, 1 pair 24-inch rolls, 1 anvil (weight 50 pounds), 1 forging hammer, 1 tinner's hammer, 1 set punches for making stovepipe, 1 rivet set, 1 grooving set, 2 iron slabs grooved on one side to mold strips of solder, 1 iron clamp to hold bodies of cans while soldering the seams, 1 triangular piece of cast iron about three-eighths of an inch in thickness and 6 inches in length, with a wooden handle attached to the apex, also used for holding can bodies in place while being seamed.

The process of canning was as follows: The bodies of the cans were first cut to proper size by the squaring shears, a line was then scribed with a gauge about three-sixteenths of an inch from one edge, and they were next formed into cylindrical shape by the rolls. They were then taken to the soldering bench and one edge lapped by the other until the edge met the line that had been scribed and fastened there by being soldered a small part of the length to hold them in place for the further purpose of seaming. They were then placed either in the iron clamp, which had a piece of wood attached to its underside, and held firmly, the clamp being closed by the operation of a treadle, or were slipped on a piece of wood, which was bolted to the bench, while being held in place by the triangular hand seamer, which was pressed down on the lap of the seam by the left hand of the operator. When this had been done a piece of solder, which had been prepared by shaking in a can together with rosin, was placed on the seam and melted and rubbed lengthwise of the seam. After cooling the bodies were ready for the end or bottom, which operation was brought about by first cutting out circular blanks with the rotary shears, and then placing them in the cast-iron die and bringing the handle of the screw press around with a swing with force enough to form up the end or bottom. In this operation there were many difficulties, as the ends or bottoms would many times stick to the upper part of the die and refuse to come off, and finger nails were pretty short in those days. To get the ends out of the lower part of the die was not so bad, as a wooden plunger operated by a treadle knocked them out, but sometimes they were in pretty bad shape. When the bottoms or ends were ready they were slipped on the bodies and the edge of the bottom rolled about in a pan of powdered rosin until the seam was well dusted. A piece of solder similar in size and preparation as used for the side seam was placed in the can. They were then placed on the smooth side of the cast-iron slabs, and the operator, with a hot soldering copper shaped to fit the circle of the can, melted the solder and by turning the can rapidly soldered the full circumference. The output of this can factory was very imperfect, as at least one-half of the seams burst, owing to the lack of experience of the manager or want of good judgment.

When the can making was well underway Mr. Hapgood then turned his attention to getting the apparatus for canning on board the house-boat. This in the cooking department consisted of a kettle made of boiler iron about 36 inches in diameter and 5 feet in depth, set in a brick furnace and fired from underneath. Alongside was a round-bottom, cast-iron pot holding about 60 gallons of water and heated in the same manner. These kettles, with a dozen coolers or circular sheet-iron pans with ropes attached and with holes cut in the bottoms for drainage, a set of 5-inch blocks and tackle, with a sheet-iron fire pot and a scratch awl, completed the bathroom outfit. The can filling and soldering room was furnished with a table through the center, where cutting the salmon in pieces to suit and the filling of the cans was done. On each side of the room there was a bench running the full length, on the end of one of which the cans were placed to receive the pickle, which was used at that time instead of the small quantity of salt that is placed in the cans during the operations of these later days.

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[a] The First Salmon Cannery. By R. D. Hume. Pacific Fisherman, Vol. II, No. 1, January, 1904, pp. 19–21.

FIG. 26.—SALMON CANNERY AT HOONAH, ALASKA.

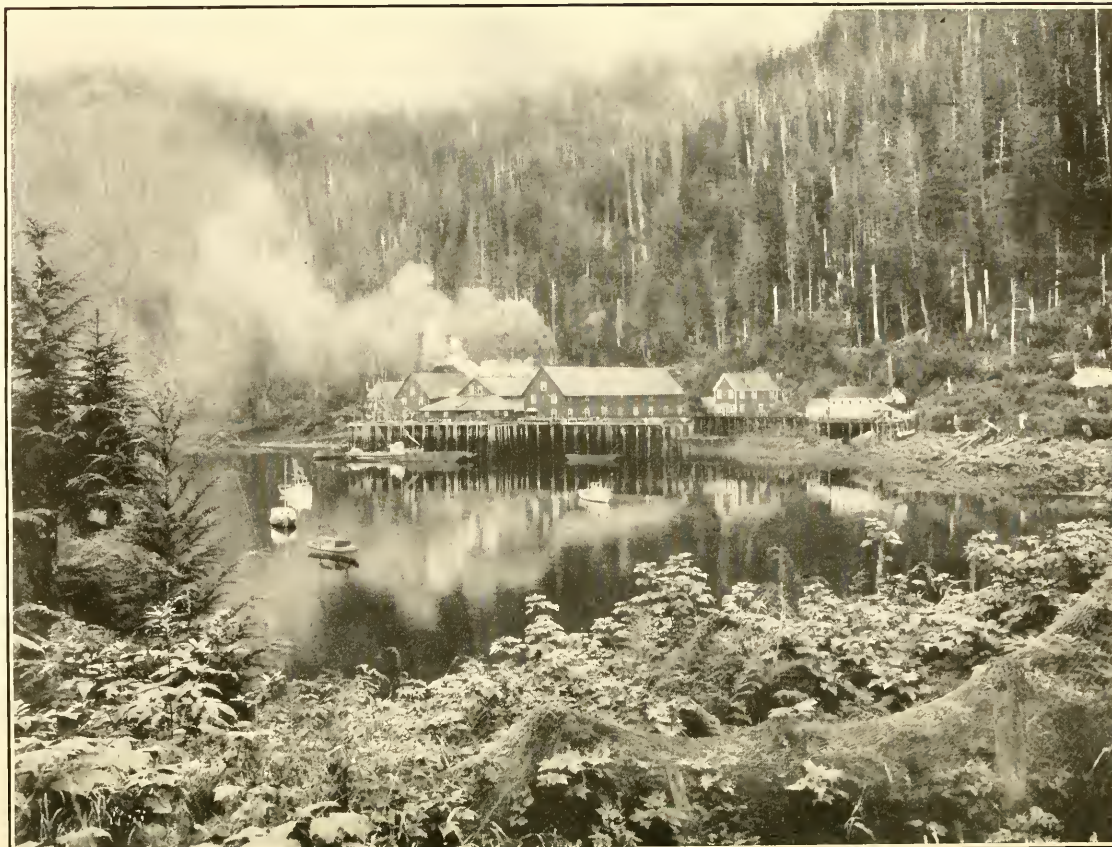

FIG. 27.—SALMON CANNERY AT SANTA ANA, ALASKA.

After the salmon had been cleaned by removing the entrails and washing them outside the covered portion of the scow, they were brought inside and placed on the table, and a man with a butcher knife in one hand and a stick in the other, which had a mark showing the length of the pieces desired, cut gashes in the side of the salmon as a guide and then cut the fish into sections corresponding to the length of the mark on the stick. He then proceeded to cut the sections in pieces to suit the cans. Then three or four operators placed the salmons in the cans and shoved them along the table to where a boy wiped the top edge and passed them along to two others who placed tops which fitted inside of the rim. The cans were then taken in wooden trays to the bench opposite the starting point, which was fitted with four sheet-iron pots, and at the one nearest the entrance to the house on the scow a man put a soldering flux on the top edge, which was made by adding zinc to muriatic acid, and then with a pointed soldering copper and a stick of solder melted the solder until a small portion could be drawn around the groove formed by the edge of the can and the bevel of the top. From there the cans were taken to the other parts of the bench, where two men finished soldering the head in, and then taken to the third man, who soldered, or, as it was called, buttoned, the end of the seam lap. The cooking department or bathroom, as it was called, was separated from the filling and soldering room by a partition. The cans were shoved through a hole in the partition.

At this time the process was a secret. Mr. Hapgood did the cooking and all the work done inside, no one but a member of the firm being allowed to go in. This privacy was continued until the firm moved to the Columbia River, and, the labor becoming too arduous for Mr. Hapgood to perform alone, a boy by the name of Charlie Taylor was taken in as an assistant. * * *

But to return to the original proposition: When the filled cans had been soldered and entered the bathroom they were put in the coolers and lowered into the cast-iron pot, one cooler of cans being cooked at a time. The cooler was lowered into the boiling fresh water until the cans were submerged to within 1 inch of the top ends and left to cook for one hour; then they were hoisted out and the vent holes in the center of the top soldered up, after which they were dumped into the boiler-iron kettle, which held a solution of salt and water of density sufficient to produce, when boiling, a heat of 228° to 230° F. They were cooked in this solution for one hour and then taken out of the kettle with an iron scoop shaped like a dip net, with a wooden handle about 6 feet in length. They were dumped into a tank of water on the other side of the partition which separated the bathroom from the packing room through an opening in the partition, receiving many a bump and bruise in the operation. Then they were washed with soap and rag to remove the dirt and grease, each can being handled separately. When this was done they were piled on the floor of the packing room and in a few days were painted with a mixture of red lead, turpentine, and linseed oil, for at that time buyers would have no canned salmon, no matter how good the quality, unless the cans were painted red.

When packs of 10,000 to 15,000 cases were made in a season only the absolutely essential machinery was used, the rest of the work, such as cutting and cleaning the fish and placing them in the cans, being done by hand. When larger canneries were constructed, especially in Alaska, where labor is expensive and difficult to obtain, the greater part of the workmen having to be brought up from the States, machinery to do as much as possible of the work became absolutely essential. The inventive genius of the country came to the rescue and one by one machines for cutting, sliming, and cleaning the fish, filling the cans, putting the tops on, and washing them were invented and put into use, while automatic weighing machines were produced and extensive improvements and alterations were made in the machines previously in use. There are to-day many large manufacturing establishments which devote all or the greater part of their facilities to furnishing machinery and supplies to this giant branch of the salmon industry.

When salmon canning was in its infancy, a pack of from 150 to 200 cases was considered a good day's work. Now it is not an uncommon occurrence for a cannery to turn out from 2,500 to 4,000 cases in one day, and there are a number which have even greater capacity.

The usual method of figuring the capacity of a salmon cannery is by the number of lines or units employed. The machinery arranged so that the fish pass through all the operations from filling to double seaming is known as a line, and the capacity is based upon the number of these lines in use in the plant.

During the height of the salmon run, a cannery is an exceedingly busy and interesting place, and a description of the methods used at the present time will show the giant strides the industry has made since the days of Hapgood, Hume & Co.

HANDLING THE SALMON.

At convenient spots near the fishing grounds large scows and lighters are anchored and the fishing crews deliver their catches aboard these, the tallyman on each scow keeping a record and giving the crew a receipt. Men fishing near the cannery deliver their catch alongside. Steamers and launches are used to tow out empty scows and bring in those filled. In the old days the fish were pitched by hand into bins on the wharves, but this laborious method has been superseded by the use of an elevator, which extends from a short distance above the top of the wharf to the water's edge, provision being made for raising or lowering the lower end according to the stage of the tide. This elevator is slanting, and is made of an endless chain operating in a shallow trough. About every 2 feet there is attached to the chain a crosspiece of wood. At the top of the elevator are chutes which deliver the fish at various convenient spots on the cutting-room floor.

A recent invention, which is rapidly coming into use, is the unloading scow. This is a scow divided by kid boards into compartments. On the side is an opening which, when not in use, is closed by planks dropped into grooves. The filled scow is run alongside an elevator with a flaring mouth box at the lower end. A chute is placed between the scow, opposite the door, and the elevator, the door opened, and the fish allowed to slide by gravity into the box, then up the elevator to the fish floor. As one compartment is emptied another is attacked by removing the partition boards, and so on until the scow is empty. Should the fish stick, a hose with running water is run a foot or more down into the pile, which loosens the fish and causes them to move freely. By the use of these scows the fish are unloaded in a very short time, with but little labor, and are not marked by pew holes, as under the old method.

If the salmon have been in the scows for from 20 to 24 hours they are used as soon as possible after being delivered at the cannery; otherwise that length of time is usually allowed to elapse, the cannerymen claiming that if not allowed to shrink the fish will be in such condition that when packed much juice will be formed, and light-weight cans will be produced. The danger of canning fish that are too fresh, however, is of minor importance as compared with the tendency in the other direction.

Before dressing the fish a stream of water is kept playing over them in order to remove the dirt and slime, after which men with pews separate the different species into piles.

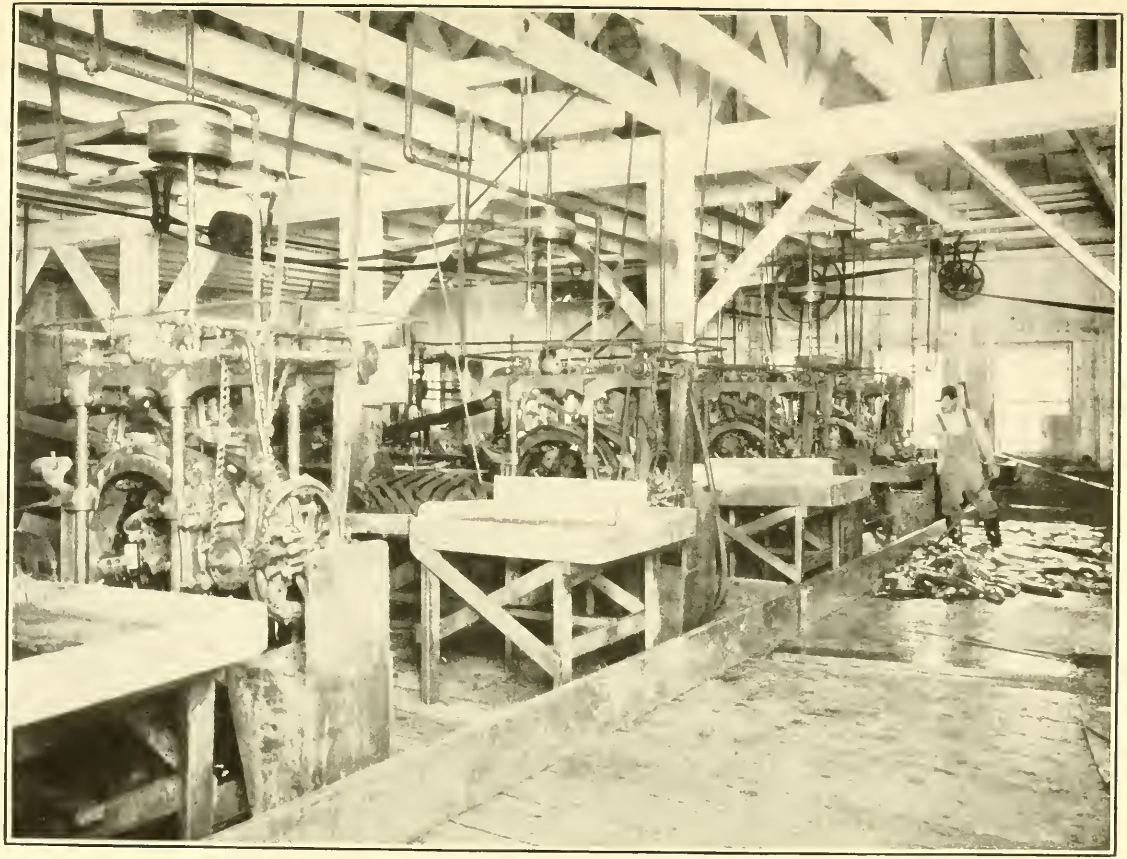

FIG. 28.—A BATTERY OF "IRON CHINKS."

FIG. 29.—CUTTING SALMON INTO PIECES OF A SIZE TO FIT THE CAN.

DRESSING.

A number of the small canneries still use the old hand method of dressing the fish, and in such places the selection of the butchering or dressing gangs is of prime importance. Two men constitute a "butcher's gang," and the number of these gangs is dependent upon the output of the plant. Boys place the fish, with the head out, upon the cutting tables. One man cuts off the heads, and is followed by another who removes the fins, tails, and viscera. The offal is thrown into a chute, whence it passes into the water under the cannery or into a scow moored underneath, while the dressed fish is transferred to a tank of water, to be scaled, washed, and scraped. It is then passed to another tank of water, where it receives a second washing, scraping, and final brushing with a whisklike broom, which removes any offal, blood, and scales that were overlooked in the first washing, after which it is removed to large bins on either side of the cutting machine.

The most useful cannery inventions in recent years have been of machines for doing the work of the dressing gangs. The one commonly known as the "Iron Chink," now in general use in canneries where such machines are employed, was first used in 1903 at Fairhaven (now Bellingham), Wash. It removes the head, tail, and fins and opens and thoroughly cleans the fish ready to cut into pieces for the cans. By the use of these machines the dressing gang is almost entirely done away with, dispensing with 15 to 20 men. This same machine is now so arranged that the fish after dressing are also "slimed;" i. e., the thick mucus covering the skin removed, and the inside of the fish cleaned.

CUTTING.

The usual method of cutting the salmon is by a machine. This is generally a large wooden cylindrical carrier, elliptical in shape, thus having a larger carrying capacity. Ledges or rests on the outside the length of the carrier are wide enough to hold the fish, and are slit in cross section through the ledges and outer casing to receive the gang knives. The latter are circular, fixed on an axle at the proper distances apart, and revolve at the highest point reached by the carrier and independently of the latter. The carrier and gang knives are set in motion, each revolving on its own shaft. As a rest on the carrier comes to a horizontal position, men stationed at the fish bins lay a fish on each ledge as it passes. Thence it is conveyed to the revolving gang knives and, after being divided, passes through on the downward course, sliding off the rest into the filling chute. The knives in these machines are so arranged as to cut the fish transversely in sections the exact length of the cans to be filled.

The rotary cutter shunts the tail pieces to one side, and these are carried by means of a chute to baskets. The tail pieces are generally canned separately. As the tail portion is much smaller, with less meat, it can not be placed in the cans with the middle and head sections without detracting from their value, but if packed under a distinct and separate label, as is now done, there is no reason why the tails should not supply the demand for a cheap grade of fish.

In some of the smaller canneries, especially in those packing flat cans, the gang knives are worked by hand. In this case, the knives are not circular, but elongated or semicircular in shape, tapering at the outer ends. They are mounted on an axle having a large iron lever at one end, and when this lever is raised the ends of the gang knives are thrown up and back. The fish is then placed in position under them and the lever pulled forward, the knives, with a scimitar-like movement, dividing the fish.

The original method of cutting was by means of a long knife wielded by a Chinaman who stood at a regular butcher's block. Although his strokes were incredibly quick, the rotary cutting machine is a vast improvement over the old way.

SALTING.

Every can of salmon is seasoned with one-fourth of an ounce of salt, which, to insure uniformity, is added by mechanical means. A table is used, in the top of which are holes equal distances apart. On the underside of the top is a sheet-iron plate, with an equal number of holes, which slides in a groove at the sides, and is worked either by a hand or foot lever. Just below is an open space large enough to accommodate a tray holding 36 or 48 cans. A workman stands in front of the table and slides a tray of cans into the open space. He then throws a quantity of salt upon the table and immediately scrapes this off with a thin piece of wood, each hole being filled in the operation, and the salt being prevented from falling through by the iron plate underneath. The lever is then pressed, the iron plate moves forward until the holes in it are directly under the holes in the table top, when the salt drops through into the cans. This operation can be repeated four or five times in a minute. Most canneries now use a small salter attached to the filling machine and this deposits the required amount in the can as it is passing by on its way to be filled.

FILLING THE CANS.

Most canneries now use filling machines for all sizes of cans, although a few, more particularly those packing flat and odd-sized cans, still fill by hand.

The filling machine consists of a chute with a belt to which are attached wire racks about 4 inches apart, set at an angle to prevent the salt from spilling out, into which the salted cans are fed from the floor above and pass into the machine. At the same time the divided sections of salmon pass down another chute into the mouth of what looks like a hand coffee mill. They pass through here down a smaller chute and are forced by two dogs into a receptacle through which the plunger, or filler, passes. Here the plunger comes opposite the open mouth of the empty can, which when it reaches this point is caught by a clasp or hook and held in front of the plunger, which is immediately thrust forward through a chamber filled with salmon, cutting the fish longitudinally and at the same time filling the can. The next movement forces the can out upon a table. When running at full speed, one of these machines will fill about 80 cans a minute.

On being released by the clamp and rolling upon the table they are righted by a workman and pushed onto an endless belt, upon which they pass into the weighing machine. If of the proper weight, they pass through this machine, but if below the required weight the cans are shunted to one side, where workers add the quantity of fish needed, a supply of small bits being kept at hand for this purpose. Generally the cans overrun in weight, frequently as much as 2 or 3 ounces. Occasionally a can is weighed on a small balance scales in order to see that the machine is in perfect adjustment.

After passing the weighing machine any bones and scraps of flesh which may be sticking up out of the can are clipped away by workers armed with scissors.

In the hand method the fillers stand on each side of a long table with a trough running down the middle from end to end. This is filled with the cut pieces of salmon, and the fillers, usually women and children, put large pieces into the cans at first and then smaller pieces to occupy the vacant spaces.

From the weighing machine the cans pass to the clinching machine, which attaches the top of the can loosely to the body in such a way that it allows the air in the can to escape, yet prevents the fish from coming in direct contact with the steam of the exhaust box. Also the water resulting from the condensation of steam, which accumulates in the exhaust box, is kept from entering the can and thus bleaching the flesh.

In many plants the cans are washed by jets of water or steam directed against them in a closed box as they are passing from the clincher to the exhaust box.

The cans then pass into a steam exhauster, consisting in one type of a box about 30 feet in length, in which are three endless-chain belts running side by side. Under and over each belt are steam coils, and under each of the lower coils are single pipes, which through small holes throw jets of live steam upon the coils, creating an intense heat. The cans pass along the first belt, are then transferred to the second belt, on which they return to the entrance of the box, whence they pass to the third belt, and continuing along this to the end pass out to the double seamer, the whole operation occupying from 5 to 15 minutes, preferably 15. One style of exhauster has 10 ovals formed by the pipe, and the cans pass along these from side to side of the exhauster until discharged at the far end. Another type is formed of a long tube through which the cans pass and are heated by perforated steam pipes. Upright exhausters, in which the cans travel along a spiral, are also in use. By this means the contents of the can are heated and the greater part of the air exhausted, which is the object of the first cooking in the retort under the method formerly in general use. In Alaska, where 1-pound tall cans form the bulk of the pack, the cans are exhausted at a temperature from 206° to 212° F., 210° being the favorite.

A recent invention, which the inventor claims will do away with the steam exhaust box, and thus save a large amount of valuable floor space in the canning "line," is the power vacuum pump, known as vacuum exhausting machine, by means of which air is exhausted from the cans, accomplishing the same purpose as the steam exhaust box. Some of these machines have been in active use for several seasons, with most satisfactory results.

Leaving the exhauster the cans pass to the double seamer, which fastens the cover on tightly with a double seam or crimp. It should be stated that no solder is used in attaching the top on the can, the curled flanges of the cover being coated around the outer edge with cement or other sealing fluid to take its place. Solder, however, is used in joining the side seam of the can, this being done when the can is manufactured. The cans then leave the machine on an endless conveyer, pass through a machine which washes the outside of the cans, and thence to the men who transfer them to the coolers, which are immediately placed upon the trucks and run into the retort for the one cooking they are to receive. By the use of these cans the soldering machine used in the old-style method is done away with. It also does away with the first cooking and the subsequent venting and soldering, a saving both in labor and time consumed.

COOKING.

The processing time varies in each district and sometimes for each species. In Alaska 1-pound tall reds, cohos, chums, and pinks are generally cooked from 90 to 120 minutes, at 12 to 18 pounds pressure and at a temperature of 242° to 248° F. One-pound flats and half-pound cans are generally cooked about 10 minutes less time. Owing to their larger bones, king salmon are generally cooked from 10 to 20 minutes longer than the other species; steelhead trout also.

On Puget Sound 1-pound tall sockeyes, cohos, and pinks are generally cooked for 90 minutes at a pressure of 10 pounds and at a temperature of 240° F. Halves and 1-pound flats are generally cooked at the same temperature but for only 80 minutes. Chum talls are generally cooked for 105 minutes at a pressure of 10 pounds and at a temperature of 240°; while spring or king salmon are cooked for 120 minutes at a pressure of 10 pounds and at a temperature of 240°.

It is the custom at all canneries, no matter what the system, to allow about 5 minutes at the beginning of the cooking to work up the required heat of the retort, and when cooking is completed there is a like period for reducing the temperature and pressure before opening the doors. The cooking times given above are exclusive of the two 5-minute periods noted here.

It should be distinctly understood that the processing times noted are only approximate. The condition of the fish, the weather—whether hot or cold, rainy or dry—etc., all must be taken into account. The canner can not go far astray, however, if he keeps generally within the narrow margins noted above. In the early days much secrecy and mystery was thrown about the cooking, and the work was carried on in a separate room, known as the "bathroom," under lock and key. The first cooking was done in common tubs. The early retorts were made of wood. Later, round iron kettles were substituted, nearly one-half consisting of cover, and round crates were used for holding the cans. At the present time only rectangular horizontal iron or steel retorts are used, and access to these is had by means of miniature railroad tracks.

For many years cannery men believed that the double cooking of salmon was absolutely necessary, but in 1898 F. A. Seufert, at his cannery on the Columbia River, at Seuferts, Oreg., a short distance above The Dalles, discarded this idea, and has since used a one-cooking method. By the new process the cans are tested for leaks after the center hole in the top is soldered up, as before, and are left in the retort 70 minutes at 245° F. and 12 pounds steam pressure. According to its originator, this method saves more than one-half the labor in the bathroom, saves nearly one-half the labor in washing the cans after cooking, and also better retains the color of the fish.

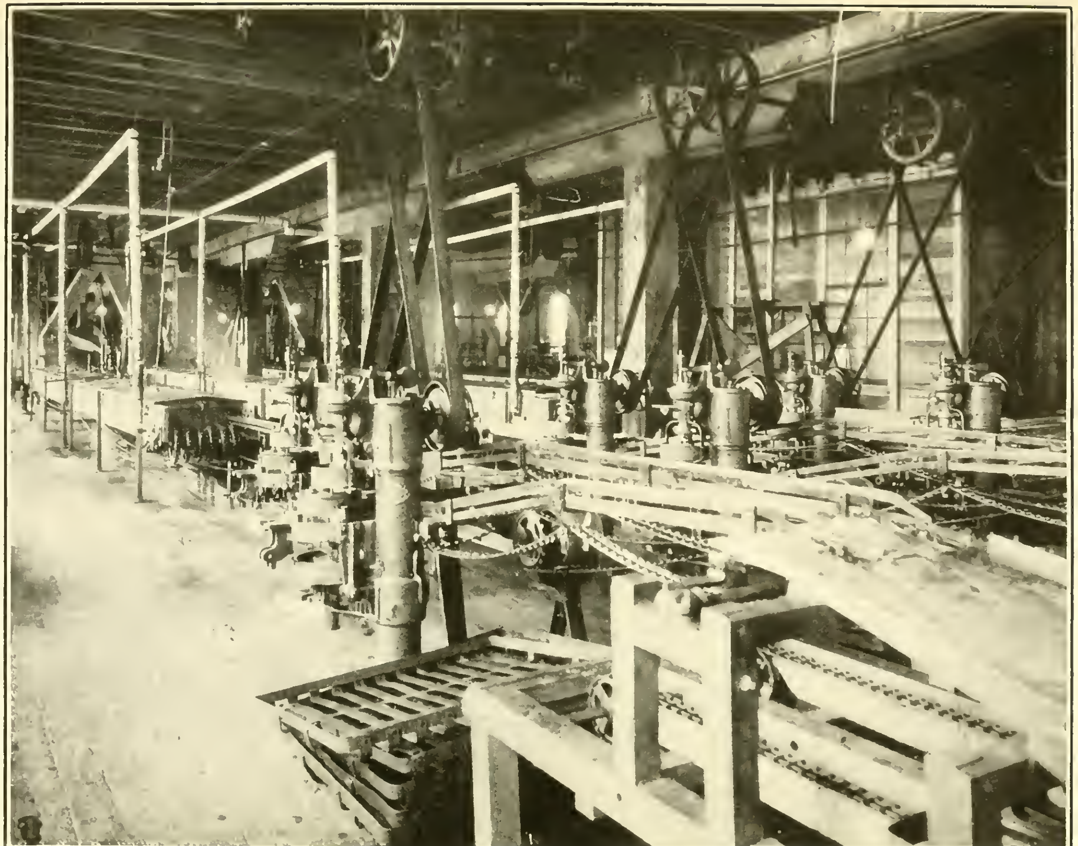

FIG. 30.—EXHAUST BOXES AND THE DOUBLE SEAMERS.

FIG. 31.—COOKING THE SALMON IN RETORTS.

REPAIRING CANS.

Imperfect cans which are discovered after cooking and are repaired at once and whose contents are recooked are still very good, the only difficulty being that by blowing or venting them a second time they lose weight. The above goods usually go in with the regular pack of their kind and are not classed as regular "do-overs." The latter were generally defective cans, which, owing to pressure of other work, could not be repaired until considerable time had elapsed, by which time decomposition had set in. The cans which can not be repaired immediately are now thrown onto the cannery dump.

On coming from the retort the coolers are lowered into a bath of lye, or, as in some canneries, the cans are run through such a bath on an endless belt, which, with the aid of a slight rinsing and a few rubs with a brush over the top, removes from the can all the grease and other material. The belt then passes them into another bath where the lye is washed off in hot fresh water. The cans then go to the cooling room, where a stream of water is played upon them, or during rainy weather are placed out of doors upon the wharf, and there allowed to cool, in order to stop the heat inside the can from continuing to cook the fish. In some canneries the lye bath before cooling is dispensed with, as the earlier washings are supposed to have cleaned the cans.

The top and bottom of the cans contract in cooling, and for several hours a sharp popping noise is heard. Here, as in nearly every process through which they pass, the cans are again tested, this time by tapping the tops with a small piece of iron about 6 inches long, or, sometimes, a 12-penny nail. The sound conveys to the ear of the tester an unmistakable meaning as to the condition of the can, and the faulty cans that escape notice during the other tests are almost invariably found in this one.

LACQUERING.

A common custom in the salmon-canning industry, but one that is not common in the canning of vegetables, fruits, etc., is that of lacquering the cans. This idea of protecting the can on the outside has been followed from the very beginning, for two reasons: (1) That the English market which, at that time especially, absorbed the greater part of these goods insisted on their shipments being finished in this way, and (2) from the fact, as these canners speedily found out, that if they did not protect their cans in some way enormous losses through rust would ensue.

The first experiment of this nature was to paint the cans by hand with red paint, treating each singly. Next a composition of logwood extract and alcohol was tried, which, however, did not produce satisfactory results for a very plain reason—the can was dyed instead of being lacquered. The next attempt was to varnish the cans with a japan varnish reduced with alcohol, but this was found to dry too slowly for speedy handling. After extended experimentation the quick-drying brown lacquer of the present time was evolved, which carries asphaltum in the form of an asphalt varnish as its base, this being supplanted in some cases by gilsonite. This lacquer can be procured in either a heavy or light body, is generally reduced with benzene or gasoline, and is applied according to the requirements of the market, which in some localities demands a heavy coating and in others a much lighter finish, the latter giving a rich golden brown color. Some experiments have also been made in using brighter colored lacquers for this work. Several of these, made to give a bright golden, copper, or other color, are extremely attractive in appearance, while at the same time protecting the tin against rust quite as well as the brown.

The industry soon outgrew the hand method of lacquering, and the process which for a number of years was universal in the trade and is still used by some canneries succeeded it. For this there are a number of rectangular box vats about 40 by 80 inches and 18 inches in depth, the number varying with the capacity of the cannery. These are usually lined with galvanized metal and provided with a gridiron-shaped iron frame, hung from a windlass or other tackle for lifting or lowering from top to bottom of the vat. The cans are loaded on this gridiron, being placed in an inclined position to allow the draining of the lacquer, and are lowered in the vat sufficiently to submerge them in the lacquer with which the vat is charged to a depth of 7 to 10 inches. The loaded gridiron is then raised to the top of the vat and the cans allowed to drain and dry before piling. This method, while being more effective in regard to the volume of work, was still of necessity a very slow and tedious operation. In damp or rainy weather, especially when it is not possible to open warehouse doors and windows, the gas arising from a number of these vats makes effective drying almost impossible.

Another principal objection to this method of lacquering, which applied also to all earlier attempts, was the impossibility of obtaining an even coat of lacquer when the can was allowed to dry in any stationary position. There was also a large waste by evaporation.

Notwithstanding repeated efforts at invention, however, it was not until 1901 that an effective machine for handling this difficult work was put on the market. The apparatus now in use by a number of canneries receives the cans on a revolving wheel fitted with rests for holding them while passing through the lacquer bath. From here they roll upon an endless chain which revolves the cans as they pass through a long box in which a hot blast dries them before they reach the end of the machine. The rotating or rolling motion given to the can after the lacquer bath, preventing the lacquer from draining to and consequently accumulating on any part of its surface, also has the effect of distributing the lacquer evenly and results in a clean and neatly finished can. The air blast facilitates the work of drying to such an extent that it requires only about two minutes after being deposited on the drying bed of the machine for the cans to be ready for handling, while the quantity of cans which can be handled in a day is vastly greater than by the old method.

A few flat and oval cans are not lacquered, but are protected from rust by wrapping in tissue paper, over which the label is placed.

Several of the largest operators have stopped lacquering the sides of the cans, depending upon the label to protect this portion from rust. Enameled ends are used, and, as these are bought from can makers, these operators are thus enabled to get away entirely from the dangers of lacquering.

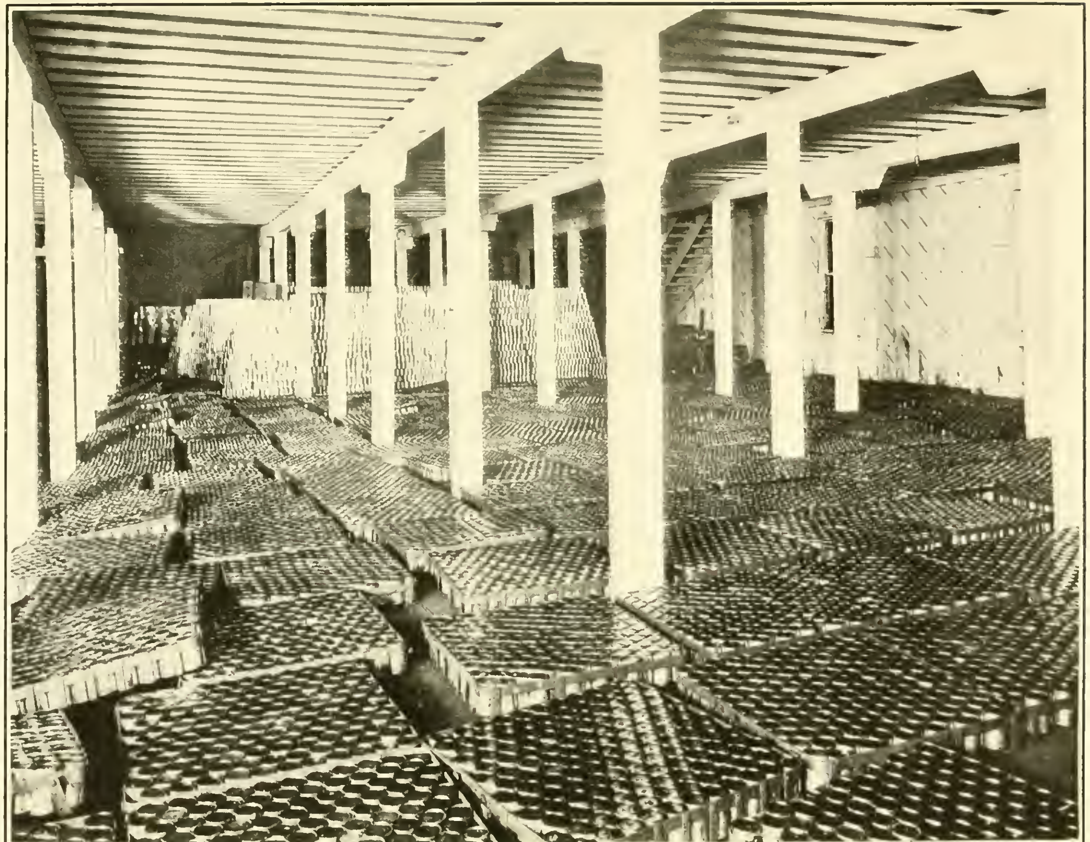

FIG. 32.—COOKED SALMON CANS COOLING.

FIG. 33.—SALMON ON THE FLOOR OF THE FISH HOUSE.

FIG. 34.—SALMON CAN-LABELING MACHINE.

LABELING.

While machines have been made for this purpose, and some of them are in use, the work is usually done by hand. A number of men or women seat themselves about 4 feet apart in front of the pile of cans. Each man has in front of him a package of several hundred labels, and by bunching them on a slant so that successive margins protrude beyond each preceding, he can apply paste to the entire number with one stroke of the brush. A can is placed on the label, is quickly rolled, and the label is on much quicker than one can tell it. Each man places to his right the cans he labels, forming a pile of length and width equal to his unlabeled pile, and when the entire lot has been labeled it has been shifted only about 4 feet. Cans of fancy brands of salmon put up on the Columbia River and in the Puget Sound region are wrapped in colored tissue paper before the label is put on. Cartons similar to those used by the sardine packers would make good containers for fancy brands and would be much cheaper than the present method.

Some of the canners now have their labels lithographed directly on the tin, and the whole covered with a transparent la quer.

Several attempts have been made to popularize salmon packed in glass and porcelain jars, and while these have met with some favor, it was not sufficient to warrant a continuance of the practice for any length of time. But few are being so packed at the present time.

BRANDS.

A very important feature of the canning industry is the selection of appropriate brands or labels for the various grades of salmon. Each company has a number of these, which it has acquired either by designing them or by absorbing another company which owned them. A well-known brand has a value in itself and sometimes is a very important asset. A company will sometimes market a considerable part of its product in one section, and here, where the consumer has become familiar with the brand and pleased with the contents of the can, he will ask for and accept no other, despite the fact that the latter might be, and probably is, the equal of the product he has been using.

For many years but few salmon canners appreciated the value of a can label, and it has taken some bitter experiences to drive home to the rest that a properly designed label placed upon good goods and the owner protected in its use by the law has real value, just as much as boats, nets, buildings, machinery, or the thousand and one material things required to carry on the business.

A free trade definition of a label would be that it is an artistic representation or intellectual production, stamped directly upon an article of manufacture, or upon a slip or piece of paper or other material, to be attached in any manner to manufactured articles, to bottles, boxes, and packages containing them, to indicate the contents of the package, the name of the manufacturer, or the place of manufacture, the quality and quantity of the goods, directions for use, etc.

Labels are subject to the copyright law and should be registered before use or publication. If not registered, there is no protection in law against infringement. The continued use of a label, however, will give the person so using a certain proprietary right in it, which can be enforced in a court of equity and may be defended by injunctions, which will generally be granted. Such proceedings are expensive, annoying to a busy man, and at best will protect one only after at least a certain amount of damage has been done, and it is far safer to avoid this by registering the label at the time of issue, which will give one the further advantage in that a description of the character and quality of the article labeled can be set forth, which will, to a certain extent at least, be protected with the label.

The commercial value of a label and name is represented by the more or less general demand for the goods protected by it. In the canned-salmon industry, as in that of other food-packing industries, certain labels, through the good quality of the goods marketed under them and the publicity created for them, have become of very considerable value to the owners. A case in point is the label Royal Crown, owned by the late R. D. Hume. This was one of the earliest brands marketed in England, and some years later a certain Liverpool firm of salmon handlers paid Mr. Hume the sum of $10,000 for the exclusive right to its use in England.

In designing a label there are several things which should be borne in mind. It should bear an easily remembered name and design; a name difficult of pronunciation should be avoided at all costs. For many years glaring red labels have been popular, but the success met with by those using more subdued and artistic designs and coloring indicates that the public appreciate them more than they do the older and coarser types The design should be as simple as possible, as experience has demonstrated that a simple form—so s mple that it can be fully understood by a mere glance—will gain by regular repetition, while a more complicated design will lose in this process.

A good many now in the business still remember the small label that was used on salmon cans before 1870. Labels about 3 by 5 inches in size, printed in one color, on white or colored newspaper, served merely the purpose of distinguishing cans, telling contents and manufacturer, and were without commercial value. About the year 1870 a few canners commenced to import from the East and Europe full-sized labels, i. e., labels that went all around the can. These were called by some "Pennington" labels, as a firm of that name supplied quite a number of them.

For some years they were used for the best grades only. They were printed in four and five colors, the design showing invariably a number of panels of different shapes and sizes. The lettering was not always plain and sometimes even intentionally irregular and puzzling. The colors were placed side by side, in boldest contrast, without any attempt to harmonize them.

It was soon discovered that the highly colored panels, while striking, lost all effect when massed on the retailer's shelves, and the different brands looked so much alike that the individual designs could not well be remembered by the customer, the only really distinctive feature being the name, and that was generally printed so small and indistinct that it could not be readily seen at a distance.

To remedy these defects, the designers soon reduced the number of panels and subdivisions, increasing meanwhile the size of the remaining ones and filling them with distinctive designs, still colored as simply as before, with no attempt at blending of colors. The back-ground, at first perfectly plain, commenced to show patterns more or less complicated, and at times quite pretentious, so as to take away from the design proper.

Gradually the panel design disappeared. In place of it some showed one continuous picture on the label, which was very unsatisfactory and soon disappeared, as only a fraction of the picture could be seen at one time. Others had two subdivisions, one showing the name of the brand with its illustrations, occasionally used as a trade-mark, the other showing the article packed in the can, both named and illustrated. Unfortunately, these subdivisions were so large that the roundness of the can prevented one from seeing the picture as a whole, but this was soon remedied by making the subdivisions narrower and filling in between with directions, weight of contents, etc.

From this point on the general plan of labels underwent few changes except that the work, both of the artist and pressman, improved wonderfully, some of the labels now designed and printed being real works of art.

Up to a few years ago one of the most serious evils in the trade was the use of misleading and lying brands. The high-grade product would almost invariably be correctly and fully branded, but "chums" and "pinks" were usually branded as "Fresh salmon," "Ch ice salmon," etc., which would deceive all persons but those well acquainted with the industry. "Do-overs," and very poor fish, were usually marketed under a brand which bore the name of a fictitious company or of no company at all.

The passage of State laws of varying degrees of efficiency governing the branding of salmon helped slightly to remedy this condition of affairs, but it was not until the pure food and drugs act, approved June 30, 1906, was put into force by the Government that any radical improvement was noticeable. At the present time but few misleading brands are in use.

BOXING OR CASING.

A case of salmon generally contains 48 one-pound cans or their equivalent, i. e., 24 two-pound cans or 96 half-pound cans. Some canneries pack their half-pound cans in cases of 48. These cases are usually made of wood and cost from 9 to 11 cents each knocked down.

CAN MAKING.

Some of the canneries in the coast States and Alaska purchase their cans ready-made, but the usual method is to purchase the sheet tin and make up the cans in the canneries. This is especially necessary in Alaska, as it would be impossible to find room on the cannery ships for such a bulk as they would make in addition to the other supplies necessary. Furthermore, the making of cans provides work for a large part of the crew, otherwise unemployed while the rest are getting ready the other necessary paraphernalia. The work is done by machinery and occupies several weeks' time.

Of recent years the objection to the great amount of space occupied by the cans when shipped by freight has been overcome by making the body of the can, pressing it flat, and shipping it in this compact shape along with the ends. At the cannery is a machine for rimming the flattened body into a round shape once more, when the end can be put on with the regular double seamer.

CANNING SMOKED SALMON.

A number of ventures in the line of canning smoked salmon have been made on this coast, but most of the pioneers were not content or able to invest the amount of capital needed and wait the time required to create a demand for such products, and soon quit.

One of the leading British Columbia packers, H. Bell-Irving & Co., some years ago put up in cans some pink salmon which had been treated to an artificial smoke in a vat, and these are said to have made a favorable impression in Australia. Another canner operating on the Fraser River smoked pink salmon, and then, cutting them to the proper length, packed them dry in half-pound cans.

In 1908 the Columbia Canning Co. put up at its cannery on Chilkoot Inlet, Alaska, some smoked salmon which had been shaved into thin strips like dried beef. These, called "Flaxamo," were packed in oil and were very good, especially in making sandwiches.

In 1915 two companies began in Seattle the smoking, slicing, and canning of coho and king salmon. These were put up in oblong flat cans of various sizes, similar to sardine cans, $2\frac{1}{4}$, $4\frac{1}{2}$, and $7\frac{1}{2}$ ounces, respectively, while for a special trade a $7\frac{1}{2}$-pound can was also packed. These fish were cut quite thin, about 40 to 50 slices to the pound, and were packed in hermetically sealed cans with cottonseed oil. The fish were all hard smoked before slicing and canning.

The same companies are also putting up kippered salmon in cans.

Salmon loaf, made by mixing salmon with flour and various other ingredients, thus producing a paste, is also being canned by several packers.

A straight salmon paste, made solely from the flesh of the salmon, and mixed with oil and spices, is being manufactured by one of the leading packers.

HOME CANNING.

At a number of places along the coast it has become the custom for the thrifty housewives to do a little home canning of salmon for winter use when the fish are abundant and cheap, and they find canning salmon as easy as canning vegetables and fruit. The fish are dressed, skinned, and the backbone removed. It is then cut into transverse strips of a size to fit either a pint or a quart glass jar, whichever is to be used. The jars are then filled with the pieces, salted to taste, the rubber ring put on, after which the can cover is put on loosely so that the steam may escape. Strips of thin wood are placed at the bottom of a kettle or wash boiler and the cans set down on them. Enough cold water is then poured into the kettle to bring it up to within about 2 inches of the top of the cans. The kettle is then put on the stove and, after it comes to a boil, note is made of the time, and the cans are cooked from one and one-half to three hours. There seems to be a great variation in the time of cooking on the part of the operators. Some even cook only one hour, but these generally use a preservaline. About three hours seems to be the best time, as the bones are then quite soft. At the end of the cooking period the tops are tightened, the kettle removed from the stove, and the water and cans allowed to cool in the kettle.

Portable retorts and hand double seamers are now available for household use, and as a result many are using tin cans as containers. A recent improvement on the double seamer permits of the use of a tin container three times, thus materially reducing the heavy expense for cans.

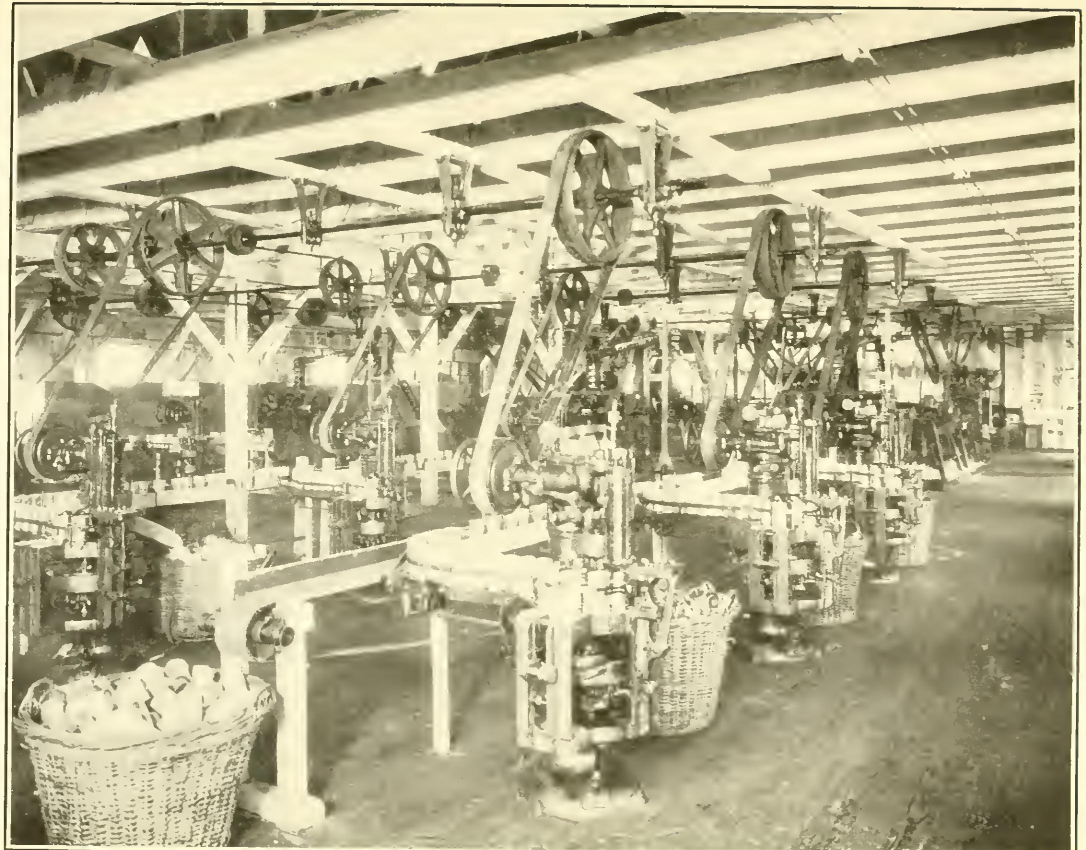

FIG. 35.—MAKING SALMON CANS.

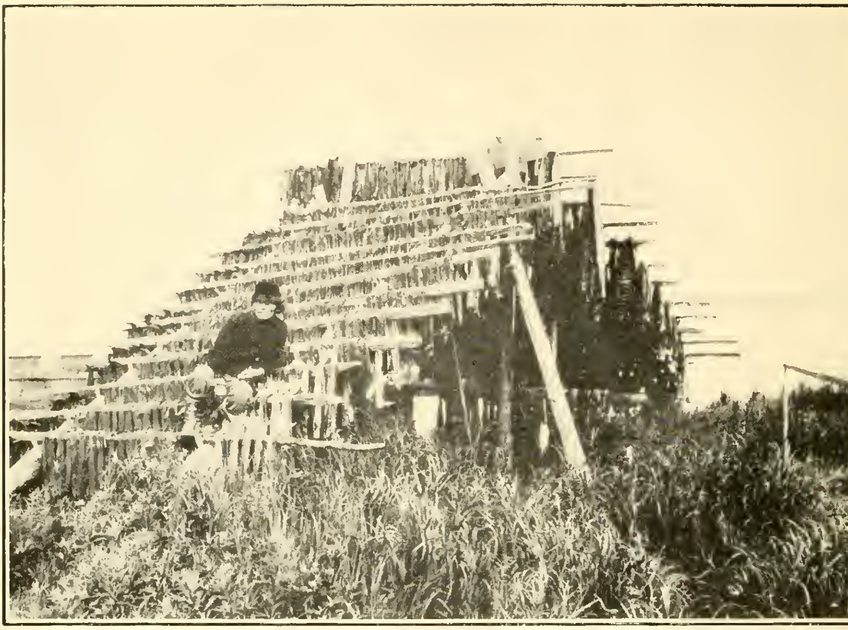

FIG. 36.—AN INDIAN SALMON DRYING RACK, BERING SEA, ALASKA.

FIG. 37.—THE BARONOVICH SALMON SALTERY; THE OLDEST SALTERY IN ALASKA.

INSPECTION OF PLANTS PACKING CANNED SALMON.

For some years there has been a desire on the part of a majority of the salmon canners for some form of inspection of the plants and of the pack made. The widespread suspicion that the salmon pack of 1918 was considerably below standard, which suspicion resulted in heavy monetary loss to the packers, gave a great impetus to this desire. The National Canners' Association, an organization composed of the majority of the canners of the United States, a few years before, at the request of the sardine canners of Maine, organized them into the sardine section of the association, and by an assessment of a small sum per case raised sufficient funds to provide an inspection service to see that the plants were put into and kept in a satisfactory sanitary condition and also to inspect the goods packed and, if they were up to the standards fixed in advance, to affix to the cans suitable certificates attesting this.

At its annual convention in 1919 the association decided to extend a similar service to any other section willing to assess itself to pay the necessary expense. In explanation of its plan the association issued the following circular shortly after the convention had adjourned:

1. This service is installed by the National Canners' Association, with which a direct contract is made by each canner.

2. It runs for a term of three years and is applied in States or local territories where similar conditions are to be met.

3. The cost of the inspection is paid by the canners in the territory named through an assessment which, in the past, has been collected by the can companies with which each canner deals. This cost is added to the can invoice, and is remitted by the can companies to the treasurer of the National Canners' Association each month.

4. In order to meet the preliminary expenses of the inspection before the regular fund becomes available, each canner who signs a contract will pay into the treasury of the National Canners' Association, within 30 days after signing the contract, an assessment of one-half cent per case on his pack of 1918, on the commodities to be inspected. Should the total sum raised during the season be greater than the expenses of inspection during the season, a refund of all or a portion of the one-half cent per case will be made after a small sum is reserved to maintain a consistent surplus.

5. The treasurer of the National Canners' Association distributes this money to the local sections where the money is to be spent.

6. The National Canners' Association has no profit in this inspection—its only requirement being that each canner under inspection is a member of the association, and pays the membership and general dues.

7. A director or supervisor of inspection is appointed by the National Canners' Association who in turn appoints his assistants. The salaries of the director or supervisor and his assistants are fixed by the National Canners' Association which works in harmony with the judgment of the advisory board. The director or supervisor must be a man of superior ability, preferably one with scientific training. He must also be a good executive.

8. The director or supervisor acts in conjunction with the advisory board which may consist of five, seven, or nine members. This advisory board is elected by the canners in the States or Territories covered. The duties of this board are what its name implies, "advisors." In point of actual experience, it is found this advisory board is able to settle all practical disputes and misunderstandings which may arise under this method of inspection. There is always a final appeal to the executive committee of the National Canners' Association.

9. The National Canners' Association does not promise or guarantee to issue certificates of inspection, but in territories where inspection has existed, the certificates have been issued on products which merit the same. It should be distinctly understood, however, that this does not form any part of the contract.

10. The cost in territories where inspection has been applied has been one and one-quarter to two cents per case. It is impossible to advise in advance definitely what the cost will be, as the local conditions differ. It should be borne in mind that there must always be a sufficient number of inspectors to protect the inspection, and

if canners are widely scattered, this, as a matter of course, will increase the number numerically—not in proportion to the pack.

11. The inspection covers sanitation in plants, quarters for employees, and sanitation of the product. It is also proposed, as the work progresses, to apply inspection to the character of the raw product, and grading of the same. This grading on staples will be worked out on recommendation from the advisory board, which will be harmonized so as to give a uniform grade to each product through the entire country.

12. In localities where inspection has been installed, local laboratories purchased and financed by the funds for inspection, have been found most useful. These laboratories furnish prompt facilities for canners for testing their product and working out manufacturing problems which come up during the activities of the canning season. These laboratories are established and work in harmony with the research laboratories of the National Canners' Association, Washington, D. C.

13. This inspection can well be made the basis of a consistent publicity advertising campaign, should the industry adopt it generally, in time to guarantee its working satisfactorily during the canning season of 1919. The present plan, however, does not include this publicity campaign, as this is a matter which must necessarily be passed upon later by the canners themselves.

14. Copy of contract with each canner is herewith inclosed, or information.

On February 17, 1919, the matter of adopting this inspection system was submitted to the salmon canners of the Pacific coast and accepted by a large majority. A chief inspector and a number of assistants were appointed, who carried on a sanitary inspection of the various canneries during the following summer. It is the intention ultimately to extend this inspection to the pack itself.

INVESTIGATION OF CANNED SALMON INDUSTRY.

In 1917 and 1918 an investigation of the canned salmon industry was made by the Federal Trade Commission and many valuable statistical data were gathered and published.[a]

The following table shows, with other data, the average number of fish per case of each grade packed in the different geographical sections.

NUMBER OF FISH CANNED AND PURCHASED, NUMBER OF CASES PACKED, AND AVERAGE NUMBER OF FISH PER CASE.[b]

1916.

District.	Grade of fish.	Number of companies reporting.	Number of fish canned.	Number of fish purchased.	Percentage of fish canned which were purchased.	Number of cases packed.	Average number of fish per case.
West Alaska	Kings	7	111,381	27,175	24.39	26,003	4.28
Central Alaska	do	6	25,483	11,602	45.52	5,854	4.35
Southeast Alaska	do	20	148,286	136,597	92.12	34,344	4.31
Puget Sound	do	15	180,580	80,574	44.62	25,606	7.05
Columbia River	do	9	865,392	842,127	97.31	265,376	3.26
Outside rivers [c]	do	7	60,656	60,143	99.15	18,607	3.25
Totals and averages		64	1.391,778	1,158,218	83.66	375,790	3.73
West Alaska	Reds	8	16,564,413	1,017,042	6.13	1,223,950	13.52
Central Alaska	do	6	1,387,647	547,261	39.43	118,891	11.67
Southeast Alaska	do	29	1,609,978	784,503	48.70	123,767	13.00
Puget Sound	do	17	2,593,240	168,584	6.50	198,205	13.04
Columbia River	do	8	775,382	439,900	56.73	67,334	11.52
Outside rivers [c]	do	1	59,352	59,352	100.00	4,645	12.78
Totals and averages.		69	22,990,012	3,016,642	13.28	1,736,792	13.24

[a] Report of the Federal Trade Commission on Canned Foods. Canned salmon. December, 1918. 83 pp. Washington, 1919.

[b] Report of the Federal Trade Commission: Op. cit., pp. 15, 16.

[c] Coastal streams in Washington, Oregon, and California.

NUMBER OF FISH CANNED AND PURCHASED, NUMBER OF CASES PACKED, AND AVERAGE NUMBER OF FISH PER CASE—Continued.

1916.

District.	Grade of fish.	Number of companies reporting.	Number of fish canned.	Number of fish purchased.	Percentage of fish canned which were purchased.	Number of cases packed.	Average number of fish per case.
West Alaska	Medium reds	4	394,048	46,619	11.83	36,078	10.92
Central Alaska	do	6	305,246	131,998	43.22	37,275	8.19
Southeast Alaska	do	29	1,018,014	505,937	49.67	117,422	8.69
Puget Sound	do	17	1,099,374	677,485	61.62	110,658	9.93
Columbia River	do	10	346,597	310,216	89.50	42,782	8.10
Outside rivers [a]	do	8	349,053	349,348	100.09	34,937	9.99
Totals and averages.		74	3,512,332	2,331,819	66.38	379,152	9.26
West Alaska	Pinks	3	4,153,353	540,248	13.00	214,482	19.36
Central Alaska	do	6	4,102,775	1,821,558	44.39	212,169	19.33
Southeast Alaska	do	27	12,266,379	4,772,128	38.89	879,953	13.93
Puget Sound	do	8	1,800,875	607		70,979	25.37
Totals and averages.		44	22,323,382	7,134,541	31.99	1,377,583	16.19
West Alaska	Chums	7	1,144,595	289,663	25.30	97,528	11.74
Central Alaska	do	6	331,423	160,465	48.41	37,870	8.75
Southeast Alaska	do	28	3,661,176	2,296,478	62.72	344,213	10.63
Puget Sound	do	15	2,981,678	1,887,278	63.29	387,373	7.70
Columbia River	do	8	374,370	358,255	95.69	62,043	6.34
Outside rivers [a]	do	5	110,809	106,973	96.53	16,896	6.56
Totals and averages		69	8,604,051	5,099,112	59.26	945,923	9.10
Columbia River	Steelheads	7	103,774	102,117	98.40	16,991	6.10
Totals and averages.		7	103,774	102,117	98.40	16,991	6.10
1917.							
West Alaska	Kings	8	107,590	18,407	17.10	21,398	5.03
Central Alaska	do	9	34,158	19,872	58.19	6,675	5.11
Southeast Alaska	do	22	283,643	202,693	71.46	45,674	6.21
Puget Sound	do	18	209,360	105,731	50.54	53,485	3.91
Columbia River	do	10	959,846	643,063	6.99	273,291	3.51
Outside rivers [a]	do	9	45,378	43,468	95.75	12,940	2.30
Totals and averages		76	1,639,975	1,033,234	63.00	413,463	3.96
West Alaska	Reds	9	21,449,913	1,192,000	5.56	1,433,780	14.90
Central Alaska	do	9	2,271,989	974,653	42.89	189,921	11.96
Southeast Alaska	do	33	1,964,993	1,074,658	54.95	158,582	12.03
Puget Sound	do	27	4,731,861	1,233,489	26.00	372,467	12.73
Columbia River	do	7	1,213,887	688,637	56.72	98,076	12.36
Outside rivers [a]	do	2	21,868	21,868	100.00	1,769	12.36
Totals and averages.		87	31,654,511	5,185,305	16.40	2,254,595	14.13
West Alaska	Medium reds	3	145,837	18,385	12.60	13,406	10.87
Central Alaska	do	9	238,572	141,424	59.29	30,430	7.84
Southeast Alaska	do	33	1,033,339	419,046	40.55	98,324	10.51
Puget Sound	do	27	813,269	501,857	73.90	91,991	8.84
Columbia River	do	10	728,221	587,879	80.72	47,861	15.11
Outside rivers [a]	do	10	394,779	376,224	95.29	34,417	11.48
Totals and averages.		92	3,349,017	2,044,515	61.05	316,429	10.58
West Alaska	Pinks	2	3,958,391	1,175,748	29.70	219,508	18.03
Central Alaska	do	10	5,221,887	2,172,476	41.62	324,230	16.11
Southeast Alaska	do	33	24,166,834	10,473,748	43.30	1,362,187	17.26
Puget Sound	do	26	11,805,693	6,361,891	53.80	858,396	13.68
Columbia River	do	1	77,081	14,635	18.98	4,761	16.21
Outside rivers [a]	do	1	62,892	62,892	100.00	4,222	14.89
Totals and averages.		73	45,292,778	20,261,390	44.90	2,773,304	16.29
West Alaska	Chums	9	527,982	194,962	36.92	54,215	9.74
Central Alaska	do	33	728,514	418,419	57.43	79,208	9.20
Southeast Alaska	do	26	4,087,578	2,554,968	62.49	480,895	8.50
Puget Sound	do	27	2,547,457	1,852,350	72.71	249,390	10.22
Columbia River	do	8	277,836	123,436	44.42	28,085	9.89
Outside rivers [a]	do	7	88,736	84,413	95.12	11,655	7.61
Totals and averages.		119	8,258,103	5,228,548	63.31	903,448	9.14
Puget Sound	Steelheads	1	33	33	100.00	5	6.60
Columbia River	do	10	138,421	145,581	105.01	22,234	6.71
Outside Rivers [a]	do	1	787	787	100.00	126	6.24
Totals and averages.		12	139,241	146,401	105.00	22,365	6.22

[a] Coastal streams in Washington, Oregon, and California.

The following table shows the relative importance of different species within each district. In 1916 the red or sockeye salmon was the most abundant, but in 1917 the humpback had usurped this place by a small m rgin.

RELATIVE IMPORTANCE OF DIFFERENT SPECIES WITHIN EACH DISTRICT.[a]

[Per cent which each species is of total pack by districts.]

District.	King or chinook.	Red or sockeye.	Medium red.	Pinks or humpback.	Chum.	Steelhead.	Total, all grades.
1916.							
West Alaska	1.6	85.4	1.6	2.6	8.8	....	100
Central Alaska	2.0	53.7	5.1	32.9	6.3	....	100
Southeast Alaska	.8	11.8	8.1	57.7	21.6	....	100
Puget Sound	5.5	11.4	21.4	.2	61.4	0.1	100
Columbia River	69.9	1.1	11.2	.1	13.5	4.2	100
Outside rivers	40.0	5.4	29.7	3.0	21.8	.1	100
Per cent of total	8.6	36.8	8.3	26.6	19.4	.3	100
1917.							
West Alaska	1.2	95.1	.3	.2	3.2	....	100
Central Alaska	1.9	72.2	3.6	13.3	9.0	....	100
Southeast Alaska	.9	6.5	4.5	65.3	22.8	....	100
Puget Sound	3.1	21.1	6.4	51.7	17.7	....	100
Columbia River	71.2	1.5	13.6	.1	9.9	3.7	100
Outside rivers	39.9	2.8	32.9	9.2	15.0	.2	100
Per cent of total	6.9	34.2	5.1	38.3	15.3	.2	100

[a] Report of the Federal Trade Commission: Op. cit , p. 33.

The following table shows the relative importance of districts in the production of each species in 1916 and 1917. Southeast Alaska leads in each year, with 35.1 and 38.1 per cent, respectively. Western Alaska was second in 1916, but was forced down to third place by Puget Sound in 1917. In 1916 Central Alaska produced 21 per cent of the humpback pack, but in 1917 this was reduced to 4.1 per cent. Puget Sound advanced from 0.1 per cent of the humpback pack in 1916 to 30.7 per cent in 1917. Humpbacks run in this district only every other year.

RELATIVE IMPORTANCE OF DISTRICTS IN PRODUCTION OF EACH SPECIES.[a]

[Per cent of total amount of each species packed in various districts.]

District.	King or chinook.	Red or sockeye.	Medium red.	Pinks or humpback.	Chum.	Steelhead.	Total, all grades.
1916.							
West Alaska	4.9	59.9	4.9	2.5	11.8	....	25.9
Central Alaska	4.0	24.8	10.5	21.0	5.5	....	17.0
Southeast Alaska	3.3	11.2	34.4	76.0	39.1	....	35.1
Puget Sound	6.9	3.4	28.1	.1	34.4	0.6	10.8
Columbia River	66.9	.3	11.2	.1	5.8	98.5	8.2
Outside rivers	14.0	.4	10.9	.3	3.4	.9	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1917.							
West Alaska	3.4	53.5	1.3	.1	4.0	....	19.1
Central Alaska	3.3	24.9	8.2	4.1	6.9	....	11.8
Southeast Alaska	4.9	7.2	32.8	64.6	57.0	....	38.1
Puget Sound	10.3	14.0	28.0	30.7	26.1	....	22.6
Columbia River	66.7	.2	17.1	.0	4.1	98.4	6.4
Outside rivers	11.4	.2	12.6	.5	1.9	1.6	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Report of the Federal Trade Commission: Op. cit., p. 34.

MILD CURING.

The beginning of the business of mild-curing salmon, or "sweet pickling," as it is sometimes called, is of comparatively recent date. In 1889 a German dealer came to the Columbia River and tried to interest some of the cannery men in the business. J. O. Hanthorn, M. J. Kinney, and J. W. Cook were persuaded to prepare some, and the plant of the Northwest Cold Storage Co., at Portland, was used to keep the fish at a low temperature during repacking and preparation for shipment. These fish were shipped to Germany, but the shippers received no financial returns, word coming back that the fish were not satisfactory.

Owing to this lack of success from the first effort, no further attempt was made until 1894, when Mueller & Loring, of Chicago, put up a carload of mild-cured salmon at Kalama, Wash., and shipped it to Germany. In 1896 Charles Ruckles and Wallace Bros., of Kalama, packed several carloads for the German market. It was not until 1898 that the business was permanently established on the Columbia, the Trescott Packing Co. and S. Schmidt & Sons putting up plants at Warrenton and Astoria, respectively.

In 1900 the Trescott Packing Co. began packing the spring and fall runs, and the Sacramento River Packers' Association packed the fall run, on the Sacramento River, the business being carried on here every year since.

In 1901 the Sacramento River Packers' Association began at Monterey the mild curing of the spring salmon that were taken with hook and line in the open ocean.

S. Elmore & Co. started the industry in 1902 at Tillamook, and the business began on Puget Sound in 1901, when the San Juan Fishing & Packing Co. and the Seattle Fish Co. took it up. The Pacific Cold Storage Co. began the next year at Anacortes.

Prior to 1906 several of the Alaska cannery men put up each season a few tierces of mild-cured salmon, but it was not until this time that the industry really began as such. In that year J. Lindenberger (Inc.) started packing at Ketchikan, Alaska. The following year several other plants were started, and in 1910 almost all of the king salmon taken in southeast Alaska were mild cured. The same is true to-day.

For mild curing the fresh fish must be given greater care in handling than is the case with any other process. Care must be exercised to see that the flesh of the fish is not bruised or broken, and in order to make sure of this the handlers usually pack several fish in one box, with cracked ice over and around them if the weather is warm. As soon as a box is filled, it is put in the hold, where the boxes are stacked one upon another, but prevent more weight than is represented inside one box coming upon any one fish.

In dressing, the head is removed, care being taken to leave as much of the bony structure of the head as possible to assist in holding the side of the hooks when it is being smoked later on; the fish is then split down the belly to the vent, the entrails removed, when a cut is made on either side of the blood clot in the back, and the fish passed to the "washer," who holds the fish on its back in a slot on the table under a spray of water, and removes the membrane of skin which covers the inside of the backbone and inside of which a good deal of thick blood lies, by means of a large spoon or some similar form of scraper. A knife should not be employed. Some curers do not remove the fins at this stage, while others do.

The body is then scored along the sides with a small knife, care being used to cut the skin only; this allows the salt to penetrate more freely and thus assist the process of cure. A specially prepared eccentric wheel is sometimes used for this purpose, which makes a series of small cuts varying from half an inch at the tail to 1½ inches long at the shoulder, and from 2 to 3 inches apart.

The fish is now ready for the splitter, who turns it on its back with the open belly toward him and forces the shoulder down on a sharp-pointed nail, so the fish will not slip during the operation. A crosscut is first made across the root of the tail to the bone, but no deeper. Then the knife is entered at the vent, immediately above the bone, and a cut, which should go no farther back than the middle of the backbone, is drawn down to the crosscut already made. Then raising the lug with his left hand, the splitter enters the knife at the shoulder above the bone, and with one sweep from head to tail, separates the entire side. This is the more easily done if the fins have been previously removed. If the work is perfect, there will be no flesh left on the bone, but a line of fat will show down the center of the side. This improves the appearance of the fish and adds to its value.

In order to remove the bone from the remaining half of the fish, the splitter inserts the knife under the bone, about the vent, and draws down toward the tail, but care must be taken, as before, not to go farther back than the spine. The splitter now takes the fish off the nail, holding it by the lug, his left thumb resting on the upper, or inside of the fish, and his fingers on the lower, or skin side. The tail is now pointing away from the splitter, who enters his knife carefully under the backbone, and with one dextrous outward sweep separates the bone from the fish right down to the root of the tail. When abreast of the crosscut, however, he turns the knife sharply downward, and cuts off the fish the same as on the other side. As with the first half, no flesh should be left adhering to the bone, and the line of fat should show down the center. In other words, the two sides should be exactly alike.

The sides are dipped into cold water in the dress tank, and are then laid, skin side down, on the table with the thin or belly edge toward the front. A man then removes any blood remaining in the veins on the inside of the fish, by pressing it away from him toward the back of the fish, either with his fingers or with a spoon. If the blood is not squeezed out in this way the salt will harden it during the process of curing, and the flesh will become dark in color. The sides are then dipped in a tank of weak brine and crushed ice to give them a final wash, but should on no account be left to soak in the brine. Upon removal, they are again scraped to insure the removal of all the blood from the veins.

Great care must be used in handling the newly split sides, as they are very tender and may be easily broken or bruised. In lifting them by the lug or collar bone, the curer should have his fingers to the inside and his thumb to the outer or skin side; otherwise the skin may be broken.

The sides are then taken to the salter, who lays them, skin side down, on a salting table, on which has been dumped a quantity of dairy salt, and gently rubs the flesh with the salt, lifts it up with only such salt as will adhere to it, and places it in the tierce.

The tierces in which the salmon sides are packed are stout casks made of fir or spruce, bound with six strong galvanized hoops. They contain about 800 pounds of fish, but when full of pickle the gross weight of cask and content is between 1,100 and 1,200 pounds. A plug hole is bored in the head of the tierce.

Two or three handfuls of salt are thrown over the bottom of the tierce, then a layer of salmon sides, skin down, and two or three handfuls of salt are sprinkled over them. In packing two sides of fish, crossed head and tail are packed close to opposite sides of the tierce, the back or thick part of each side being placed close up against the side of the tierce. Other sides of fish are packed from the sides toward the center of the tierce, napes and tails alternately, the back of each side being drawn halfway up and resting on the side already laid. When complete, the layer should be perfectly level, and this depends a good deal on how the last or center piece is laid. Salt is sprinkled between each layer in the manner and quantity noted above and the process continued until the tierce is full. The tiers should be crossed in packing. The top layer should be placed with the skin up and have extra salt put on. From 85 to 100 pounds of salt are used to 800 pounds of fish.

The tierce is then headed up, after which pickle is poured in until the tierce is quite full. This pickle may be made with the same salt as is used for rousing and sprinkling the fish. Perfectly clear water should be provided and broken ice should be added in liberal quantities, if the weather is warm. Before using, the pickle should be strained through a fine sieve or a clean cloth, to remove froth and sediment. A centigrade saltmeter is used by most mild curers. The pickle is made to a strength of at least 90°, but it usually weakens to about 70° during the first 10 days of cure, whereas after repacking it should not readily come below 85°, and it should retain that strength for a long time.

When tierces have been filled with pickle they are rolled inside a cold-storage room, with a temperature of 35 to 38° F., where they may be tiered two tiers high. Very little variation in the temperature is allowable, as it would start the oil or fat in the flesh, allowing it to escape into the brine.

Unless the tierces are kept quite full of pickle the sides of fish are apt to be broken when the cask is rolled about. The tierces must be examined frequently to see that they are full of brine, as there are always small leaks, while the staves absorb more or less moisture. Furthermore, if the tierces were allowed to leak, ugly yellow spots would show on the parts of the fish that were left dry. Thus it is of the utmost importance, both during the two or three weeks allowed for pining and also after repacking, to see that they are kept full of pickle. Several gallons of pickle may be absorbed by each cask during the first two or three weeks of cure.

The actual shrinkage during the two or three weeks in which the fish lie in the first packing may be reckoned at 30 per cent. Fat, well-conditioned fish, especially those which are caught in the ocean, shrink less, but poor fish, especially those caught when well on their way to the spawning grounds, shrink more—sometimes up to 35 per cent.

After holding the fish in storage for at least 20 and not more than 90 days they are taken out of the tierces. Each side of fish should be lifted out carefully, as described above, and sponged with a large sponge until all salt and slime are entirely removed, leaving only a clean, red side of fish. Either pure ice water or ice pickle may be used for this washing, but it will depend entirely on the quality and condition of the fish. Soft, poor fish would require pickle, but good firm fish may be washed in clean ice water.

The sides are then weighed and graded accordingly, 6 to 8 pounds, 8 to 10 pounds, and so on, being the grades. Sides of 11 pounds and over are called *large* fish, and "L" is marked on the side of the tierce. Some curers grade their sides from 9 to 11 pounds and class them as *medium* and mark them "M;" smaller sides are termed *small* and are marked "S."

After the sides have been graded they should be counted and repacked, the defective sides, such as thin-bellied, torn or broken, being put by themselves. Fish which are considered perfect are called No. 1; those which do not come up to that standard are termed No. 2, and are marked accordingly; while fish that have any taint of sourness are marked "T." In repacking, the sides of fish should be replaced as nearly as possible in their original position, those curved in shape being placed against the sides of the cask and straight pieces laid in the center of the tier. No salt is used in repacking, but as soon as the tierce is filled, the head put in, and the air test applied it is laid on its bilge and filled up with ice-cold pickle made to a strength of 90° salometer (90 per cent saturation) that can be made from fresh or salt water, whichever is handiest and cleanest, half-ground salt being used. There will be about 830 pounds of fish on an average in the tierce after repacking, and some 14 gallons of pickle may be required to fill the cask up. They are then put back into cold storage and pickled at the bilge daily for at least a week. If kept for any length of time, they would, of course, have to be tested, regularly—a tap with a hammer would do—and any leakage promptly rectified. If properly cured, the fish should keep in good condition for months in cold storage, provided the casks are sound and kept full of pickle.

On the head of each tierce are put the following marks: Initials of packer or packers; initials of place where packed; number of tierce (consecutive); number of sides in tierce, the tare, and the gross weight (weight of pickle not counted); quality of fish (I, II, or T); and size of fish (L, M, or S).

If of first quality, no mark is necessary, but second-quality and tainted fish have to be noted.

In the early days of the industry different preparations, which included salicylic and boracic acids, were used to help preserve the fish. This caused much complaint from the Germans, and finally their Government subjected our product to a rigid inspection, with most salutary results, as now it is one of the purest and best products put up on this coast, the use of acids being done away with entirely.

The king salmon is almost invariably the species mild cured, being the only one large enough to answer the requirements of the trade. In 1907 a Ketchikan (Alaska) packer put up a quantity of coho, dog, and humpback salmon, but he found so much difficulty in disposing of the product that he abandoned further efforts in this line. A few cohos are put up each year.

The principal consumers of the mild-cured salmon are the smokers, who take them from the tierce, wash and soak them for a few minutes, and then have a practically fresh fish to smoke, and not, as in the days when hard-pickled salmon were used, one that had lost most of its oil and flavor through the excessive amount of salt needed to preserve it.

The greater part of the product put up on this coast goes to Europe, Germany being the principal consumer, but considerable quantities are sold in Norway, Sweden, and other countries, while the smokers of the cities east of the Rocky Mountains use large quantities every year.

In Germany, the principal market for mild-cured salmon, nearly all of the fish are smoked. One of the most popular ways of using the smoked salmon is in the making of sandwiches, and probably the greater portion of these are used in the beer halls and the automatic restaurants in that country.

PICKLING.

The earliest method of preserving salmon on the coast was by pickling. At times this industry attained to large proportions, but during the last 10 years it has been declining, largely because the canners are able to pay more for the raw fish than the salters. All species of salmon are pickled , but the most popular is the red salmon.

In dressing salmon for pickling the head is removed, the fish split along the back, the cut ending with a downward curve on the tail. The viscera and two-thirds of the backbone are removed, and the blood, gurry, and black stomach membrane scraped away. The fish are then thoroughly scrubbed and washed in cold water. They are next placed in pickling butts with about 15 pounds of half-ground salt to every 100 pounds of fish. The fish should be laid in a tier, flesh side up, and the salt well sprinkled over it, repeating until the tank is full. Several boards are then laid across the fish and these are weighted down with large stones in order to keep the fish submerged in the pickle which will form. The fish remain here about one week, the brine being held at about 90°. They are then removed, rubbed clean with a scrub brush, and repacked in market barrels, one sack of salt being used to every three barrels of 200 pounds each. About 40 to 52 red salmon, 25 to 35 coho salmon, 70 to 80 humpback salmon, 10 to 14 king salmon, and 25 to 30 dog salmon are required in packing a barrel of pickled salmon.

A few salteries also pack "bellies." This product is merely the belly of the fish, which is the fattest portion, and as most of the packers threw away the rest of the fish, thus causing a very large waste of choice food, this method has come under the ban of the law in some of the coast States and in Alaska. As a result, but few "bellies" are packed now, and most of these only when some economic use is made of the remainder. Humpback salmon furnish the major part of the "belly" pack.

In preparing salmon bellies, the operator first cuts off the two pectoral fins, and them removes the head, care being taken to follow the curve of the body until the backbone is reached, which should then be severed straight across. With the smaller salmon the fish is then turned on its back, and the operator inserts his knife in the body just above the backbone and cuts down through the body, the knife coming out just in front of the vent. If properly done, the cut will come close to the upper wall of the stomach. With large king salmon it is sometimes necessary to make the cut first on one side, then turn the fish over and make the cut on the other side. The belly is then laid flat on the cutting table and the membrane at one end cut so the belly will lie flat. The bellies are then washed and salted the same as hard-salted salmon.

When bellies are cut, the backs are saved and either dried in the open air, without salt, or else pickled.

With large kings, the operator, after the belly has been cut out, scrapes the inside of the remainder of the carcass. The knife is then inserted under the backbone at the end nearest the tail, and it is cut away with as little flesh as possible adhering to it. The blood is then scraped off, the fish thoroughly washed, and then salted the same as the whole fish.

Some of the old-time fishermen save parts of the salmon heads as food. In this event, the head is split lengthwise clear to the bony covering which protects the top of the head. The gill rakers are then removed from each side of the split head, leaving the nutritious parts intact. The cleaned heads are then salted down the same as whole salmon.

DRY SALTING.

During the progress of the Russian-Japanese War the preparation of dry-salted dog salmon became an important industry, but as soon as the Japanese fishermen resumed their former occupations the demand fell off so much that the industry was virtually abandoned in the United States, although a number of Japanese continue it in British Columbia. The fish, after being dressed, were packed in boxes, in salt, these boxes holding about 560 pounds of fish, and were shipped in this condition to Japan.

At a number of places in Alaska the bellies of red and coho salmon are cut out and salted, after which the backs are dried in the sun and, thus cured, are used for fox food at the numerous fox ranches. This product is called "ukalu."

SMOKING.

The smoking of salmon is virtually a continuation of the pickling, as the fish must be pickled before being smoked, the main purpose of the pickling being to preserve them until the time arrives for smoking, which may be weeks or months after the fish are caught. For smoking the salmon are taken out of the barrel and soaked until as much of the salt as possible is removed. They are then put into the smokehouse and subjected to the heat and smoke of a fairly hot fire for about two days in order that they may be thoroughly dried and hardened. Exposure to a smoldering fire (alder wood is a favorite fuel) for about three days completes the process.

For shipment smoked salmon are packed in wooden boxes, oil paper being placed between the fish.

In the manufacture of smoked salmon, the mild-cured product is most in demand. The necessary quantity of sides is taken from the cold-storage and placed in large tanks filled with fresh water. In these they are soaked over night, the water being changed several times, depending upon the salinity of the fish, the variation of which depends upon the length of time the product has been held in storage, those held longest absorbing the most salt.

After soaking, the sides are taken from the tanks, piled on tables, and allowed to drain as much as possible. They are then taken one at a time, laid flesh side down, and a bacon hanger, which is made of wire and has six or more points bent at right angles to the frame, terminating at the top in a hook, is pressed firmly into the flesh on the skin side and at the upper end of the side. They are then hung upon a round stick, which latter is then set in position in the smokehouse, each end resting upon supports on the side. The fish are placed so that no two of them will touch. When the smokehouse is full, a small fire of any nonresinous wood is then built underneath to dry them, the ventilator in the top being left open so the moist air can escape. The fires should not be allowed to become too hot; the object is to give the fish smoke rather than heat, as in the latter case they would become partially cooked. For a mild cure, for ready consumption, from 8 to 10 hours, according to the condition of the fish, should be sufficient. If immediate sale should not be possible the fish must be kept in a cold-storage room with a temperature of about 24° F.

In sections where the products move more slowly into consumption, a harder smoking is wanted. In this event, they are held over the fire until dried, which would depend upon climatic conditions, but probably around two days. After the fish have dried sufficiently, the fire is smothered with sawdust, which produces a dense smoke, giving the sides their color. During the latter period the ventilator is partly closed, but must be watched to prevent the fish from sweating.

When thoroughly smoked the sides are removed from the smokehouse, taken off the hanger, and each side wrapped in paper, then packed in wooden boxes holding each 30 pounds.

Kippered salmon.—On the Pacific coast practically all of the kippered salmon is prepared from frozen white-meated king salmon, which on account of the color of the flesh is not in much demand. It is, however, fully the equal, in both flavor and food value, of the red-meated kings. It is not absolutely essential that the fish be first frozen, as the fresh fish may be kippered after dressing, but the latter is always a little soft when so prepared, owing to an excess of moisture, which is largely removed in freezing. Fresh salmon is available only part of the year, so it is found most convenient to freeze and store the stock and work it up when needed throughout the year.

Before freezing, the fish have been dressed, so when thawed in cold-running water, it is only necessary to split and cut them into pieces of a pound or less, these being about 6 inches long, or perhaps 3 inches broad, depending upon the part of the fish the piece is taken from, and place them in a tank of strong brine to season for several hours. They are then dipped in a harmless vegetable coloring, similar to that used by the butchers for coloring sausage; this gives the outside of the product a red color, a concession to popular prejudice.

From the coloring tank, the pieces are placed on a tray with wood frame and bottom of one-half inch square meshed wire; care is taken that the pieces do not touch each other.

The tray is then slipped into a rack which will hold a number of these, placed one above the other, and this rack is then run on a track into the smokehouse.

A medium fire is then kindled which dries and slightly smokes the pieces from 16 to 18 hours.

When they reach a proper stage the fire is enlarged, but great care must be exercised in order to prevent their being overheated, and this is done by means of the damper at the bottom of the smokehouse and the ventilator at the top. The fish are baked in this manner from 25 to 35 minutes, the thermometer showing from 250 to 275° of heat.

When the cooking is completed the cars are pulled out and the fish allowed to cool, after which each piece is wrapped in a square of parchment paper and packed in a box or basket which holds 10 pounds.

The product is quite perishable, and if it can not be used at once, when of course it is at its best, must be placed in cold storage. The packer endeavors to turn out daily only the amount he can market that day.

Beleke.—A smoked product, known locally as "beleke," is put up at Kodiak, Alaska, from red and coho salmons. Steelhead trout are the best for this purpose, but are not often utilized owing to their scarcity in this region. In preparing "beleke" only the backs of the fish are used, the belly part being cut out and pickled separately. The backs are divided into three grades, according to size, viz, "small," "medium," and "large." They are first put into a brine, the "large" being put in first, followed by the "medium" and "small" at intervals of one hour each, so that all will be cured at about the same time. The coho backs, being the largest, are kept in the brine from 19 to 20 hours, while the red salmon backs, which are smaller, remain in the brine only about 16 hours. After being thoroughly salted the backs are removed from the brine and rinsed in fresh water, then hung in the air for about 24 hours to dry and to allow a thin skin to form on the outside. They are then hung in the smokehouse, in the presence of a little fire of cottonwood or alder. On dry days the gable windows are thrown open and the wind allowed to pass through while the smoking is going on. The smoking must be done slowly, two weeks being devoted to it.

There is a good demand for this product locally, the fish selling for from 15 to 20 cents a pair, but little effort has been made to extend its sale outside of central Alaska.

FREEZING.

The process of preserving fish by freezing was first introduced in 1888. Previous to this the comparatively ancient method of packing with ice, or in rare instances letting the fish freeze naturally during the winter months, was followed. Packing with ice is in quite general use to-day for shipments of fish which are to be preserved for short periods of time. Cooling with ice never results in a temperature lower than 32° F., which, of course, does not freeze the fish.

The freezing of salmon and steelhead trout began on the Sacramento and Columbia Rivers in the late eighties. It was taken up in a small way on Puget Sound in 1892. That year Wallace Bros. and Ainsworth & Dunn froze a small lot, the work being done for them by the Seattle Ice Co. (now the Ice Delivery Co.), and the venture was so successful that the next year nearly all of the wholesale dealers on the Sound took up the business. The Crescent Creamery, of Tacoma, also engaged in the business for the fish dealers for a year or two shortly thereafter. In 1902 the British Columbia Packers' Association bought a large cold-storage plant at New Westminster, British Columbia, at that time the only large and modern plant in the Province, and began the active freezing of fish. Since then a number of excellent plants have been built and operated. In Alaska the preparing of frozen salmon began in 1902. The San Juan Fishing & Packing Co., soon to be succeeded by the Pacific Cold Storage Co., put up a cannery and cold-storage plant at Taku Harbor, in southeast Alaska, in 1901, though it did not operate the cold-storage portion until 1902. The Taku Harbor Canning & Cold Storage Co. later on succeeded to the ownership and operation of this plant. This is the only plant which was operated in Alaska until the New England Fish Co. erected in 1909 a large plant at Ketchikan for the freezing of halibut primarily, but considerable quantities of salmon have been frozen also.

In 1911 the schooner *Metha Nelson* was fitted up as a floating freezer by the Alaska Packers Association and sent to Kodiak Island. As the vessel arrived in San Francisco shortly before the State's closed season on salmon began, and it was a difficult matter to dispose of the catch before then, the business was abandoned.

In 1912 J. Lindenberger (Inc.) opened a freezing plant at Craig, on Fish Egg Island, Alaska, while the ship *William H. Smith* was outfitted as a floating cannery and freezer by the Weiding & Independent Fisheries Co., at Saginaw Bay, Alaska. The latter operated only one season.

The year 1913 saw quite a development in the industry. The Columbia & Northern Fishing & Packing Co., at Wrangell, the Juneau Cold Storage Co., at Juneau, the Booth Fisheries Co., at Sitka, and the floating cold-storage ship *Glory of the Seas*, by the Glacier Fish Co., at Idaho Inlet, were all started this year.

In 1914 the Ketchikan Cold Storage Co. opened a freezer for the general commercial freezing of fish.

In 1917 the San Juan Fishing & Packing Co. built and operated a cold-storage plant at Seward.

In 1918 Henry Goemaere operated for the first time a plant at Washington Bay; while the National Independent Fisheries Co. and the Trout Fisheries Co. froze salmon at Ketchikan. All the other freezers operated as usual, the only change being the purchase by Libby, McNeill & Libby of the cold-storage plant and cannery of the Taku Harbor Canning & Cold Storage Co. at Taku Harbor.

The freezing of salmon is almost invariably carried on in connection with other methods of handling and preserving, and the purpose is usually to secure the fish when numerous and cheap, freeze them, and then hold them until the runs are over and the fish are once more in good demand at high prices. The business proved so profitable, however, that the dealers began to look for wider markets for their product. Europe, more especially Germany, was prospected and a profitable market soon developed, with the result that to-day frozen Pacific salmon can be secured in nearly every town of any size in western Europe, while large quantities are marketed all over our own country.

There are four important features in packing and using frozen salmon: (1) To get fresh fish; (2) to keep them cold (about 15° above zero) after they are frozen; (3) to keep a coat of ice on them; and (4) to allow them to thaw slowly in cold water or in the air before cooking.

In selecting salmon for freezing, only the finest and freshest of each species are used. The current belief that freezing destroys the flavor of the fish is erroneous, the flavor depending entirely upon the condition before freezing, and the quicker they are frozen after being caught the better will the natural flavor of the fish be preserved. Frozen salmon are just as wholesome as fresh, and their chemical constituents are almost identical. The danger lies in the temptation to freeze the fish after decomposition has set in, but, fortunately, this is now very rarely practiced in the salmon industry.

The coho, or silver, and the chum, or dog, salmon are the choicest of the salmons for freezing. The other species, except the red, or sockeye, which is too oily and rarely frozen, are also frozen in varying quantities. The steelhead trout, which is ranked by the Pacific coast dealers among the salmon, is considered the choicest fish of all for freezing.

Some of the most modern plants in the country are on this coast. These have numerous freezers, generally, in which a temperature of from 25° to 30° F. below zero can be maintained if desired, although a temperature of more than 10° below zero is rarely ever required. All freezing is by direct expansion and each freezer is piped with about 2 feet of 1¼-inch pipe per cubic foot of freezing space. The bunkers in the freezers are in pairs, generally nine pipes wide, spaced 10 inches apart. This leaves about a 3½-foot passage through the center of each freezer opposite the swing doors. The salmon are laid on metal sheets, which are placed on the tiers of pipes.

After freezing the salmon are passed through openings in the rear of the freezers into the glazing room, which has a temperature of about 20° F., where they are dipped into water, and when removed are covered with a thin glaze of ice, which may be thickened by repeated dippings. This is an extra precaution to exclude the air from the fish.

After being thoroughly frozen and glazed, each fish is covered first with a parchment, like rolls of butter, and then with a piece of heavy brown paper. They are then packed in boxes holding about 250 pounds each, placed in cold-storage cars and shipped.

The method of freezing fish in brine is now under serious consideration by a number of fishermen and dealers A brine freezer may be of small capacity and carried on a fishing boat or it may be a freezer of large capacity at some central point convenient for receiving the catches. In this method a strong brine solution, cooled by circulation through crushed ice, is used for freezing the fish. By this method large fish may be frozen in from 1 to 3 hours, a great saving in time as compared with the method at present in use.

FIG. 38.—SHIP, "WM. H. SMITH," FLOATING CANNERY AND COLD-STORAGE PLANT.

FIG. 39.—SALMON OFFAL READY FOR DELIVERY TO THE FERTILIZER AND FISH-MEAL PLANTS.

UTILIZING SALMON EGGS AND MELT.

Every year immense quantities of salmon eggs are thrown away in the fisheries of the west coast, though there is but little doubt that, if properly prepared, a market could in time be found for this now waste part of the fish. In France there is a good market for a product known as "rogue," which is the spawn of cod, haddock, hake, and pollock, salted in casks, and which is used as bait in the sardine fisheries. Salmon spawn is the choicest and most successful bait used on this coast, and if properly prepared would undoubtedly answer the purpose as well as the regular "rogue" if not better, owing to its oiliness and attractive color. The roes should be soaked for some days in old brine and then packed in strong casks holding about 25 gallons each. It might also prove to be a good bait for tolling mackerel on the Atlantic coast.

In 19[illegible]0 a considerable quantity of salmon roe was prepared in Siberia and sold in competition with caviar, which is prepared from sturgeon eggs. The product met with favor in Europe and now large quantities are prepared each season.

In this country Miss Ida Tuholski, of San Francisco, who had been engaged in the preparation of sturgeon caviar for some years, put up a number of sample lots of salmon caviar which are fully the equal of the best sturgeon caviar. Capital has been chary, however, about engaging in the business, although undoubtedly it will be an important industry some day.

For making caviar the eggs should be as fresh as possible, and in order to make sure of this the salmon are taken alive, if possible, shortly after coming from the water, killed and bled, the belly opened up and the roe taken out. This work can best be done on work and living scows anchored close to the fishing camps. The roe is placed upon a stand, the top of which is formed of a small-meshed galvanized-iron wire screen. On the underside is arranged a zinc-lined trough. The operator gently rubs the mass of eggs back and forth over the screen, the mesh of which is just large enough to let the eggs drop through, and, as they are separated from the membrane by the rubbing, they fall through into the trough and are thence drawn off into tubs by means of a sliding door at the end of the trough.

After all the roe has been separated the tub is removed and a certain proportion of salt (the sturgeon caviar makers employ the best Luneburg, Germany, salt in this work, while some of the Siberian makers of salmon caviar use No. 2 Berkshire salt from England) is added to the roe, after which the mass is mixed with the hands. The most delicate part of the whole operation is in the manner of mixing. No direct rule can be given for doing this portion of the work, as the condition of the roe regulates the time consumed and the manner of handling. It requires practical experience to become proficient, but this should be an easy matter for one used to handling salted products. The sturgeon caviar makers use about 11 pounds of salt in preparing a keg of caviar.

After the salt has been added the mass of eggs first dries up, but in a few minutes the strength of the salt draws from the eggs their watery constituents and a copious brine is formed, which can be poured off when the tub becomes too full. In Siberia the caviar makers put the eggs into a brine solution of 19 to 22 per cent Baumé strength immediately after they come from the trough. The salted eggs are then poured into very fine-meshed sieves which hold about 10 pounds each. In the caviar house are arranged long, sloping boards with narrow strips nailed on each side. On these the sieves are placed and left here from 8 to 20 hours in order to thoroughly drain.

The Siberian caviar makers hasten the operation by putting the eggs into a brine solution as noted above, leave them there for from 25 to 45 minutes, then place them in bags and subject them to heavy pressure, after which they are packed. While this method occupies less time, it is not thought the resulting product is as good as that prepared by the slower method outlined above.

The eggs are then transferred to small casks (holding about 135 pounds). The sturgeon caviar makers use oak or pine casks, but some of the Siberian makers say that oak casks turn the salmon caviar black. The casks are steamed before use in order to prevent any possible leakage. It is especially necessary that the kegs or barrels used be air-tight, as otherwise the product will spoil. Barrels such as used in packing salt salmon are rarely ever tight enough to hold caviar. The casks are covered and allowed to stand until the gas escapes and the eggs settle. The vacant space caused by the settling is then filled, the cask headed up and put in a cool place until ready for shipment.

The Siberian salmon caviar makers use a small quantity of "preservaline" in each keg for the purpose of aiding in preserving them, as cold-storage facilities are quite primitive as yet in that country, and it is the addition of this powder which forms the mysterious part to the uninitiated. No preservative would be needed in Alaska, however, as the kegs could be shipped in cold storage along with the mild-cured salmon.

Several establishments are putting up these eggs in jars and hermetically sealed cans for use as bait in sport fishing.

In 1916 one of the companies operating in Alaska put up some salmon melt in cans. No difficulty was experienced in canning this product and it met with considerable favor from those who tried it, but nothing has been done with it since.

MISCELLANEOUS PRODUCTS.

A few years ago a company on the Columbia River put up what was known as "fish pudding." In preparing this the salmon was ground fine, mixed with milk and eggs, and then packed in tin cans. The preparation was soon abandoned.

In 1903 one of the Point Roberts canneries packed a new product which was called "salmon paste." For this the fish was ground up, cooked, seasoned with spices, etc., and made into fish balls, a very palatable dish when warmed over.

In 1905 a Seattle concern began the manufacture of wienerwurst sausages from halibut and salmon.

The Indians in the Bristol Bay region of Alaska occasionally dress the skins of salmon and make of them leather for the tops of boots, also bags and other small articles.

A product, which was first made in Norway, is prepared by means of an invention which quickly dries and pulverizes the flesh of fresh fish. The resulting powder, called "fish flour," is easy to transport from one place to another and has great nutritive value. It is probable that the tailpieces of the fish, which are at present thrown away, and the cheaper grades of salmon might be prepared in this way and thus furnish another market for salmon.

MEAL, FERTILIZER, AND OIL.

As early as 1888 there was a small plant at Astoria, Oreg., where the refuse of the canneries was utilized for the manufacture of oil and fertilizer. In that year 8,000 gallons of oil (chiefly from salmon heads) and 90 tons of fertilizer were prepared. The oil was worth 22½ cents per gallon and the fertilizer had a market value of $20 per ton. Most of the refuse was dumped into the river, however. In 1898 a similar plant was established in the Puget Sound district of Washington. At present the plants of the Robinson Fisheries Co. at Anacortes; the Pacific American Fisheries at Eliza Island, near Bellingham; the Wannenwetsch Reducing Co., at Blaine; and the Japanese-American Fertilizer Co. on Lummi Island, all on Puget Sound, operate quite largely on the offal from the Sound salmon canneries.

In 1882 the Alaska Oil & Guano Co. established a fertilizer plant at Killisnoo, Alaska, for the extraction of oil and fertilizer from herring, and has operated the plant continuously ever since. In some years large quantities of whole salmon have been handled at this plant, and the resulting product was found to sell as well as that from herring.

In Alaska the Fish Canners By-Products (Ltd.), in 1914 built a large plant at Ward Cove, near Ketchikan, where salmon offal is used in the preparation of fertilizer, meal, and oil. The company is now experimenting in the preparation of various chemical products from the raw material.

Probably the most serious evil in the salmon industry to-day is the enormous wastage which annually occurs. About one-fourth of the total weight of each fish handled at the various packing plants is thrown away. With the exception of the tailpiece, which is discarded at some canneries owing to the excessive amount of bone which would be in the product if canned, this waste material could not be utilized as food, comprising as it does the head, viscera, fins, and tail. When not conveniently near the very few fertilizer plants at present in operation this product is either allowed to pass through chutes into the water under the cannery, or is dumped into scows and towed to the ocean or the deeper waters of the sounds, and there thrown overboard. This procedure is not only exceedingly wasteful, but is also far from beneficial to the waters where deposited.

The great desideratum in the salmon fisheries of the Pacific coast at the present time is the invention of a small odorless fertilizer plant, costing not more than $2,500 or $3,000, which can be installed at the various salmon canneries and salteries. The offal from the cannery could there be utilized and the product obtained would doubtless net a fair return on such an investment, while at the same time the present (in the aggregate) enormous waste would be stopped, and the waters adjacent to the canneries rendered far more agreeable to the fishes as well as to the people on shore. It is absolutely essential that the plant shall be odorless, as the smell of the ordinary fertilizer establishment would be very offensive to persons visiting the cannery and would not enhance the demand for canned salmon. At the present time the cheapest plant available costs about $10,000, and very few canneries can afford to invest this sum of money in the disposal of their own offal alone.

A great impetus has been given to the industry during the last two years, owing to the big demand which has come from the farmers and poultrymen for fish meal or scrap, which, after it has been mixed with other ingredients, can be fed to cattle, hogs, and poultry. Experiments carried out at various agricultural experiment stations, both here and in Europe, show conclusively that this class of food increases the appetite of the animal, and consequently the weight, while it does not affect the flavor of the flesh of the animals.

SHIPPING FRESH SALMON DIRECT TO CONSUMER.

An important new feature in the salmon industry is the shipping of individual salmon direct to consumers by express, or, for certain short distances, by parcel post, for a certain fixed sum, which includes the fish itself and the cost of delivering same to the buyer.

This business began in Tacoma, Wash., in 1914, and those who originated it advertised throughout the country that they would ship a fresh salmon to any express office in the United States (except Southern Express), express prepaid, for $1.25, weight 7 to 8 pounds. In 1915 the cost, delivered east of the Mississippi River, was raised to $1.50 each, the old rate of $1.25 still being in force for shipments west of the Mississippi River. The price has since been increased to $2.50 for any place in the United States. The number of shippers has increased very much, and the business is now carried on from a number of places in Washington, Oregon, and California.

In shipping an individual fish, it is packed in a box containing 20 pounds of cracked ice. These boxes are collected by the express companies and are generally sent out in their own regular cars attached to trains leaving in the evening. About every 15 to 20 hours the box is opened and from 5 to 7 pounds, depending upon the weather, of cracked ice added to the box to make up the loss through melting.

As the Post Office Department will not accept packages in which ice is used for preserving fish, the use of the parcel post for shipments of individual fish is limited to the first postal zone (up to 50 miles from the initial point), except in winter, when the postmasters are authorized, in their discretion, to accept shipments for the second zone (50 to 100 miles from the initial point). In making fresh-fish shipments by parcel post, frozen fish are generally used.

Most of the orders come from the Middle West, where fresh fish are not abundant, but orders are received from all sections of the country.

The success met with in shipping fresh salmon led to a considerable expansion of the industry, with the result that now one can obtain not only a fresh salmon, but also may purchase salt, smoked, and kippered salmon, salt codfish, and fresh halibut, smelt, crabs, and other sea food in their season.

NUTRITIVE QUALITIES OF SALMON.

More and more attention is being paid by the consuming public to the nutritive qualities of the food products offered them, and this is especially true as regards fishery products.

The proper functions of food are two-fold, first, to furnish protein for building and repairing the body, and second, to supply energy for heat and muscular work. Foods which supply an abundance of both at a reasonable price are of the greatest importance from an economical standpoint.

ANALYSES OF CANNED AND FRESH PACIFIC SALMON.

Despite the great prominence of the salmon industry, but little time has been devoted to it by the chemist.

Prof. W. O. Atwater was the first American investigator to devote any portion of his energies to the analysis of Pacific salmon. In "Principles of Nutrition and Nutritive Value of Food" (Farmers Bulletin No. 142, United States Department of Agriculture, 1901), he gives the following analysis of canned Pacific coast salmon:

Water, 63.5 per cent; protein, 21.8 per cent; fat, 12.1 per cent; ash, 2.6 per cent; fuel value per pound, 915 calories. [a]

C. F. Langworthy, in "Fish as Food" (Farmers Bulletin No. 85, United States Department of Agriculture, 1898), gives the following analyses of fresh and canned Pacific coast salmon:

Fresh salmon, California (sections): Refuse (bone, skin, etc.), 5.2 per cent; water, 60.3 per cent; protein, 16.5 per cent; fat, 17 per cent; mineral matter, 1 per cent; total nutrients, 34.5 per cent; fuel value per pound, 1,025 calories.

Canned salmon: Refuse (bone, skin, etc.), 3.9 per cent; salt, 1 per cent; water, 59.3 per cent; protein, 19.3 per cent; fat, 15.3 per cent; mineral, 1.2 per cent; total nutrients, 35.8 per cent; fuel value per pound, 1,005 calories.

Dr. Harvey W. Wiley gives the following as the composition of a Pacific coast salmon (species not given): [b]

Fresh—Water, 63.61 per cent; protein, 17.46 per cent; fat, 17.87 per cent; ash, 1.06 per cent. Dry—Protein, 52.31 per cent; fat, 49.05 per cent; ash, 2.92 per cent.

On page 137 of the same work Dr. Wiley gives the following as the mean of three samples of Pacific coast canned salmon:

Composition of canned salmon.—Mean of three samples. Water-free substance: Protein, 53.52 per cent; fat, 40.52 per cent; ash, 6.24 per cent.

Prof. Knisely,[c] of the Oregon State Agricultural College at Corvallis, Oreg., analyzed canned salmon packed at the Funter Bay (Alaska) cannery of the Thlinket Packing Co., with the following results:

Species.	Moisture.	Protein.	Fat.	Ash.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Sockeye or red	64.74	24.19	9.11	2.06
Coho or medium red	68.22	26.56	3.61	1.66
Humpback or pink	69.43	24.00	4.86	1.68
Keta or chum	67.08	25.06	6.59	1.26

[a] The unit used to show the fuel value is the "calorie," which is the amount of heat required to raise the temperature of about 1 pound of water 4° F.
[b] Foods and their Adulteration, etc., p. 135. By Harvey W. Wiley. 8°, Philadelphia, 1907.
[c] Pacific Fisherman, Vol. VI, No. 1, January, 1908, p. 21.

H. M. Loomis, formerly chief of the Seattle food and drug inspection laboratory, Bureau of Chemistry, United States Department of Agriculture, reports as follows on analyses of both canned and fresh Pacific salmon made at this laboratory.[a]

CANNED SALMON (1911 PACK.)[a]

Sample.	Water.	Ethyl ether extract.[b]	Protein (Nx6.25).	Total ash.	NaCl.[c]	Ammoniacal nitrogen.	
						Richardson method.	Alcohol vapor method.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
No. 1. Puget Sound sockeye....	62.44	15.17	20.25	2.50	0.79	0.0403	0.0348
No. 2. Puget Sound sockeye....	61.84	13.74	21.77	2.73	1.10	.0437	.0410
No. 3. Alaska medium red......	69.97	7.81	20.40	2.58	1.09	.04965	....
No. 4. Alaska chum............	73.48	2.88	21.33	2.57	.83	.0563	.0557
No. 5. Alaska pink or humpback....................	74.12	4.75	19.75	1.98	.50	.0404	....
No. 6. Alaska red.............	70.88	5.26	21.79	2.35	.64	.0455	....

FRESH SALMON (CAUGHT MAY 7, 1912), EDIBLE PORTIONS.

	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Puget Sound sockeye...........	67.48	8.86	22.24	1.36	....	0.0121	0.0205
Puget Sound steelhead or salmon trout.....................	67.89	9.39	21.80	1.35	....	.0135	.0218

[a] Each sample is average of two or more cans. All samples, except No. 2, are old form 1-pound tall cans. No. 2 is ½-pound flat cans.
[b] Represents the fat.
[c] Represents the salt.

ANALYSES OF CANNED SALMON BY SOUTH DAKOTA AUTHORITIES.

In 1916 the South Dakota Food and Drug Department analyzed a considerable number of samples of canned salmon for the purpose of determining, if possible, whether inferior grades of the fish were substituted for the better grades, and for the further purpose of discovering some means of identifying the different types of salmon by chemical analysis.

Thirty-three samples of commercial canned salmon, including 30 different brands, were analyzed. Thirteen of these were labeled as belonging to the sockeye class, five to the coho, six to the humpback, and one to the chum. Five samples were not labeled as to variety. One sample was labeled "Salmon Steaks" and two samples were labeled "Fresh Alaska." The last eight samples, because they were not labeled to show the common name of the fish contained in the can, were in violation of the F. I. D. No. 105 referred to above.

All of the cans but one were labeled to show the net weight of fish in the can. Sixteen per cent of them contained less than the declared amount of contents, but the greatest shortage was but 3.1 per cent of the declared weight, while the greatest excess in weight was 18.7 per cent of the declared weight. The weight is usually stated considerably under the actual amount of the contents.

The amount of liquid in the cans is an important factor to consider in computing the value of the contents. The free liquor in the cans examined varied widely from 3.95 per cent in sample number 15–209, labeled salmon steaks, to 26.54 per cent in sample number 15–63, which was not labeled as to variety. As a rule, the largest amount of free liquor is found in the lower priced grades, but there are exceptions, notably number 15–70, which contained 24.14 per cent of free liquor.

It will be noticed from the results given in the table that the amount of total moisture varies inversely as the amount of fat (called ether extract in the table). That is, salmon containing an excessive amount of moisture contains little fat, but those samples which contain the lower amounts of moisture contain the largest amounts of fat. The protein content seems to be fairly constant in all samples, the average amount

[a] Salmon Canning Industry of North America. By H. M. Loomis. Original communications, Eighth International Congress of Applied Chemistry, Washington and New York, Sept. 4 to 13, 1912, Vol. XVIII, pp. 239–245. The Rumford Press, Concord, N. H.

being 19.34 per cent, while the minimum found is 15.66 per cent and the maximum 22.45 per cent. The total phosphoric acid varies from 4.2 per cent to 9.8 per cent, the average being 6.6 per cent.

As would be expected, the samples containing the larger proportions of fat liberate the larger quantities of heat units, or calories, per pound, and it will be noted that the price is not in all cases an accurate measure of value, some of the higher priced varieties being in reality much lower in actual cost, when their food value is taken into consideration, than some of the cheaper varieties.[a]

The table below has been condensed from that shown in the report. The brand, name of the jobber, and the data about these samples, where the species is not shown on the label, have been eliminated, as they were not essential to our purpose. All of the other data have been reproduced exactly as they appeared in the original report. Not a single one of the samples apparently bore the packer's label, all being jobber's labels.

Laboratory No.	Variety.	Total moisture.	Ether extract.	Protein.	Ash.	
					Soluble.	Insoluble.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
15-56	Red	52.32	17.68	19.50	2.15	0.81
15-210	Fancy sockeye	59.29	16.83	18.28	1.63	.88
15-209	Salmon steaks	60.45	17.96	17.31	1.47	.33
15-60	Fancy red	60.46	15.40	18.22	1.33	2.89
15-72	Sockeye	60.80	18.19	19.15	.81	.78
15-65	....do	60.95	15.94	18.56	1.50	1.11
15-59	Red sockeye	61.60	15.48	16.89	1.99	.57
15-64	....do	62.18	13.10	19.13	1.45	.65
15-204	Red Alaska	65.44	10.57	20.31	2.15	.51
15-58	Coho salmon	65.65	9.62	17.32	1.61	1.33
15-220	Red Alaska	66.12	8.63	21.22	1.73	.62
15-64	Coho salmon	67.18	9.59	17.60	1.18	1.20
15-222	Pink salmon	69.53	6.62	20.48	1.85	.78
15-219	Red salmon	69.87	6.36	20.38	2.24	.57
15-207	Pink salmon	70.45	7.28	17.66	1.53	.90
15-221	Chum	70.52	4.57	19.73	.80	.72
15-205	Red salmon	70.86	4.04	21.11	1.60	1.13
15-70	....do	71.45	4.47	20.75	2.15	1.60
15-61	Pink salmon	71.64	4.35	18.31	1.56	1.01
15-208	Gorbouscha[b]	73.17	5.33	17.35	1.27	.45
15-206	Alaska salmon[c]	73.30	2.43	21.22	1.45	.96
15-214	....do	73.76	3.98	18.31	1.62	.54
15-57	Pink Alaska	74.08	3.90	15.66	1.50	1.02

Laboratory No.	Variety.	Phosphoric acid.[d]		Sodium chloride.	Calories per lb.	Price per lb.
		Soluble.	Insoluble.			
		Per cent.	Per cent.	Per cent.	Number.	Value.
15-56	Red	4.2	3.5	1.45	1,110	$0.31
15-210	Fancy sockeye	4.2	4.0	.81	1,050	.30
15-209	Salmon steaks	3.7	1.5	.51	1,080	.36
15-60	Fancy red	2.8	3.8	.53	990	.29
15-72	Sockeye	3.1	3.7	.14	1,125	.25
15-65	....do	2.2	5.3	.68	1,020	.29
15-59	Red sockeye	3.6	2.6	1.10	965	....
15-64	....do	3.2	3.5	.60	910	.30
15-204	Red Alaska	4.0	2.3	1.15	825	....
15-58	Coho salmon	2.5	5.7	1.02	730	.25
15-220	Red Alaska	1.9	2.8	.82	760	....
15-64	Coho salman	2.4	5.9	.53	730	.21
15-222	Pink salmon	1.8	3.6	.90	660	....
15-219	Red salmon	2.0	2.7	1.26	545	....
15-207	Pink salmon	3.4	4.1	.74	635	.15
15-221	Chum	1.0	4.1	Trace.	565	....
15-205	Red salmon	3.3	3.2	.65	560	.30
15-70	....do	2.7	3.1	1.17	575	.30
15-61	Pink salmon	2.4	4.7	.81	525	.15
15-208	Gorbouscha[b]	2.9	2.1	.45	550	....
15-206	Alaska salmon[c]	2.7	4.4	.66	500	.15
15-214	....do	1.7	2.5	.75	510	.15
15-57	Pink Alaska	2.0	4.5	.85	455	.25

[a] Bulletin, South Dakota Food and Drug Department, Vol. IV, Nos. 2 and 3, October-December, 1916, pp. 8-11.

[b] Probably pink salmon (author). [c] Probably chum salmon (author). [d] Mgm. of P_2O_5 per gram.

ANALYSIS OF SALTED SALMON.

Falkenburg & Co., of Seattle, have recently made an analysis of the food value of salted salmon, as follows:[a]

Regarding the salmon recently inspected and analyzed for you by ourselves with the following results:

Protein	21.97 per cent.
Fat	4.34 per cent.
Salt	19.08 per cent.
Ash	.84 per cent.
Moisture	54.35 per cent.
Calories per pound	592

If this salmon were freshened, as is the custom in preparing it for the table, removing all but about 2 per cent of the salt, the fish would then have the following analysis:

Protein	27.13 per cent.
Fat	5.36 per cent.
Salt	2.47 per cent.
Moisture	65.11 per cent.
Ash	1.03 per cent.
Calories per pound	734

Bulletin No. 28 of the United States Department of Agriculture, "Chemical Composition of American Food Products" gives on page 51 the food value of the average canned salmon as purchased as follows:

Refuse	14.2 per cent.
Protein	19.5 per cent.
Fat	7.5 per cent.
Ash	2.0 per cent.
Moisture	56.8 per cent.
Calories per pound	680

STATISTICS OF THE SALMON OUTPUT.

SALMON CATCH IN 1918.

The following tables show the total catch, by species, of salmon and steelhead trout on the Pacific coast of North America in 1918, and the catch, by apparatus and species, for each geographic section of Alaska and Washington in 1918:

SUMMARY, BY SECTION AND SPECIES, OF PACIFIC COAST SALMON CATCH IN 1918.

Section.	Pounds.
Alaska:	
Coho, or medium red	17,470,086
Chum, or keta	113,286,544
Humpback, or pink	193,265,448
King, or spring	16,010,764
Red, or sockeye	176,690,325
Total	516,723,167
Washington:	
Coho, or medium red	12,621,704
Chum, or keta	10,153,240
Humpback, or pink	353,568
King, or spring	20,907,322
Washington—Continued.	
Steelhead	1,446,733
Sockeye, or red	4,127,280
Total	49,609,847
Oregon: Salmon [b] [c]	34,551,253
California: Salmon [b]	13,026,076
British Columbia: Salmon [b]	152,992,500
Grand total	766,902,843

[a] Pacific Fisherman, Seattle, Wash., Vol. XVII, No. 4, April, 1919, p. 76.
[b] Species not given separately.
[c] Estimated.

SALMON CATCH IN 1918, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA.[a]

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Seines:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Coho, or silver	2,239,596	546,966	23,454	2,810,016
Chum, or keta	42,507,872	15,239,240	1,744,418	59,491,560
Humpback, or pink	53,774,192	19,615,380	443,501	73,833,076
King, or spring	368,830	32,296	119,658	520,784
Red, or sockeye	3,979,215	9,528,400	4,492,510	18,000,125
Total	102,869,705	44,962,282	6,823,574	154,655,561
Gill nets:				
Coho, or silver	1,495,494	2,757,504	763,164	5,016,162
Chum, or keta	1,589,760	2,199,696	5,459,944	9,249,400
Humpback, or pink	365,540	118,388	885,992	1,369,920
King, or spring	460,570	1,983,190	2,040,808	4,484,568
Red, or sockeye	2,583,605	8,688,790	117,100,100	128,372,495
Total	6,494,969	15,747,568	126,250,008	148,492,545
Pound nets:				
Coho, or silver	4,198,356	2,030,592	60,000	6,288,948
Chum, or keta	29,164,536	11,275,288	1,681,560	42,121,384
Humpback, or pink	96,348,688	19,941,668	1,722,468	118,012,824
King, or spring	696,674	614,922	217,844	1,529,440
Red, or sockeye	7,113,930	20,191,895	1,892,915	29,198,740
Total	137,522,184	54,054,365	5,574,787	197,151,336
Lines:				
Coho, or silver	1,802,370			1,802,370
Chum, or keta	236,000			236,000
Humpback, or pink	37,076			37,076
King, or spring	8,177,818			8,177,818
Red, or sockeye	105,540			105,540
Total	10,358,804			10,358,804
Dip nets:				
Coho, or silver		51,018		51,018
King, or spring		195,580		195,580
Red, or sockeye		1,013,425		1,013,425
Total		1,260,023		1,260,023
Wheels:				
Coho, or silver			1,501,572	1,501,572
Chum, or keta			2,188,200	2,188,200
Humpback, or pink			12,552	12,552
King, or spring			1,102,574	1,102,574
Total			4,804,898	4,804,898
Total:				
Coho, or silver	9,735,816	5,386,080	2,348,190	17,470,086
Chum, or keta	73,498,168	28,714,224	11,074,152	113,286,544
Humpback, or pink	150,525,496	39,675,436	3,064,516	193,265,448
King, or spring	9,703,892	2,825,988	3,480,884	16,010,764
Red, or sockeye	13,782,290	39,422,510	123,485,525	176,690,325
Grand total	257,245,662	116,024,238	143,453,267	516,723,167

[a] Figured from data in "Alaska Fisheries and Fur Industries in 1918," pp. 42, 43. By Ward T. Bower. U. S. Bureau of Fisheries Document No. 872, Appendix VII, Report U. S. Commissioner of Fisheries, 1918. Washington, 1919. In changing from number of fish to pounds the species were figured on the following basis: Coho, 6 pounds; chum, 8 pounds; humpback, 4 pounds; king, 22 pounds; and red, 5 pounds.

SALMON CATCH IN 1918, BY APPARATUS AND SPECIES FOR EACH GEOGRAPHIC DISTRICT OF WASHINGTON.

Apparatus and species.	Puget Sound.	Grays Harbor.	Willapa Harbor.	Columbia River.	Total.
Seines, drag:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Coho, or silver	148,086			41,898	189,984
Chum, or keta	478,304			5,600	483,904
Chinook, or spring	21,208			470,448	491,656
Humpback, or pink	92			908	1,000
Sockeye, or red	385			67,845	68,230
Steelhead				158,568	158,568
Total	648,075			745,267	1,393,342
Seines, purse:					
Coho, or silver	3,083,838			145,908	3,229,746
Chum, or keta	6,398,664				6,398,664
Chinook, or spring	325,182			952,116	1,277,298
Humpback, or pink	12,388			1,540	13,928
Sockeye, or red	225,365			935	226,300
Steelhead	95,320			27,840	123,160
Total	10,140,757			1,128,339	11,269,096
Pound, or trap, nets:					
Coho, or silver	4,219,038	55,272	253,404	577,398	5,105,112
Chum, or keta	1,390,256	22,920	132,528	93,496	1,639,200
Chinook, or spring	8,392,098	50,754	180,488	2,109,294	10,732,634
Humpback, or pink	240,724			688	241,412
Sockeye, or red	2,479,550			90,355	2,569,905
Steelhead	95,864	56	112	432,016	528,048
Total	16,817,530	129,002	566,532	3,303,247	20,816,311
Gill nets:					
Coho, or silver	1,072,860	423,570	102,162	310,698	1,909,290
Chum, or keta	749,104	102,256	40,640	262,336	1,154,336
Chinook, or spring	856,812	415,866	133,408	4,783,284	6,189,370
Humpback, or pink	6,072			12,320	18,392
Sockeye, or red	88,260	4,125	15	534,115	626,515
Steelhead	19,624	4,120	344	396,824	420,912
Total	2,792,732	949,937	276,569	6,299,577	10,318,815
Set nets:					
Coho, or silver	586,776	327,780	133,508	11,340	1,059,404
Chum, or keta	211,568	95,936	130,888	13,024	451,416
Chinook, or spring	332,662	168,652	28,930	103,004	633,248
Humpback, or pink	2,216	644		26,072	28,932
Sockeye, or red	770	1,630	470	105,975	108,845
Steelhead	66,528	26,832	4,552	62,256	160,168
Total	1,200,520	621,474	298,348	321,671	2,442,013
Reef nets:					
Coho, or silver	75,804				75,804
Chum, or keta	7,312				7,312
Chinook, or spring	33,330				33,330
Humpback, or pink	49,792				49,792
Sockeye, or red	10,180				10,180
Total	176,418				176,418
Fish wheels:					
Coho, or silver				66	66
Chinook, or spring				212,410	212,410
Sockeye, or red				508,915	508,915
Steelhead				53,408	53,408
Total				774,799	774,799
Bag nets:					
Coho, or silver	300				300
Chum, or keta	16,400				16,400
Chinook, or spring	66			2,750	2,816
Steelhead				808	808
Total	16,766			3,558	20,324

Salmon Catch in 1918, by Apparatus and Species for Each Geographic District of Washington—Continued.

Apparatus and species.	Puget Sound.	Grays Harbor.	Willapa Harbor.	Columbia River.	Total.
Hooks and lines:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Coho, or silver	638,436	34,170	3,036	376,356	1,051,998
Chum, or keta	960	888		160	2,008
Chinook, or spring	391,312	8,160	1,184	933,904	1,334,560
Humpback, or pink	112				112
Sockeye, or red	2,645			5,745	8,390
Steelhead	64			1,597	1,661
Total	1,033,529	43,218	4,220	1,317,762	2,398,729
Total:					
Coho, or silver	9,825,138	840,792	492,110	1,463,664	12,621,704
Chum, or keta	9,252,568	222,000	304,056	374,616	10,153,240
Chinook, or spring	10,352,670	643,432	344,010	9,567,210	20,907,322
Humpback, or pink	311,396	644		41,528	353,568
Sockeye, or red	2,807,155	5,755	485	1,313,885	4,127,280
Steelhead	277,400	31,008	5,008	1,133,317	1,446,733
Grand total	32,826,327	1,743,631	1,145,669	13,894,220	49,609,847

BRISTOL BAY WATERS SALMON CATCH, 1913 TO 1917.

Broadly speaking, about one-third of the yield of salmon from Alaskan waters comes from the important Bristol Bay region. The following table shows the catches made in the more important waters fished in the Bristol Bay district in the period of five years from 1913 to 1917:

Salmon Catch, by Streams, in Bristol Bay Region, 1913 to 1917.[a]

Species and stream.	1913	1914	1915	1916	1917	Total.
Red salmon:	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*	*Number.*
Nushagak	5,236,008	6,174,097	5,676,457	3,592,574	5,679,818	26,358,954
Igushik	173,925	283,718	228,405	223,343	167,421	1,076,812
Kviehak-Naknek	13,691,050	12,584,809	7,156,488	11,551,086	15,762,582	60,746,015
Ugaguk	902,728	897,767	1,216,252	1,578,862	1,856,600	6,452,209
Ugashik	577,615	254,716	509,076	647,422	1,047,111	3,035,940
Total	20,581,326	20,195,107	14,786,678	17,593,287	24,513,532	97,669,930
King salmon:						
Nushagak	67,622	89,599	116,281	81,591	73,839	428,932
Igushik	34	94	106	330	477	1,041
Kviehak-Naknek	5,648	10,657	29,392	20,934	16,155	82,786
Ugaguk	251	405	510	365	143	1,677
Ugashik	691	1,209	1,739	1,904	531	6,074
Total	74,249	101,964	148,028	105,124	91,145	520,510
Coho salmon:						
Nushagak	66,640	81,434	117,172	293,210	62,260	620,716
Kviehak-Naknek	2	17,462	13,271	288	3	31,026
Ugaguk	165	165				330
Total	66,807	99,061	130,443	293,498	62,263	652,072
Pink and chum salmon:						
Nushagak	683,201	932,477	444,146	1,818,566	303,437	4,181,827
Igushik				738	183	921
Kviehak-Naknek	13,940	173,831	232,082	304,117	83,019	806,989
Ugaguk	7,450	7,450	12,004	7,500	5,726	40,130
Ugashik	14,704	14,613	18,212	49,196	879	97,604
Total	719,295	1,128,371	706,444	2,180,117	393,244	5,127,471
Grand total	21,441,677	21,524,503	15,771,593	20,172,026	25,060,184	103,969,983

[a] From "Alaska Fisheries and Fur Industries in 1917," p. 32. By Ward T. Bower and Henry D. Aller. Appendix II, Report, U. S. Commissioner of Fisheries, 1917. Washington, 1918.

PACK OF CANNED SALMON IN 1919.

The following table shows, by species, grades, and sizes, the pack of canned salmon for the Pacific coast of North America in 1919:

PACK OF CANNED SALMON ON THE PACIFIC COAST IN 1919.[a]

Species, grades, and sizes.	Alaska.	Puget Sound.	Hoh River.	Queets River.	Quinault River.	Grays Harbor.	Willapa Harbor.	Columbia River.
Coho, silver, or medium red:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
½-pound flat	10,087	15,640	....	175	....	2,548	....	14,387
1-pound flat	10,357	32,936	....	....	....	2,167	....	27,471
1-pound tall	209,694	162,307	233	850	775	7,499	2,927	48,870
Total	230,138	210,883	233	1,025	775	12,214	2,927	90,728
Chinook or king, red:								
Fancy—								
½-pound flat	....	....	....	....	....	....	....	143,558
1-pound flat	8,323	....	....	....	....	....	....	130,056
1-pound tall	20,259	....	....	....	....	....	....	38,749
Standard—								
½-pound flat	7,422	21,685	....	450	....	1,454	....	24,279
1-pound flat	2,961	8,398	....	....	....	506	....	25,038
1-pound tall	112,768	35,874	....	....	165	2,410	1,152	30,445
Total	151,733	65,957	....	450	165	4,370	1,152	392,125
Chinook or king, white:								
½-pound flat	....	172	....	....	....	....	....	....
1-pound tall	....	2,413	....	....	....	....	....	....
Total	....	2,585	....	....	....	....	....	....
Chum or keta:								
½-pound flat	3,846	3,403	....	....	....	6	....	3,018
1-pound flat	....	3,242	....	....	....	2,739	....	2,129
1-pound tall	1,344,616	518,896	332	50	650	25,967	9,125	70,346
Total	1,348,462	525,541	332	50	650	28,712	9,125	75,493
Humpback or pink:								
½-pound flat	27,776	17,379	....	....	....	....	....	....
1-pound flat	7,548	41,574	....	....	....	....	....	....
1-pound tall	1,622,110	362,262	18	....	....	....	....	....
Total	1,657,434	421,215	18	....	....	....	....	....
Sockeye or red:								
½-pound flat	116,205	43,556	....	100	1,144	....	....	7,268
1-pound flat	109,933	13,688	....	....	....	....	....	....
1-pound tall	978,205	7,102	....	....	....	....	....	....
Total	1,204,343	64,346	....	100	1,144	....	....	7,268
Steelhead trout:								
½-pound flat	....	....	....	....	....	....	....	7,212
1-pound flat	....	5,099	....	....	....	....	....	5,896
1-pound tall	91	....	....	....	....	....	....	1,306
Total	91	5,099	....	....	....	....	....	14,414
Grand total	4,592,201	1,295,626	583	1,625	2,734	45,296	13,204	580,028

[a] Reduced to a common basis of forty-eight 1-pound cans to the case.

PACK OF CANNED SALMON ON THE PACIFIC COAST IN 1919—Continued.

Species, grades, and sizes.	Nehalem River.	Tillamook Bay.	Nestugga River.	Alsea Bay and River.	Siletz River.	Siuslaw River.	Umpqua River.	Coquille River.
Coho, silver, or medium red:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
½-pound flat	...	4,000	300	1,658	300	...	...	1,364
1-pound flat	...	...	100	525	200			...
1-pound tall	8,124	3,150	2,000	424	5,392	3,760	7,500	3,646
Total	8,124	7,150	2,400	2,607	5,892	3,760	7,500	5,010
Chinook or king, red:								
Standard—								
½-pound flat	...	1,000	1,500	1,157	500	...	...	1,027
1-pound flat	...	...	100	100	19	...	...	...
1-pound tall	500	500	300	1,255	874	...	...	...
Total	500	1,500	1,900	2,512	1,393	...	...	1,027
Chum or keta:								
½-pound flat	...	3,150	50	50	...	...	...	...
1-pound tall	1,183	1,200	400	485	472	...	...	45
Total	1,183	4,350	450	535	472	...	...	45
Grand total	9,807	13,000	4,750	5,654	7,757	3,760	7,500	6,082

Species, grades, and sizes.	Rogue River.	Smith River.	Klamath River.	Sacramento River.	Noyo River.	Monterey Bay.	British Columbia.	Total.
Coho, silver, or medium red:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
½-pound flat	227	...	625	...	...	...	92,890	144,201
1-pound flat	444	...	520	...	...	...	5,201	79,921
1-pound tall	...	...	...	...	...	...	101,902	569,053
Total	671	...	1,145	...	...	...	199,993	793,175
Chinook or king, red:								
Fancy—								
½-pound flat	4,000	...	...	...	...	...	...	147,558
1-pound flat	3,000	...	...	...	...	...	...	141,379
1-pound tall	1,580	...	...	...	...	...	...	60,588
Standard—								
½-pound flat	4,710	4,271	1,870	...	4,500	...	45,726	121,551
1-pound flat	3,947	95	4,421	401	3,000	...	2,892	51,878
1-pound tall	...	...	...	768	...	2,000	33,638	222,649
Total	17,237	4,366	6,291	1,169	7,500	2,000	82,256	745,603
Chinook or king, white:								
½-pound flat	...	...	...	...	...	...	4,016	4,188
1-pound flat	...	...	...	...	...	...	346	346
1-pound tall	...	...	...	...	...	...	13,933	16,346
Total	...	...	...	...	...	...	18,295	20,880
Chum or keta:								
½-pound flat	...	...	...	...	...	...	49,257	62,780
1-pound flat	...	...	...	...	...	...	11,984	20,094
1-pound tall	...	...	...	...	...	...	310,794	2,284,561
Total	...	...	...	...	...	...	372,035	2,367,435
Humpback or pink:								
½-pound flat	...	...	...	...	...	...	127,435	172,590
1-pound flat	...	...	...	...	...	...	14,839	63,961
1-pound tall	...	...	...	...	...	...	204,365	2,188,755
Total	...	...	...	...	...	...	346,639	2,425,306
Sockeye or red:								
½-pound flat	...	...	...	...	...	...	293,720	461,993
1-pound flat	...	...	...	...	...	...	13,339	136,960
1-pound tall	...	...	...	...	...	...	59,945	1,045,252
½-pound oval	...	...	...	...	...	...	1,941	1,941
1-pound oval	...	...	...	...	...	...	500	500
Total	...	...	...	...	...	...	369,445	1,646,646
Steelhead trout:								
½-pound flat	...	...	145	...	...	...	3,586	10,943
1-pound flat	...	...	150	...	...	...	116	11,261
1-pound tall	...	...	...	...	...	...	791	2,188
Total	...	...	295	...	...	...	4,493	24,392
Grand total	17,908	4,366	7,731	1,169	7,500	2,000	1,393,156	8,023,437

CANNING INDUSTRY, 1864 TO 1919.

SUMMARY OF CANNING INDUSTRY.

From the beginning of the canning of salmon on this coast it has been the most important branch of the industry, and the following table shows in condensed form the number of cases packed in each year on the Pacific coast of North America from the beginning of the industry in 1864 to 1919, both inclusive.

As British Columbia is a Province of the Dominion of Canada it does not come strictly within the scope of this report, but in order to show the pack of canned salmon on the North American shores of the Pacific Ocean, which would be incomplete without that of the Province, it has been included also.

PACK OF CANNED SALMON ON THE PACIFIC COAST, BY YEARS AND WATERS.

Year.	Puget Sound.	Coastal streams of Washington.	Grays Harbor.	Willapa Harbor.	Columbia River.	Coastal streams of Oregon.	Smith River, Calif.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
1866	...	...	...	...	4,000	...	...
1867	...	...	...	...	18,000	...	...
1868	...	...	...	...	28,000	...	...
1869	...	...	...	...	100,000	...	...
1870	...	...	...	...	150,000	...	...
1871	...	...	...	...	200,000	...	...
1872	...	...	...	...	250,000	...	...
1873	...	...	...	...	250,000	...	...
1874	...	...	...	...	350,000	...	...
1875	...	...	...	...	375,000	...	...
1876	...	...	...	...	450,000	...	...
1877	5,500	...	...	...	380,000	7,804	...
1878	238	...	5,42	...	460,000	26,934	4,277
1879	1,300	...	...	...	480,000	8,571	...
1880	5,100	...	...	...	530,000	7,772	7,500
1881	8,500	...	...	...	550,000	12,320	...
1882	7,900	...	...	...	541,300	19,186	...
1883	1,500	...	...	...	629,400	23,156	...
1884	5,500	...	...	...	620,000	27,876	5,500
1885	12,000	...	8,200	...	553,800	33,410	1,550
1886	17,000	...	18,700	13,600	448,500	77,547	...
1887	22,000	...	...	...	356,000	73,996	...
1888	21,975	...	37,000	22,500	372,477	92,863	2,347
1889	11,674	...	...	...	309,885	98,800	...
1890	8,000	...	...	...	435,774	47,009	...
1891	20,529	...	500	8,000	398,953	24,500	...
1892	26,426	...	16,500	14,500	487,338	83,600	...
1893	89,774	...	22,000	16,195	415,876	52,778	2,000
1894	95,400	...	21,400	15,100	490,100	54,815	2,000
1895	179,968	...	11,449	22,600	634,696	77,878	2,250
1896	195,664	...	21,274	24,941	481,697	91,860	...
1897	494,026	...	13,300	29,600	552,721	68,683	...
1898	400,200	...	12,100	21,420	487,944	83,209	...
1899	919,611	...	24,240	21,314	332,774	82,041	...
1900	469,450	...	30,800	26,300	358,772	12,237	...
1901	1,380,590	...	41,500	34,000	390,183	58,618	...
1902	581,659	...	31,500	39,492	317,143	44,236	...
1903	478,488	...	...	5,890	339,577	54,861	...
1904	291,488	...	27,559	26,400	395,104	98,874	...
1905	1,018,641	...	22,050	14,950	397,273	89,055	...
1906	430,602	...	22,000	14,440	394,898	107,332	...
1907	698,080	...	14,000	13,382	324,171	79,712	...
1908	448,765	...	14,000	20,457	277,719	83,994	...
1909	1,678,737	...	21,436	12,024	274,196	58,169	...
1910	567,883	...	55,480	11,508	391,415	104,617	...
1911	1,551,028	18,431	75,941	25,497	553,331	138,146	...
1912	416,119	19,914	47,287	28,148	286,026	84,074	...
1913	2,583,463	13,124	19,895	12,050	266,479	38,492	...
1914	817,354	21,459	32,434	16,837	454,621	106,617	3,000
1915	1,269,206	31,735	40,992	12,842	558,534	80,499	3,033
1916	1,052,917	15,777	60,336	18,553	547,861	81,924	2,505
1917	1,990,258	13,324	42,696	8,379	553,346	84,475	6,300
1918	622,732	13,732	35,972	8,827	591,381	92,241	4,653
1919	1,295,626	4,942	45,296	13,204	580,028	76,218	4,366
Total	22,192,871	152,438	893,257	572,950	21,376,293	2,750,999	51,281

PACK OF CANNED SALMON ON THE PACIFIC COAST, BY YEARS AND WATERS—Con.

Year.	Klamath River, Calif.	Eel River, Calif.	Noyo River, Calif.	Sacramento River.	Alaska.	British Columbia.	Total.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*[a]
1864				2,000			2,000
1865				2,000			2,000
1866							4,000
1867							18,000
1868							28,000
1869							100,000
1870							150,000
1871							200,000
1872							250,000
1873							250,000
1874				2,500			352,500
1875				3,000			378,000
1876				10,000		7,247	467,247
1877		8,500		21,500		58,387	481,691
1878		10,500		34,017	8,159	89,946	639,491
1879				13,855	12,530	61,093	577,349
1880		6,250		62,000	6,539	61,849	687,010
1881				181,200	8,977	169,576	930,573
1882				200,000	21,745	240,461	1,030,592
1883		15,000		123,000	48,337	163,438	1,003,831
1884		8,200		81,450	64,886	123,706	937,118
1885		5,750		90,000	83,415	108,517	896,642
1886		12,500		39,300	142,065	152,964	922,176
1887				36,500	206,677	204,083	899,256
1888	4,400			68,075	412,115	184,040	1,217,792
1889				57,300	719,196	417,211	1,614,066
1890				25,065	682,591	411,257	1,609,696
1891				10,353	801,400	314,511	1,578,746
1892	1,047			2,281	474,717	248,721	1,355,130
1893	1,600			23,336	643,654	610,202	1,877,415
1894	1,700			28,463	686,440	492,232	1,887,650
1895	1,600			25,185	626,530	587,692	2,169,848
1896				13,387	966,707	617,782	2,413,312
1897				38,543	909,078	1,027,183	3,133,134
1898				29,731	965,097	492,551	2,492,252
1899	1,600			32,580	1,078,146	765,519	3,257,825
1900				39,304	1,548,139	606,540	3,091,542
1901				17,500	2,016,804	1,247,212	5,186,407
1902	2,500			14,043	2,536,824	627,161	4,194,558
1903				8,200	2,246,210	473,674	3,606,900
1904	3,400			14,407	1,953,756	465,894	3,276,882
1905				2,780	1,894,516	1,167,460	4,606,725
1906					2,219,044	629,460	3,817,776
1907					2,169,873	547,459	3,846,677
1908					2,618,048	542,689	4,005,672
1909	5,633				2,395,477	967,920	5,413,592
1910	8,016	6,000			2,413,054	762,201	4,320,174
1911	7,604	8,400		4,142	2,823,817	948,965	6,155,302
1912	18,000	11,000			4,054,641	996,576	5,961,785
1913	6,376			950	3,739,185	1,353,901	8,033,915
1914	11,000			17,315	4,056,653	1,111,039	6,648,329
1915	12,900			[b] 6,179	4,500,293	1,133,381	7,649,594
1916	8,884			[c] 19,445	4,900,627	995,065	7,703,894
1917	8,030			[d] 11,443	5,947,286	1,557,485	10,223,022
1918	10,200		2,000	4,036	6,605,835	1,616,157	9,607,766
1919	7,731		7,500	[d] 3,169	4,592,201	1,393,156	8,023,437
Total	122,221	92,100	9,500	1,419,534	74,801,284	26,753,563	151,188,291

[a] Reduced to a common basis of forty-eight 1-pound cans to the case.
[b] Includes 950 cases packed at Monterey.
[c] Includes 12,809 cases packed at Monterey.
[d] Includes 2,000 cases packed at Monterey.

CANNING INDUSTRY, BY SPECIES AND WATERS.

The tables which follow show separately, by waters and as far as possible by species, the salmon canned on the Pacific coast from the beginning of the industry until 1919. It is only within recent years that the published statistics have shown the pack of the different species separately. In the early years of canning the chinook, or quinnat, salmon was used exclusively, the other species not being utilized until the chinook had begun to decrease in abundance, or a demand had arisen for a cheaper product. There is a very great difference in the selling value of the highest and lowest grades, and it is necessary to have complete statistical data now in order intelligently to comprehend the trend of the industry. While every effort has been made to make these tables complete, there are, unfortunately, some gaps which it was found impossible to fill. Such ellipses indicate that either the canneries did not operate or that no data were available for such periods.

Although there are only five species of salmon found on the Pacific coast, each bears several common names which are in general use in one or more of the many fishing districts. Trade names of each species as known in each district follow:

Districts.	1	2	3	4	5
Alaska	Red	King	Coho Medium Red. Silver.	Pink	Chum.
British Columbia	Sockeye	Spring	Coho	Humpback	Keta.
Puget Sound	do	Tyee Spring	do	do	Chum.
Columbia River	Blueback	Chinook	Silverside	(None packed)	Do.
Outside rivers	Quinault	Quinnat	do	do	Do.

PACK OF CANNED SALMON ON PUGET SOUND IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Sockeye.		Medium red or silver.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1877	1	......	......	......	......	5,000	......
1878	1	......	......	......	......	238	......
1879	1	......	......	......	......	1,300	$5,690
1880	1	......	......	......	......	......	......
1881	1	......	......	......	......	......	......
1882	1	......	......	......	......	......	......
1883	1	......	......	......	......	......	......
1884	1	......	......	......	......	......	......
1888	4	......	......	......	......	......	......
1889	2	240	$1,200	......	......	7.480	37,400
1890	1	1,000	5,000	......	......	3,000	15,000
1891	2	382	2,101	5,538	$24,921	5,869	19,308
1892	2	86	473	2,954	11,816	7,206	24,500
1893	3	1,200	6,480	47,852	103,371	11,812	59,000
1894	3	......	......	41,781	188,014	22,418	89,672
1895	7	1,542	7,325	65,143	273,108	50,865	154,218
1896	11	13,495	67,475	72,979	350,299	82,640	264,448
1897	12	9,500	39,045	312,048	1,248,192	91,900	282,133
1898	18	11,200	50,624	252,000	1,058,400	98,600	335,240
1899	19	24,364	103,180	499,646	2,368,334	111,387	418,176
1900	19	22,350	134,100	229,800	1,149,000	128,200	512,800
1901	......	......	......	1,220,000	......	......	......
1902	21	30,049	150,245	372,301	2,047,655	85,817	429,085
1903	22	14,500	72,500	167,211	1,003,260	103,450	413,800
1904	13	14,441	69,352	109,264	653,871	118,127	447,851
1905	24	1,804	9,922	825,453	4,952,718	79,335	337,174
1906	16	8,139	48,834	178,748	1,251,236	94,497	472,485
1907	14	1,814	16,326	93,122	698,416	119,472	476,288
1908	11	95,210	666,470	170,951	1,196,657	128,922	644,922
1909	24	13,019	72,604	1,097,904	6,183,300	143,133	630,446
1910	15	10,064	60,324	248,014	1,673,095	162,755	895,153
1911	21	21,823	172,582	127,769	1,168,145	256,123	1,711,178
1912	21	20,252	101,706	184,680	1,660,173	149,727	761,200
1913	32	1,234	5,247	1,673,099	10,871,178	61,019	235,372
1914	22	27,140	179,532	339,787	2,751,832	158,933	715,995
1915	40	28,466	145,555	64,584	676,769	180,783	902,335
1916	32	45,072	270,432	90,866	817,790	208,967	1,044,835
1917	45	70,918	638,262	454,336	4,543,360	115,860	926,880
1918	33	62,821	565,385	52,587	736,225	235,795	2,004,258
1919	35	68,542	856,775	64,346	1,029,536	[a] 210,883	2,529,996

[a] Includes 1,892 cases packed with reds brought from Alaska.

PACK OF CANNED SALMON ON PUGET SOUND IN SPECIFIED YEARS—Continued.

Year.	Canneries operated.	Chum.		Pink.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1877	1			500		5,500	
1878	1					238	
1879	1					1,300	$5,000
1880	1					5,100	
1881	1					8,500	
1882	1					7,900	
1883	1					1,500	
1884	1					5,500	
1885						12,000	
1886						17,000	
1887						22,000	
1888	4					21,975	126,356
1889	2	1,145	$3,435	2,809	$7,584	11,674	49,619
1890	1	4,000	12,000			8,000	32,000
1891	2	3,093	10,825	5,647	15,246	20,529	72,461
1892	2	16,180	56,630			26,426	93,419
1893	3	11,380	31,295	17,530	47,331	89,774	247,537
1894	3	22,152	60,918	9,049	24,432	95,400	363,036
1895	7	38,785	94,741	23,633	62,556	179,968	591,948
1896	11	26,550	73,013			195,664	755,235
1897	12	23,310	64,103	57,268	171,804	494,026	1,805,277
1898	18	38,400	105,600			400,200	1,549,864
1899	19	31,481	86,427	252,733	734,241	919,611	3,710,358
1900	19	89,100	245,025			469,450	1,940,925
1901						1,380,590	
1902	21	93,492	467,460			581,659	3,094,445
1903	22	12,001	30,002	181,326	407,984	478,488	1,927,546
1904	13	49,656	124,254			291,488	1,295,328
1905	24	41,057	102,643	70,992	212,976	1,018,641	5,615,433
1906	16	149,218	708,781			430,602	2,481,336
1907	14	50,249	150,847	433,423	1,300,269	698,080	2,642,146
1908	11	47,607	142,821	6,075	18,225	448,765	2,669,095
1909	24	53,688	128,916	370,993	902,342	1,678,737	7,917,608
1910	15	146,942	514,297	108	388	567,883	3,143,256
1911	21	98,321	391,123	1,046,992	4,302,344	1,551,028	7,745,372
1912	21	60,760	154,193	700	2,185	416,119	2,679,457
1913	32	56,225	124,970	791,886	2,092,401	2,583,463	13,329,168
1914	22	290,477	903,675	1,017	4,615	817,354	4,555,649
1915	40	411,724	1,155,474	583,649	1,795,285	1,269,206	4,675,418
1916	32	564,194	2,031,098	143,804	575,216	[a] 1,052,917	4,739,455
1917	45	218,977	1,270,067	1,130,163	6,780,978	[b] 1,990,258	14,159,583
1918	33	264,922	1,669,009	6,607	42,946	622,732	5,017,823
1919	35	525,541	3,363,462	421,215	3,369,720	[c] 1,295,626	11,149,489

[a] Includes 14 cases of steelheads, valued at $84. The totals also include large quantities of salmon brought to the sound canneries from other waters, principally in British Columbia, and packed here, these when prepared for market comprising approximately 141,917 cases of humpbacks or pinks, valued at $566,952; 136,316 cases of chums, valued at $538,937, and 53,135 cases of silvers, valued at $87,185; a grand total of 331,368 cases and $1,193,074.

[b] Includes 4 cases of steelheads, valued at $36.

[c] Includes 5,099 cases of steelheads from sound waters.

PACK OF CANNED SALMON ON SOLEDUCK RIVER, WASH., IN SPECIFIED YEARS.[a]

Year.	Canneries operated.	Chinook.		Sockeye.		Silverside.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1912	1	414	$2,484	15	$156	940	$4,324
1913	1	206	1,442			1,040	3,536
1914	1	237	1,185			1,439	5,574
1915	1	388	1,940			1,320	6,072

Year.	Canneries operated.	Pink.[b]		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1912	1	103	$268	76	$182	1,518	$7,414
1913	1			28	61	1,274	5,039
1914	1	189	567	103	291	1,968	7,617
1915	1	826	2,478	192	538	2,726	11,028

[a] None packed since 1915. [b] These are virtually all light-colored chinooks.

PACK OF CANNED SALMON ON HOH RIVER, WASH., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1917	1	372	$3,348	204	$1,665	110	$715	686	$5,728
1918	1	60	540	294	2,499	17	108	371	3,147
1919	1	18	216	233	2,796	332	2,125	583	5,137

PACK OF CANNED SALMON ON QUEETS RIVER, WASH., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Sockeye.		Silverside.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1912	1	750	$4,500	200	$2,080	2,500	$11,500
1913	1	1,082	7,574	220	1,848	1,680	5,712
1914	1	1,175	5,875	200	2,134	1,800	6,966
1915	1			1,512	9,072		
1916	1	1,506	9,036			617	3,085
1917	1	713	6,417			1,196	9,759
1918	1	381	3,429	20	280	1,138	9,673
1919	1	450	5,400	100	1,600	1,025	12,300

Year.	Canneries operated.	Chum.		Steelhead.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1912	1	1,000	$2,400			4,450	$20,480
1913	1	670	1,461	600	$3,300	4,252	19,895
1914	1	1,020	2,887	500	2,750	4,695	20,612
1915	1					1,512	9,072
1916	1	415	1,245			2,538	13,366
1917	1	47	306	129	1,161	2,085	17,643
1918	1			[a] 87	870	1,626	14,252
1919	1	50	320			1,625	19,620

[a] 68 cases of these were smoked.

PACK OF CANNED SALMON ON QUINAULT RIVER, WASH., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Sockeye.		Silverside.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1911[a]	1	5,000	$35,000	2,031	$16,000	6,000	$42,000
1912	2			4,500	40,500	3,916	18,014
1913	1			492	4,133	7,106	24,160
1914	2	51	255	12,074	120,740	1,623	6,281
1915	2	1,144	6,864	22,972	239,989	1,388	6,807
1916	2	1,365	8,190	10,315	92,835	1,093	5,465
1917	2	309	2,781	4,608	55,296	2,609	21,289
1918	2	1,497	13,473	2,470	30,869	6,086	51,731
1919	2	165	2,063	1,144	18,304	775	9,300

Year.	Canneries operated.	Chum.		Total.	
		Cases.	Value.	Cases.	Value.
1911[a]	1	5,400	$27,000	18,431	$120,000
1912	2	5,500	13,200	13,916	71,714
1913	1			7,598	28,293
1914	2	1,048	2,966	14,796	130,242
1915	2	1,993	5,580	27,497	259,240
1916	2	466	1,398	13,239	107,888
1917	2	1,821	11,836	[b] 10,553	98,438
1918	2	1,682	10,874	11,735	106,947
1919	2	650	4,160	2,734	33,827

[a] Previous to this date the fish were transported to the Aberdeen and Hoquiam canneries and prepared there.
[b] Includes 1,206 cases of humpbacks, valued at $7,236.

PACK OF CANNED SALMON ON GRAYS HARBOR IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1878	1							5,420	$29,268
1879	1								
1885								8,200	
1886								18,700	
1888	4							37,000	212,750
1891	1			500	$1,500			500	1,500
1892	1	4,500	$15,390	9,000	30,780	3,000	$9,415	16,500	55,585
1893	1	4,500	22,500	12,000	48,000	5,500	14,850	22,000	85,350
1894	1	12,300	61,500	4,100	16,400	5,000	13,500	21,400	91,400
1895	1	56	202	8,876	28,403	2,517	6,922	11,449	35,527
1896	2	7,816	36,806	9,278	29,689	4,180	11,495	21,274	57,990
1897	1	3,100	11,741	8,300	23,481	1,900	5,000	13,300	40,222
1898	2	5,100	23,052	4,800	16,320	2,200	6,050	12,100	45,422
1899	1	5,000	21,250	15,740	59,025	3,500	8,750	24,240	89,025
1900	2	6,700	33,500	12,900	51,600	11,200	30,800	30,800	115,900
1901								41,500	
1902	1	4,000	20,000	10,000	45,000	17,500	70,000	31,500	135,000
1904	2	4,339	20,163	14,904	51,854	8,316	21,022	27,559	93,039
1905	2	2,050	9,225	13,000	52,000	7,000	18,200	22,050	79,425
1906	2	2,500	10,000	11,500	43,900	8,000	21,500	22,000	75,400
1907	1	1,000	7,000	9,500	47,500	3,500	11,500	14,000	66,000
1908	1	1,000	7,000	9,500	47,500	3,500	11,500	14,000	66,000
1909	1	5,721	20,819	9,019	38,146	5,047	11,608	a 21,436	79,624
1910	3	15,495	90,718	21,768	108,840	13,867	48,534	b 55,480	272,017
1911	4	15,773	110,411	28,991	202,937	c 31,177	155,885	75,941	469,233
1912	5	9,060	54,360	26,162	120,345	12,065	28,956	47,287	203,661
1913	4	1,253	8,771	5,723	19,458	12,919	28,163	19,895	56,392
1914	4	11,899	59,495	9,156	35,434	11,379	32,203	32,434	127,132
1915	4	4,219	20,089	14,036	61,707	22,737	63,678	40,992	145,474
1916	5	12,400	74,403	11,580	57,898	32,560	117,744	d 60,336	265,229
1917	9	12,124	109,116	9,589	51,246	10,910	70,915	e 42,696	291,715
1918	6	8,731	99,912	21,994	201,705	5,247	37,915	35,972	339,532
1919	6	4,370	54,626	12,214	146,608	28,712	183,757	45,296	384,991

a Includes 1,649 cases, valued at $9,051, packed with sockeyes brought from Puget Sound.
b Includes 4,350 cases of "quinault," or sockeye, salmon, valued at $23,925.
c Includes 6,730 cases of humpbacks.
d Includes 3,796 cases of humpbacks, valued at $15,184.
e Includes 10,073 cases of humpbacks, valued at $60,438.

PACK OF CANNED SALMON ON WILLAPA HARBOR IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook or black.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1886								13,600	
1887	4								
1888	3							22,500	$129,375
1891	1			8,000	$24,000			8,000	24,000
1892	1	3,000	$10,260	9,000	30,780	2,500	$7,745	14,500	48,785
1893	1	1,700	9,180	7,895	31,580	6,600	18,150	16,195	58,910
1894	1	2,700	14,580	5,600	22,400	6,800	18,700	15,100	55,680
1895	2	4,636	23,180	13,047	41,150	4,917	13,222	22,600	77,552
1896	2	4,551	22,755	11,940	38,208	8,450	21,238	24,941	82,201
1897	1	8,100	33,291	14,600	44,822	6,900	18,975	29,600	97,088
1898	2	5,865	26,510	9,809	33,351	5,746	15,802	21,420	75,663
1899	3	5,650	25,425	10,675	40,031	4,989	13,720	21,314	79,176
1900	3	6,700	33,500	12,400	49,600	7,200	19,800	26,300	102,900
1901								34,000	
1902	2	5,836	29,186	9,128	41,076	24,528	97,112	39,492	167,368
1903	1	2,300	13,800	2,390	10,755	1,200	3,300	5,890	27,855
1904	2	3,000	12,000	7,400	28,440	16,000	38,700	26,400	79,140
1905	2	4,650	20,925	4,300	17,200	6,000	15,000	14,950	53,125
1906	2	4,000	16,000	5,340	21,360	5,100	13,260	14,440	50,620
1907	2	3,530	15,354	9,228	36,682	624	2,496	13,382	54,532
1908	2	4,017	20,585	5,923	23,692	10,517	36,809	20,457	81,086
1909	1	1,455	5,869	4,822	17,359	5,747	13,163	12,024	36,391
1910	1	2,923	15,077	5,096	25,480	3,489	22,711	11,508	63,268
1911	2	5,717	40,019	9,298	65,086	10,482	52,410	25,497	157,515
1912	3	6,123	36,738	8,030	36,938	9,533	22,879	a 28,148	108,156
1913	2	67	469	3,111	10,577	8,872	19,368	12,050	30,414
1914	3	2,924	14,431	7,179	27,749	6,734	19,077	16,837	61,256
1915	2	3,148	19,380	4,008	18,437	5,686	15,921	12,842	53,738
1916	2	5,115	30,690	3,365	16,825	10,073	36,262	18,553	83,777
1917	2	1,720	18,920	2,143	19,287	4,516	30,708	8,379	68,915
1918	2	921	10,131	5,249	50,390	2,657	18,599	8,827	79,120
1919	2	1,152	13,824	2,927	35,124	9,125	58,400	13,204	107,348

a Includes 4,462 cases of humpbacks, valued at $11,601.

PACK OF CANNED SALMON ON THE COLUMBIA RIVER FROM THE INCEPTION OF THE INDUSTRY TO 1919.

Year.	Canneries operated.	Chinook.		Blueback.		Silverside.	
		Cases.	Value.	Cases.	Value	Cases.	Value.
1866	1	4,000	$64,000				
1867	1	18,000	288,000				
1868	2	28,000	392,000				
1869		100,000	1,350,000				
1870		150,000	1,800,000				
1871		200,000	2,100,000				
1872		250,000	2,325,000				
1873		250,000	2,250,000				
1874	13	350,000	2,625,000				
1875	13	375,000	2,250,000				
1876	17	450,000	2,475,000				
1877		380,000	2,052,000				
1878	30	460,000	2,300,000				
1879	30	480,000	2,640,000				
1880	35	530,000	2,650,000				
1881	35	550,000	2,475,000				
1882		541,300	2,600,000				
1883		629,400	3,147,000				
1884		620,000	2,915,000				
1885		553,800	2,500,000				
1886	39	448,500	2,135,000				
1887		356,000	2,124,000				
1888	28	372,477	2,327,981				
1889	21	266,697	1,600,182	17,797	$101,051		
1890	21	335,604	1,946,087	57,345	290,069		
1891	22	353,907	2,038,566	15,482	284,242		
1892	24	344,267	1,996,388	66,547	372,909	4,176	$20,880
1893	24	288,773	1,559,374	30,459	152,295	29,107	116,428
1894	24	351,106	1,895,976	43,814	224,430	42,758	171,032
1895	24	444,909	2,428,658	18,015	86,523	99,601	329,683
1896	24	370,943	1,840,511	16,983	81,518	44,108	141,145
1897	22	432,753	1,804,221	12,972	51,888	60,850	197,762
1898	23	329,566	1,490,394	66,670	300,015	65,431	222,465
1899	17	255,824	1,458,175	23,969	134,723	29,608	112,055
1900	16	262,392	1,821,258	13,162	92,184	44,925	202,163
1902	14	270,580	1,428,743	17,037	86,465	10,532	44,732
1903	16	301,762	1,610,614	8,383	42,867	12,181	49,869
1904	20	320,378	1,944,690	12,911	78,048	31,254	118,357
1905	19	327,106	1,962,636	7,768	46,608	26,826	114,011
1906	19	311,334	1,868,007	7,816	54,712	41,446	124,338
1907	19	258,433		5,504		31,757	
1908	14	210,096		8,581		31,432	
1909	15	162,131	1,203,546	[a] 27,908	214,561	42,178	185,070
1910	15	244,285	1,882,137	6,234	34,287	68,922	363,688
1911	15	405,862	2,204,185	5,988	47,904	79,416	549,478
1912	15	220,317	1,988,526	8,210	85,384	31,842	177,248
1913	15	192,116	1,664,670	11,152	93,677	40,969	175,412
1914	17	289,464	2,573,502	35,311	376,924	69,769	380,666
1915	19	406,486	3,694,361	5,459	56,707	33,336	173,234
1916	20	395,166	3,572,203	3,790	27,288	52,084	335,114
1917	20	403,637	5,023,529	7,968	111,552	64,299	700,680
1918	20	400,952	5,222,983	37,833	605,328	98,145	1,072,843
1919	21	392,125	5,031,207	7,268	73,116	90,728	1,052,767

[a] Of these, 2,846 cases, valued at $23,203 were packed with sockeyes brought from Puget Sound.

PACK OF CANNED SALMON ON THE COLUMBIA RIVER FROM THE INCEPTION OF THE INDUSTRY TO 1919—Continued.

Year.	Canneries operated.	Chum.		Steelhead trout.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1866	1					4,000	$64,000
1867	1					18,000	288,000
1868	2					28,000	392,000
1869						100,000	1,350,000
1870						150,000	1,800,000
1871						200,000	2,100,000
1872						250,000	2,325,000
1873						250,000	2,250,000
1874	13					350,000	2,625,000
1875	13					375,000	2,250,000
1876						450,000	2,475,000
1877						380,000	2,052,000
1878	30					460,000	2,300,000
1879	30					480,000	2,640,000
1880	29					530,000	2,650,000
1881	35					550,000	2,475,000
1882						541,300	2,600,000
1883						629,400	3,147,000
1884						620,000	2,915,000
1885						553,800	2,500,000
1886	39					448,500	2,135,000
1887						356,000	2,124,000
1888	28					372,477	2,327,981
1889	21			25,391	$108,587	309,885	1,809,820
1890	21			42,825	171,300	435,774	2,407,456
1891	22			29,564	118,156	398,953	2,440,964
1892	24			72,348	288,892	487,338	2,679,069
1893	24	2,311	$6,933	65,226	260,904	415,876	2,095,934
1894	24			52,422	209,688	490,100	2,501,126
1895	24	22,493	62,591	49,678	203,542	634,696	3,110,997
1896	24			49,663	198,652	481,697	2,261,826
1897	22			46,146	165,440	552,721	2,219,311
1898	23			26,277	60,352	487,944	2,073,226
1899	17	11,379	33,836	11,994	39,186	332,774	1,777,975
1900	16	17,696	63,706	20,597	102,985	358,772	2,282,296
1901						390,183	1,942,660
1902	14	10,401	41,604	8,593	42,965	317,143	1,644,509
1903	16	10,000	37,500	7,251	36,255	339,577	1,777,105
1904	20	20,693	52,691	9,868	48,892	395,104	2,242,678
1905	19	25,751	65,206	9,822	49,110	397,273	2,237,571
1906	19	27,802	69,505	6,500	32,500	394,898	2,149,062
1907	19	22,556		5,921		324,171	1,763,490
1908	14	16,884		10,726		277,719	1,380,708
1909	15	24,542	57,115	17,382	99,796	[a] 274,196	1,760,220
1910	15	66,538	232,883	5,436	31,203	391,415	2,544,198
1911	15	53,471	203,198	8,594	47,399	553,331	3,052,164
1912	15	18,699	46,590	6,958	22,108	286,026	2,319,856
1913	15	13,303	29,486	8,939	49,142	266,479	2,012,387
1914	17	49,285	305,541	10,792	59,356	454,621	3,695,989
1915	19	86,530	251,632	26,723	129,358	558,534	4,305,292
1916	20	77,766	307,483	18,999	118,987	[b] 547,861	4,361,299
1917	20	53,659	386,596	23,783	292,583	553,346	6,514,940
1918	20	29,846	215,669	24,605	350,071	591,381	7,466,894
1919	21	75,493	441,989	14,414	144,140	580,028	6,743,219

[a] Includes 55 cases of humpbacks, valued at $132, packed with humpbacks brought from Puget Sound.
[b] Includes 56 cases of humpbacks, valued at $224.

Pack of Canned Salmon on the Columbia River, by States, 1916–1919.

States and species.	1916		1917		1918		1919	
	Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
Washington:								
Blueback	1,377	$12,389	2,801	$33,612	19,450	$245,070	2,329	$18,632
Chinook	179,083	1,074,495	146,140	1,753,680	145,511	1,715,874	[a] 130,185	1,671,007
Chum	46,012	165,643	14,539	93,050	12,173	85,211	39,279	235,674
Humpback	[b] 56	224	....	....	....	....	....	....
Silverside	26,788	133,940	15,989	183,874	35,746	343,162	34,927	349,270
Steelhead	14,348	86,091	6,053	66,583	8,699	104,388	7,148	71,480
Total	267,664	1,472,782	185,522	2,130,799	221,579	2,493,705	213,868	2,346,063
Oregon:								
Blueback	2,413	14,899	5,167	77,940	18,383	360,258	4,939	54,484
Chinook	216,083	2,497,708	257,497	3,269,849	255,441	3,507,109	261,940	3,360,200
Chum	31,754	141,840	39,120	293,546	17,673	130,458	36,214	206,315
Silverside	25,296	201,174	48,310	516,806	62,399	729,681	55,801	703,497
Steelhead	4,651	32,896	17,730	225,955	15,906	245,683	7,266	72,660
Total	280,197	2,888,517	367,824	4,384,096	369,802	4,973,189	366,160	4,397,156
Grand total	547,861	4,361,299	553,346	6,514,895	591,381	7,466,894	580,028	6,743,219

[a] Includes 106,328 cases spring chinooks, valued at $1,382,264; 21,740 cases fall chinooks, valued at $273,924; and 2,117 cases light-colored chinooks, valued at $14,819.
[b] Fish brought in from Puget Sound.

Pack of Canned Salmon on Nehalem River, Oreg., in Specified Years.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1887	1	....	....	....	....	....	....	5,000	$30,000
1889	....	....	....	....	....	....	....	6,000	32,000
1890	....	....	....	....	....	....	....	9,000	45,500
1891	1	....	....	....	....	....	....	3,500	14,000
1892	1	....	....	10,000	$40,000	....	....	10,000	40,000
1893	1	1,692	$6,768	5,031	20,124	....	....	6,723	26,892
1894	1	1,627	6,508	4,866	19,464	....	....	6,493	25,972
1895	1	1,752	7,008	5,152	16,486	....	....	6,904	23,494
1896	1	2,828	8,484	5,218	15,654	....	....	8,046	24,138
1897	2	3,384	10,152	8,366	25,098	....	....	11,750	35,250
1898	1	3,808	9,891	5,700	19,380	....	....	9,508	29,271
1899	1	1,384	5,536	7,405	26,658	1,288	$3,864	10,077	36,058
1900	1	....	....	....	....	....	....	....	....
1901	1	268	1,139	3,273	13,092	2,669	7,206	6,210	21,437
1902	1	271	1,431	3,169	13,468	2,570	10,280	6,010	25,179
1903	1	686	3,670	4,615	19,614	....	....	5,301	22,284
1904	1	500	2,500	5,000	20,000	6,000	12,000	11,500	34,500
1905	1	2,700	16,200	2,900	12,325	6,000	15,000	11,600	43,525
1906	1	3,987	23,922	4,976	14,928	2,057	5,143	11,020	42,993
1907	1	4,000	28,000	6,600	19,800	2,000	6,000	12,600	53,800
1908	1	5,000	35,000	6,100	18,300	2,016	6,048	13,116	59,348
1909	1	1,985	10 542	4,554	20,253	909	2,091	7,448	32,886
1910	1	3,500	24,500	5,400	29,700	1,500	4,500	10,400	58,700
1911	2	5,821	46,568	14,878	81,829	3,439	13,048	24,138	141.445
1912	2	....	....	13,331	73,321	1,571	3,927	14,902	77,248
1913	1	300	1,500	764	3,056	5	11	1,069	4,567
1914	2	4,841	33,887	11,800	63,720	1,668	4,150	18,309	101,777
1915	2	400	2,400	5,400	24,840	2,260	6,328	8,060	33,568
1916	2	2,700	21,656	3,474	17,370	833	2,499	7,007	41,525
1917	2	783	7,047	851	6,808	472	3,304	2,106	17,159
1918	2	1,685	18,535	9,200	88,320	519	3,633	11,404	110,488
1919	2	500	6,250	8,124	97,488	1,183	7,571	9,807	111.309

PACK OF CANNED SALMON ON TILLAMOOK BAY, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1884								4,500	
1885								9,800	
1886	2							37,000	
1887	2							21,000	$115,500
1888	2							14,633	84,140
1889								9,500	52,250
1890								14,009	79,049
1891	1								
1892	1			18,000	$72,000			18,000	72,000
1893	1	497	$1,988	4,000	16,000	6,919	$17,297	11,416	35,285
1894	1	700	2,800	7,763	31,052	700	1,750	9,163	35,602
1895	1			6,514	20,845	7,001	19,253	13,515	40,098
1896	1	2,200	6,600	4,860	14,580			7,060	21,180
1897	1	2,000	6,000	9,000	27,000			11,000	33,000
1898	1	5,000	13,000	10,342	35,162			15,342	48,162
1899	1	2,180	8,720	3,889	14,036	5,121	15,363	11,190	38,119
1900	1								
1901	1	848	4,240	2,133	9,598	3,901	10,728	6,882	24,566
1902	1	215	1,135	2,287	9,720	4,093	16,372	6,595	27,227
1903	1			2,727	11,590	2,620	10,480	5,347	22,070
1904	1			4,400	17,600	6,500	13,000	10,900	30,600
1905	1	1,100	6,600	1,700	7,650	8,800	22,000	11,600	36,250
1906	1	1,870	11,220	2,364	7,092	1,270	3,175	5,504	21,487
1907	1	2,000	14,000	3,410	10,230	2,314	6,942	7,724	31,172
1908	1	2,300	16,100	6,000	21,000	4,000	12,000	12,300	49,100
1909	1	2,615	15,663	5,029	21,809	3,712	8,538	11,356	46,010
1910	1	2,900	20,300	4,500	24,750	2,000	6,000	9,400	51,050
1911	2	8,433	67,464	12,663	69,647	5,277	20,053	26,373	157,164
1912	2	3,811	26,677	6,418	32,090	4,550	11,375	14,779	70,142
1913	1	2,600	15,600	1,000	4,000	1,000	2,200	4,600	21,800
1914	2	4,734	33,138	4,131	22,307	6,707	16,867	15,572	72,312
1915	3	5,675	34,300	4,549	20,925	9,099	25,477	19,323	70,702
1916	3	9,465	75,720	4,333	21,665	7,530	22,590	21,328	119,975
1917	3	8,822	79,398	5,522	44,176	6,941	48,587	21,285	172,161
1918	1	107	1,177	3,461	33,226	1,567	10,969	5,135	45,372
1919	2	1,500	18,750	7,150	85,800	4,350	27,840	13,000	132,390

PACK OF CANNED SALMON ON NESTUGGA RIVER, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1887	1							4,300	$23,650
1888	1							5,000	28,750
1889								6,700	36,850
1891	1								
1899	1	1,109	$4,436	3,034	$10,922	513	$1,539	4,656	16,897
1900	1								
1901	1	279	1,116	3,553	13,323	396	1,089	4,228	15,528
1905	1	3,000	18,000	1,000	4,250	400	1,000	4,400	23,250
1906	1	2,622	15,732	2,468	7,404	165	413	5,255	23,549
1907	1	2,100	14,700	3,540	10,620	150	450	5,790	25,770
1908	1	2,000	14,000	3,000	10,500	100	300	5,100	21,800
1910	1	2,000	14,000	3,300	18,150	140	420	5,440	32,570
1911	1	3,562	28,496	7,124	39,182	641	2,436	11,327	70,114
1912	1	3,090	18,540	6,180	30,900	708	1,770	9,978	51,210
1913	1	126	756	243	972			369	1,728
1914	1	3,542	24,794	5,730	30,942	265	662	9,537	56,398
1915	1	200	1,300	3,930	18,078	800	2,240	4,930	21,618
1916	1	2,400	19,200	4,056	20,280	200	600	6,656	40,800
1917	1	2,000	18,000	3,800	30,400	260	1,820	6,060	50,220
1918	1	3,000	33,000	3,206	30,778	215	1,505	6,421	65,283
1919	1	1,900	23,750	2,400	28,800	450	2,880	4,750	55,430

Pack of Canned Salmon on Siletz River, Oreg., in Specified Years.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1896	1	2,500	$7,500	1,900	$5,700			4,400	$13,200
1897	1	3,510	10,530	5,015	15,045			8,525	25,575
1898	1	3,200	8,360	4,330	14,722			7,530	23,082
1899	1	2,200	9,900	2,319	8,696	200	$550	4,719	19,146
1900	1								
1901	1	876	4,380	3,740	16,830	360	1,260	4,976	22,470
1902	1	600	3,168	1,917	8,147	500	2,000	3,017	13,315
1904	1	1,000	5,000	3,300	13,200	1,000	2,000	5,300	20,200
1905	1	1,500	9,000	1,700	7,225	900	2,250	4,100	18,475
1906	1	2,635	15,810	3,192	9,576	167	418	5,994	25,804
1907	1	2,333	16,331	4,300	12,900	200	600	6,833	29,831
1908	1	2,100	14,700	4,700	16,450	300	900	7,100	32,050
1910	1	2,200	15,400	4,600	25,300	250	750	7,050	41,450
1911	1	3,584	28,672	7,164	39,402	237	901	10,985	68,975
1912	1	3,277	19,662	6,554	32,770	283	707	10,114	53,139
1913	1	15	75	354	1,416	17	37	386	1,528
1914	1	3,356	23,492	6,712	36,245	196	490	10,264	60,227
1915	1	100	600	3,000	13,800	100	280	3,200	14,680
1916	1	1,000	8,000	3,000	15,000	210	630	4,210	23,630
1917	1	1,800	16,200	3,400	28,200	222	1,554	5,422	45,954
1918	2	4,304	47,344	7,789	74,774	384	2,688	12,477	124,806
1919	2	1,393	17,413	5,892	70,704	472	3,021	7,757	91,138

Pack of Canned Salmon on Yaquina Bay and River, Oreg., in Specified Years.[a]

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1887	2								
1888	3							5,088	$29,256
1889								5,000	27,500
1891	1								
1896	1	1,714	$5,142	615	$1,845			2,329	6,987
1898	1	170	442	1,530	5,202			1,700	5,644
1899	2	316	1,422	3,234	12,127	1,300	$3,575	4,850	17,124
1900	1								
1901	1	96	480	2,848	12,816	549	1,647	3,493	14,943
1903	1			1,238	5,262	315	787	1,553	6,049
1904	1	50	200	2,600	8,840	450	1,080	3,100	10,120
1905	1	200	1,200	2,050	8,613	62	155	2,312	9,968
1906	1	500	3,000	3,100	9,300	60	150	3,660	12,450
1907	1	834	5,838	1,000	3,000	49	147	1,883	8,985
1908	1			4,000	14,000			4,000	14,000
1909	1			1,139	4,556	33	76	1,172	4,632
1910	1			2,669	13,345			2,669	13,345
1911	1			1,009	5,549	51	289	1,060	5,838

[a] Cannery not operated from 1912 to 1916, both years inclusive. In 1917 it was consolidated with Waldport cannery owned by same party.

PACK OF CANNED SALMON ON ALSEA RIVER AND BAY, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1886	1								
1887	2							11,180	$64,285
1888	3							9,620	55,315
1889								10,000	55,000
1891	1								
1892	1			3,600	$14,400			3,600	14,400
1893	1	1,260	$6,300	3,240	12,960			4,500	19,260
1894	1	440	2,200	4,160	16,640			4,600	18,840
1895	1	1,700	6,375	3,280	11,808			4,980	18,183
1896	1	3,500	10,500	3,400	10,200			6,900	20,700
1897	1	1,800	5,400	3,200	9,600			5,000	15,000
1898	1	4,296	11,170	2,170	7,378			6,466	18,548
1899	1	2,150	9,138	5,010	19,038			7,160	28,176
1900	1								
1901	1	695	3,475	4,629	18,790	891	$3,118	6,215	25,383
1902	1	701	3,702	4,530	19,253	670	2,680	5,901	25,635
1903	1	1,031	5,516	4,242	18,029	44	88	5,317	23,633
1904	1	1,000	5,000	6,500	26,000	300	600	7,800	31,600
1905	1	2,500	15,000	1,800	7,650	700	1,750	5,000	24,400
1906	1	3,702	22,212	3,843	11,529			7,545	33,741
1907	1	800	5,600	5,100	15,300	350	1,050	6,250	21,950
1908	1	1,200	8,400	6,000	21,000	400	1,200	7,600	30,600
1909	1	1,119	6,714	5,486	24,027	80	184	6,685	30,925
1910	1	2,500	17,500	5,900	31,950	100	300	8,500	49,750
1911	2	4,161	33,288	9,329	51,309	688	2,614	14,178	87,211
1912	2	3,731	22,386	8,286	41,430	524	1,310	12,541	65,126
1913	2	1,607	8,035	4,304	17,216	160	352	6,071	25,603
1914	2	4,546	31,822	6,728	36,331	73	183	11,347	68,336
1915	2	1,668	10,763	6,966	32,044	178	498	8,812	43,305
1916	2	2,624	20,992	3,864	19,320	292	876	6,780	41,188
1917	2	2,727	24,543	6,621	52,968	418	2,926	9,766	80,437
1918	2	2,000	22,000	7,215	69,264	312	2,178	[a] 10,068	99,934
1919	2	2,512	31,400	2,607	31,200	535	3,718	5,654	66,318

[a] Includes 541 cases of bluebacks, valued at $6,492.

PACK OF CANNED SALMON ON THE SIUSLAW RIVER, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1878	2							10,300	$55,620
1879	2								
1886	1							1,500	
1888	3							11,960	68,770
1889	1							12,000	66,000
1891	2								
1892	2			18,000	$72,000			18,000	72,000
1893	2	1,471	$7,355	11,830	47,320			13,301	54,675
1894	2	1,871	9,355	14,987	59,948			16,858	69,303
1895	2	1,637	6,139	10,465	35,274			12,102	41,413
1896	1	2,700	8,100	9,000	27,000			11,700	35,100
1897	1	1,100	3,300	3,900	11,700			5,000	15,000
1898	1	850	2,210	10,000	34,000			10,850	36,210
1899	1	1,162	4,648	7,323	26,363	115	$345	8,600	31,356
1900	2								
1901	1	1,735	8,675	7,488	29,952			9,223	38,627
1902	1	1,288	6,800	4,320	18,260			5,608	25,060
1903	1	1,519	8,127	6,842	29,079			8,361	37,206
1904	1	500	2,500	6,500	26,000			7,000	28,500
1905	1								
1906	2	4,500	27,000	15,000	45,000	1,500	3,750	21,000	75,750
1907	1			15,773	47,319			15,773	47,319
1908	1			8,600	30,100			8,600	30,100
1909	2	632	3,792	7,436	32,956			8,068	36,748
1910	2	856	5,992	12,800	70,400	8,502	25,506	22,158	101,898
1911	2	1,120	8,960	10,266	56,463	5,000	19,000	16,386	84,423
1912	2			6,108	30,540			6,108	30,540
1913	[a] 1			4,281	17,124			4,281	17,124
1914	1			9,266	50,036			9,266	50,036
1915	1			1,755	8,073			1,755	8,073
1916	1	875	7,000	3,021	15,105			3,896	22,105
1917	1			350	2,800			350	2,800
1918	1			3,000	28,800			3,000	28,800
1919	1			3,760	43,120			3,760	43,120

[a] The two canneries combined and operated one plant.

PACK OF CANNED SALMON ON THE UMPQUA RIVER, OREG., IN SPECIFIED YEARS.[a]

Year.	Canneries operated.	Chinook.		Silverside.		Chum.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
1878	2							8,100	$43,740
1879	2								
1884	2							3,700	
1885	1							10,500	
1886	1							18,600	
1887	1							4,000	22,000
1888	1							9,000	51,750
1889	1							12,000	66,000
1891	1								
1892	1			10,000	$40,000			10,000	40,000
1893	1	809	$4,045	3,204	12,816			4,013	16,861
1894	1	235	1,175	6,875	27,500			7,110	28,675
1895	1	992	3,720	7,697	28,863			8,689	32,583
1896	1	1,300	3,900	8,000	24,000			9,300	27,900
1899	2	925	3,860	7,576	27,006	115	$345	8,616	31,211
1900	2								
1903	1	23	123	6,733	28,615			6,756	28,738
1904	1	500	2,500	9,500	38,000	500	1,000	10,500	41,500
1905	1	6,100	36,600	10,500	44,625			16,600	81,225
1906	1	1,143	6,858	5,613	16,839			6,756	23,697
1909	1	500	3,000	7,753	31,012			8,253	34,012
1910	1	2,000	14,000	11,000	60,500			13,000	74,500
1911	1	300	2,400	6,118	33,649			6,418	36,049
1912	1	30	210	3,759	18,795			3,789	19,005
1914	1	1,000	8,000	2,000	10,000			3,000	18,000
1915	2			5,100	23,460			5,100	23,460
1916	2			2,900	14,500			2,900	14,500
1917	1			5,366	42,928	47	329	5,413	43,257
1918	1	1,703	18,733	3,409	32,726	1	7	5,113	51,466
1919	1			7.500	90,000			7,500	90,000

[a] No canning done in 1913.

PACK OF CANNED SALMON ON COOS BAY AND RIVER, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook.		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1887	2					11,300	$62,150
1888	1					5,500	31,625
1889	1					7,000	38,500
1891	2	3					
1893	1			3,125	$12,500	3,125	12,500
1894	1	163	$815	8,428	33,712	8,591	34,527
1895	1	5,110	19,163	2,332	8,934	7,442	28,097
1896	1	13,000	39,000	2,000	6,000	15,000	45,000
1897	1	6,200	18,600	2,200	6,600	8,400	25,200
1898	2	3,142	8,169	7,180	24,412	10,322	32,581
1898	2	1,273	5,092	5,174	18,626	6,447	23,718
1900	2						
1901	1	1,215	6,075	4,082	16,328	5,297	22,403
1902	1	412	2,175	2,640	11,220	3,052	13,395
1904	1	2,033	7,725	7,200	24,480	9,233	32,205
1906	1	2,043	12,258	1,755	5,265	3,798	17,523
1909	1	275	1,475	3,959	17,927	4,234	19,402
1910	1	500	3,500	5,500	30,250	6,000	33,750
1911	2	2,630	21,040	7,260	39,930	9,890	60,970
1912	2	1,457	10,199	3,989	19,945	5,446	30,144
1913	2			7,383	29,532	7,383	29,532
1914	1			9,300	50,220	9,300	50,220
1915	1			3,500	16,100	3,500	16,100
1916	1			2,485	12,425	2,485	12,425
1917	1						
1918	1			3,800	36,480	3,800	36,480

PACK OF CANNED SALMON ON COQUILLE RIVER, OREG., IN SPECIFIED YEARS.

Year.	Canneries operated.	Chinook		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1883	1					7,000	
1884	1					7,300	
1885	1					3,800	
1886	2					8,300	
1887	3						
1888	2					11,000	$63,250
1889						8,600	47,300
1891	1						
1892	1			5,000	$20,000	5,000	20,000
1893	1			6,500	26,000	6,500	26,000
1894	[a] 1			2,000	8,000	2,000	8,000
1895	2	760	$2,887	8,724	32,615	9,484	35,502
1896	2	1,225	3,675	7,800	23,400	9,025	27,075
1898	2	541	1,407	7,485	25,499	8,026	26,906
1899	2	950	3,800	7,550	28,500	8,500	32,300
1900	1	2,636	13,180	9,601	38,404	12,237	51,581
1901	1	133	665	5,096	20,384	5,229	21,049
1902	1	286	1,510	5,877	24,927	6,163	26,437
1903	1	331	1,771	8,685	36,911	9,016	38,682
1904	2	600	2,400	13,686	54,744	14,286	57,141
1905	2	2,100	12,600	11,343	48,208	13,443	60,808
1906	2	821	4,926	17,979	53,937	18,800	58,863
1907	2	306	2,142	13,220	39,660	13,526	41,802
1908	2			19,174	67,109	19,171	67,109
1909	2	250	1,255	9,818	42,687	10,068	43,942
1910	2	420	2,940	16,637	91,504	17,057	91,444
1911	2	715	5,720	16,676	91,718	17,391	97,438
1912	2	377	2,639	6,040	30,200	6,417	32,839
1913	2			8,910	35,640	8,910	35,640
1914	2			12,097	65,324	12,097	65,324
1915	2	1,079	6,474	5,131	25,515	6,210	31,989
1916	2	869	6,952	2,652	13,260	3,521	20,212
1917	2	694	6,246	8,005	64,040	[b] 8,706	70,335
1918	2	1,318	14,498	10,096	96,922	[c] 11,650	113,129
1919	2	1,027	12,837	5,010	60,120	[d] 6,082	72,957

[a] Burned.
[b] Includes 7 cases of chums, valued at $49.
[c] Includes 217 cases of chums, valued at $1,519, and 19 cases of steelheads, valued at $190.
[d] Includes 45 cases of chums.

PACK OF CANNED SALMON ON ROGUE RIVER, OREG., IN SPECIFIED YEARS.[a]

Year.	Canneries operated.	Chinook.		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1877	1					7,804	
1878	1					8,534	
1879	1					8,571	
1880	1					7,772	
1881	1					12,320	
1882	1					19,186	
1883	1					16,156	
1884	1					12,376	
1885	1					9,310	
1886	1					12,147	
1887	1					17,216	
1888	1					21,062	$121,107
1889	1					22,000	132,000
1890	1					24,000	120,000
1891	1					21,000	105,000
1892	1	10,000	$59,000	9,000	$36,000	19,000	95,000
1893	[b] 1	3,200	16,000			3,200	16,000
1895	1	10,377	41,508	4,385	15,347	14,762	56,855
1896	1	15,000	75,000	3,000	9,000	18,000	84,000
1897	1	15,355	61,420	3,653	10,959	19,008	72,379
1898	1	12,964	51,550	501	1,303	13,465	52,853
1899	1	5,481	30,145	1,745	6,980	7,226	37,125
1900	1						

[a] Shut down in 1911 and 1912 through the closing of the river to all fishing.
[b] Burned down during season. Not opened the next year.

PACK OF CANNED SALMON ON ROGUE RIVER, OREG., IN SPECIFIED YEARS—Contd.

Year.	Canneries operated.	Chinook.		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1901	1	2,681	$13,405	4,184	$17,736	6,865	$31,141
1902	1	3,799	20,058	4,091	17,387	7,890	37,445
1903	1	8,418	45,036	4,792	20,366	13,210	65,402
1904	1	16,000	64,000	3,255	11,392	19,255	75,392
1905	1	18,500	111,000	1,500	6,375	20,000	117,375
1906	1	12,000	72,000	6,000	18,000	18,000	90,000
1907	1	7,537	56,528	1,796	8,980	9,333	65,508
1908	1	4,354	32,655	2,650	13,250	7,004	45,905
1909	1	186	1,300	699	2,977	885	4,277
1910	1	232	1,786	2,711	16,266	2,943	18,052
1913	1	3,020	27,160	2,403	11,857	5,423	39,017
1914	1	6,938	62,060	987	5,453	7,925	67,513
1915	2	19,094	135,301	515	2,369	19,609	137,670
1916	2	22,640	181,120	501	2,505	23,141	183,625
1917	2	24,707	271,777	660	5,280	25,367	277,057
1918	2	20,469	225,159	2,704	24,336	23,173	249,495
1919	3	17,237	215,463	671	8,052	17,908	223,515

PACK OF CANNED SALMON ON SMITH RIVER, CALIF., IN SPECIFIED YEARS.

Year.	Canneries operated.	Quinnat.		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1878	1	4,277	$23,096			4,277	$23,096
1880	1	7,500	41,250			7,500	41,250
1884	1	5,500	33,000			5,500	33,000
1885	1	1,550	9,300			1,550	9,300
1888	1	2,347	14,082			2,347	14,082
1893	1	1,500	7,500	500	$1,500	2,000	9,000
1894	1	1,500	7,500	500	1,500	2,000	9,000
1895	1	2,250	9,990			2,250	9,990
1914	1			3,000	18,000	3,000	18,000
1915	1	1,955	13,685	1,078	6,220	3,033	19,905
1916	1	1,515	12,120	990	4,950	2,505	17,070
1917	1	6,300	69,300			6,300	69,300
1918	1	4,041	44,451	612	5,508	4,653	49,959
1919	1	4,366	56,758			4,366	56,758

PACK OF CANNED SALMON ON KLAMATH RIVER, CALIF., IN SPECIFIED YEARS.

Year.	Canneries operated.	Quinnat.		Silverside.		Total.	
		Cases.	Value.	Cases.	Value.	Cases.	Value.
1888	1	4,400	$26,400			4,400	$26,400
1892	1	1,047	4,188			1,047	
1893	1	1,600	6,400			1,600	6,400
1894	1	1,700	6,800			1,700	6,800
1895	1	1,200	5,321	400	$1,500	1,600	6,821
1899	1	1,600	8,800			1,600	8,800
1902	1	2,500	13,500			2,500	13,500
1904	1	3,400	20,800			3,400	20,800
1909	1	5,633	33,000			5,633	33,000
1910	1	8,016	52,000			8,016	52,000
1911	1	7,400	46,000	204	816	7,604	48,816
1912	2	18,000	117,000			18,000	117,000
1913	2	6,376	40,500			6,376	40,500
1914	1	7,500	48,500	3,500	14,000	11,000	62,500
1915	1	10,400	72,800	2,500	13,000	12,900	85,800
1916	1	6,484	51,872	2,400	12,000	8,884	63,872
1917	1	5,130	56,430	2,900	23,200	8,030	79,630
1918	1	5,555	61,105	4,292	38,628	[a] 10,200	102,557
1919	1	6,291	81,783	1,145	13,740	[b] 7,731	95,523

[a] Includes 353 cases of steelheads, valued at $2,824. [b] Includes 295 cases of steelheads.

PACK OF CANNED SALMON ON EEL RIVER, CALIF., IN SPECIFIED YEARS.[a]

Year.	Canneries operated.	Quinnat.		Year.	Canneries operated.	Quinnat.	
		Cases.	Value.			Cases.	Value.
1877	1	8,500	$51,000	1885	1	5,750	....
1878	1	10,500	56,700	1886	1	12,500	$75,000
1880	1	6,250	....	1910	1	6,000	42,000
1883	1	15,000	....	1911	1	8,400	52,500
1884	1	8,200	....	1912	1	11,000	71,500

[a] Shut down since 1912.

PACK OF CANNED SALMON ON NOYO RIVER, CALIF., IN SPECIFIED YEARS.

Year.	Canneries operated.	Quinnat.	
		Cases.	Value.
1918	1	2,000	$22,000
1919	1	7,500	97,500

PACK OF CANNED SALMON ON THE SACRAMENTO RIVER IN SPECIFIED YEARS.

Year.	Canneries operated.	Quinnat.		Year.	Canneries operated.	Quinnat.	
		Cases.	Value.			Cases.	Value.
1864	1	2,000	....	1893	3	23,336	....
1865	1	2,000	....	1894	2	28,463	....
1874	....	2,500	....	1895	3	25,185	$111,821
1875	....	3,000	....	1896	....	13,387	....
1876	2	10,000	....	1897	....	38,543	....
1877	....	21,500	....	1898	....	29,731	....
1878	6	34,017	$183,692	1899	....	32,580	150,688
1879	4	13,855	59,577	1900	....	39,304	....
1880	9	62,000	....	1901	....	17,500	....
1881	20	181,200	....	1902	....	14,043	....
1882	19	200,000	....	1903	....	8,200	....
1883	21	123,000	....	1904	2	14,407	66,936
1884	....	81,450	....	1905	1	2,780	....
1885	6	90,000	....	1911	1	4,142	28,994
1886	9	39,300	....	1913	1	950	6,650
1887	....	36,500	....	1914	2	17,315	95,232
1888	6	68,075	423,750	1915	2	5,229	35,453
1889	3	57,300	....	1916	1	6,636	53,088
1890	....	25,065	....	1917	3	9,443	94,430
1891	....	10,353	....	1918	2	4,036	44,396
1892	....	2,281	....	1919	2	1,169	15,197

PACK OF CANNED SALMON AT MONTEREY BAY IN SPECIFIED YEARS.

Year.	Canneries operated.	Quinnat.		Year.	Canneries operated.	Quinnat.	
		Cases.	Value.			Cases.	Value.
1915	1	950	$7,300	1918	....	....	....
1916	1	12,809	102,472	1919	1	2,000	$26,000
1917	1	2,000	20,000				

PACK OF CANNED SALMON IN ALASKA, BY DISTRICTS, SINCE THE INCEPTION OF THE INDUSTRY.

Year.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Canneries operated.	Pack.	Canneries operated.	Pack.	Canneries operated.	Pack.	Canneries operated.	Pack.
		Cases.		Cases.		Cases.		Cases.
1878	2	8,159					2	8,159
1879	2	12,530					2	12,530
1880	1	6,539					1	6,539
1881	1	8,977					1	8,977
1882	1	11,501	2	10,244			3	21,745
1883	4	20,040	2	28,297			6	48,337
1884	4	22,189	2	42,297	1	a 400	7	64,886
1885	3	16,728	2	52,687	1	14,000	6	83,415
1886	4	18,660	2	74,583	3	48,822	9	142,065
1887	5	31,462	2	102,515	3	72,700	10	206,677
1888	6	81,128	6	241,101	4	89,886	16	412,115
1889	12	141,760	21	461,451	4	115,985	37	719,196
1890	12	142,901	19	421,300	4	118,390	35	682,591
1891	11	156,615	14	511,367	5	133,418	30	801,400
1892	7	115,722	6	295,496	2	63,499	15	474,717
1893	8	136,053	11	399,815	3	107,786	22	643,654
1894	7	142,544	10	435,052	4	108,844	21	686,440
1895	7	148,476	10	327,919	6	150,135	23	626,530
1896	9	262,381	12	485,990	8	218,336	29	966,707
1897	9	271,867	13	382,899	7	254,312	29	909,078
1898	9	251,385	14	395,009	7	318,703	30	965,097
1899	9	310,219	14	356,095	9	411,832	32	1,078,146
1900	16	456,639	14	492,223	12	599,277	42	1,548,139
1901	21	735,449	13	562,142	21	719,213	55	2,016,804
1902	26	906,676	12	583,690	26	1,046,458	64	2,536,824
1903	21	642,305	12	417,175	27	1,186,730	60	2,246,210
1904	12	569,003	11	499,485	32	885,268	55	1,953,756
1905	13	433,607	9	371,755	25	1,089,154	47	1,894,516
1906	20	767,285	8	473,024	19	978,735	47	2,219,044
1907	22	887,503	8	522,836	18	759,534	48	2,169,873
1908	23	1,022,723	8	425,721	19	1,169,604	50	2,618,048
1909	19	852,870	8	391,054	18	1,151,553	45	2,395,477
1910	23	1,066,399	10	432,517	19	914,138	52	2,413,054
1911	32	1,580,868	11	499,743	21	743,206	64	2,823,817
1912	51	2,033,648	14	625,062	22	1,395,931	87	4,054,641
1913	42	1,782,898	14	447,249	23	1,509,038	79	3,739,185
1914	44	1,776,075	14	658,791	23	1,621,787	81	4,056,653
1915	46	2,549,212	17	632,848	24	1,318,233	87	4,500,293
1916	54	2,214,280	19	1,075,913	27	1,610,434	100	4,900,627
1917	62	3,294,845	27	1,017,206	29	1,635,235	118	5,947,286
1918	76	3,375,445	29	1,391,951	30	1,838,439	135	6,605,835
1919	75	3,108,364	30	775,557	28	708,280	133	4,592,201
Total		32,373,930		17,320,059		25,107,295		74,801,284

a Experimental pack.

PACK OF CANNED SALMON IN ALASKA FROM 1898 TO 1919, BY SPECIES.

Year.	Coho, or silver.		Chum, or keta.		Humpback, or pink.	
	Cases.	Value.	Cases.	Value.	Cases.	Value.
1898	54,711	....	5,184	....	109,399	....
1899	39,402	....	1,931	....	149,159	....
1900	50,984	....	30,012	....	232,022	....
1901	65,509	....	47,464	....	541,427	....
1902	82,723	....	159,849	....	549,602	....
1903	120,506	....	35,052	....	355,799	....
1904	85,741	....	21,178	....	299,333	....
1905	67,394	$215,875	41,972	$113,056	168,597	$498,194
1906	109,141	382,109	254,812	730,235	348,297	1,046,951
1907	85,190	337,384	184,173	547,757	561,973	1,799,280
1908	68,932	274,089	218,513	554,197	641,133	1,733,379
1909	56,556	231,029	120,712	274,110	464,873	1,114,839
1910	114,026	559,666	254,218	773,409	554,322	1,764,055
1911	133,908	762,647	323,795	1,199,563	1,005,278	3,972,706
1912	166,198	741,377	664,633	1,584,130	1,280,138	3,296,598
1913	75,779	261,654	290,918	643,948	1,372,881	3,550,587
1914	157,063	690,086	663,859	2,240,765	986,049	3,459,116
1915	124,268	536,124	479,946	1,243,321	1,875,516	5,217,203
1916	261,909	1,399,491	724,115	2,420,600	1,737,793	6,330,185
1917	193,231	1,682,745	906,747	5,572,047	2,296,976	14,794,062
1918	218,958	2,004,979	1,364,960	8,562,872	2,438,954	16,068,456
1919	230,138	2,761,656	1,348,462	8,630,157	1,657,434	13,259,472

Year.	King, or spring.		Red, or sockeye.		Total.	
	Cases.	Value.	Cases.	Value.	Cases.	Value.
1898	12,862	....	782,941	....	965,097	....
1899	23,400	....	864,254	....	1,078,146	....
1900	37,715	....	1,197,406	....	1,548,139	....
1901	43,069	....	1,319,335	....	2,016,804	....
1902	59,104	....	1,685,546	....	2,536,824	....
1903	47,609	....	1,687,244	....	2,246,210	....
1904	41,956	....	1,505,548	....	1,953,756	....
1905	42,125	$141,999	1,574,428	$5,335,547	1,894,516	$6,304,671
1906	30,834	116,222	1,475,960	5,620,875	2,219,044	7,896,392
1907	43,424	181,718	1,295,113	5,915,227	2,169,873	8,781,366
1908	23,792	99,867	1,662,678	7,524,251	2,618,048	10,185,783
1909	48,034	207,624	1,705,302	7,610,550	2,395,477	9,438,152
1910	40,221	214,802	1,450,267	7,774,390	2,413,054	11,086,322
1911	45,518	295,088	1,315,318	8,363,233	2,823,817	14,593,237
1912	43,317	243,331	1,900,355	10,426,481	4,054,641	16,291,917
1913	34,370	139,053	1,965,237	8,936,362	3,739,185	13,531,604
1914	48,039	241,105	2,201,643	12,289,517	4,056,653	18,920,589
1915	88,251	408,266	1,932,312	11,248,101	4,500,293	18,653,015
1916	65,873	353,420	2,110,937	12,765,733	4,900,627	23,269,429
1917	61,951	644,447	2,488,381	23,610,789	5,947,286	46,304,090
1918	49,226	485,295	2,533,737	23,920,347	6,605,835	51,041,949
1919	151,733	1,820,796	1,204,343	15,656,459	[a] 4,592,201	42,128,540

[a] Includes 91 cases of steelheads; value not given.

OUTPUT [a] OF CANNED SALMON IN ALASKA, 1912 TO 1918.[b]

Product.	1912	1913	1914	1915	1916	1917	1918	Total.
Coho, or silver:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
½-pound flat	2,719	3,587	4,579	2,050	13,145	30,412	26,238	82,730
1-pound flat	17	266	285	2,338	8,191	362	12,786	24,245
1-pound tall	163,462	71,926	152,199	119,880	240,573	162,457	179,934	1,090,431
Total	166,198	75,779	157,063	124,268	261,909	193,231	218,958	1,197,406
Chum, or keta:								
½-pound flat	2,795	985	373	....	1,423	26,760	3,559	35,895
1-pound flat	....	2,619	5,568	317	....	2,530	2,996	14,030
1-pound tall	661,838	287,314	657,918	479,629	722,692	877,457	1,358,405	5,045,253
Total	664,633	290,918	663,859	479,946	724,115	906,747	1,364,960	5,095,178
Humpback, or pink:								
½-pound flat	13,712	20,822	2,103	4,325	41,491	91,403	63,557	237,413
1-pound flat	....	3,258	9,286	3,508	14,796	6,014	20,215	57,077
1-pound tall	1,266,426	1,348,801	974,660	1,867,683	1,681,506	2,199,559	2,355,182	11,693,817
Total	1,280,138	1,372,881	986,049	1,875,516	1,737,793	2,296,976	2,438,954	11,988,307
King, or spring:								
½-pound flat	5,151	1,585	3,143	2,404	2,617	12,973	6,000	33,873
1-pound flat	....	....	4,804	3,755	3,804	5,133	5,267	22,763
1-pound tall	38,166	32,785	40,092	82,092	59,452	43,845	37,959	334,391
Total	43,317	34,370	48,039	88,251	65,873	61,951	49,226	391,027
Red, or sockeye:								
½-pound flat	28,024	29,041	53,825	52,033	81,565	124,309	137,008	505,805
1-pound flat	16,242	11,735	64,671	112,847	86,395	89,612	151,864	533,366
1-pound tall	1,856,089	1,924,461	2,083,147	1,765,139	1,936,971	2,274,460	2,244,865	14,085,132
1½-pound nominals	....	....	....	2,293	....	....	....	2,293
2-pound nominals	....	....	....	....	6,006	....	....	6,006
Total	1,900,355	1,965,237	2,201,643	1,932,312	2,110,937	2,488,381	2,533,737	15,132,602
Grand total	4,054,641	3,739,185	4,056,653	4,500,293	4,900,627	5,947,286	6,605,835	33,804,520

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND CANS OF ALASKA SALMON, 1908 TO 1918.[b]

Product.	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
Coho, or silver	$3.98	$4.07	$4.89	$5.67	$4.44	$3.45	$4.39	$4.31	$5.34	$8.76	$9.15
Chum, or keta	2.53	2.28	3.04	3.72	2.37	2.21	3.37	2.59	3.34	6.14	6.27
Humpback, or pink	2.69	2.40	3.15	3.94	2.55	2.58	3.50	2.78	3.64	6.44	6.58
King, or spring	4.20	4.32	5.34	6.48	5.37	4.04	5.01	4.63	5.36	10.40	9.85
Red, or sockeye	4.52	4.53	5.30	6.33	5.45	4.54	5.58	5.82	6.04	9.48	9.44

[a] The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.
[b] From "Alaska Fisheries and Fur Industries in 1918," p. 49, by Ward T. Bower. Appendix VII, Report, U. S. Commissioner of Fisheries, 1918. Washington, 1919.

PACK OF CANNED SALMON IN BRITISH COLUMBIA SINCE THE INCEPTION OF THE INDUSTRY, BY WATERS.

Year.	Canneries operated.	Fraser River.	Skeena River.	Rivers Inlet.	Naas River.	Outlying districts.	Total.
		Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
1876	2	7,247	....	....	....	....	7,247
1877	5	55,387	3,000	....	....	....	58,387
1878	8	81,446	8,500	....	....	....	89,946
1879	9	50,490	10,603	....	....	....	61,093
1880	9	42,155	19,694	....	....	....	61,849
1881	11	142,516	21,560	....	....	5,500	169,576
1882	16	199,204	24,522	5,635	6,500	4,600	240,461
1883	20	105,701	31,157	10,780	9,400	6,400	163,438
1884	14	34,037	53,786	20,383	8,500	7,000	123,706
1885	9	89,617	12,900	....	....	6,000	108,517
1886	16	99,177	37,587	15,000	....	1,200	152,964
1887	20	130,088	58,592	11,203	....	4,200	204,083
1888	21	76,616	70,106	20,000	12,318	5,000	184,040
1889	28	310,122	58,405	21,722	19,800	7,162	417,211
1890	33	244,352	91,645	33,500	24,700	17,060	411,257
1891	38	177,989	77,057	36,500	11,058	11,907	314,511
1892	36	98,491	90,750	14,955	26,100	18,425	248,721
1893	44	474,237	59,021	35,416	15,680	25,848	610,202
1894	42	363,566	61,005	40,161	20,000	7,500	492,232
1895	49	432,920	69,356	58,575	20,541	6,300	587,692
1896	56	375,344	97,863	107,473	14,649	22,453	617,782
1897	65	879,776	61,310	40,090	20,000	26,007	1,027,183
1898	67	264,225	80,102	105,362	20,000	22,862	492,551
1899	68	527,396	112,562	76,428	19,442	29,691	765,519
1900	69	331,371	135,424	74,196	20,200	45,349	606,540
1901	78	998,913	125,845	66,794	15,004	40,656	1,247,212
1902	69	327,197	155,936	70,298	23,212	50,518	627,161
1903	61	237,125	98,669	69,390	12,100	56,390	473,674
1904	51	128,903	154,869	94,292	19,085	68,745	465,894
1905	64	877,136	114,085	83,122	32,725	60,392	1,167,460
1906	59	240,486	162,420	122,878	32,534	71,142	629,460
1907	42	163,116	159,255	94,064	31,832	99,192	547,459
1908	50	89,184	209,177	75,090	46,908	122,330	542,689
1909	86	567,203	140,739	91,014	40,990	127,974	967,920
1910	58	223,148	222,035	129,398	39,720	147,900	762,201
1911	59	301,344	254,410	101,066	65,684	226,461	948,965
1912	57	173,921	254,258	137,697	71,162	359,538	996,576
1913	78	732,059	164,055	68,096	53,423	336,268	1,353,901
1914	63	328,390	237,634	109,052	94,890	341,073	1,111,039
1915	63	289,199	279,161	146,838	104,289	313,894	1,133,381
1916	73	106,440	223,158	85,383	126,686	453,398	995,065
1917	90	377,988	292,219	95,302	119,495	672,481	1,557,485
1918	83	206,003	374,216	103,155	143,908	788,875	1,616,157
1919	74	158,718	398,877	80,367	97,512	657,682	1,393,156
Total	....	12,119,943	5,367,525	2,550,675	1,440,047	5,275.373	26,753,563

NUMBER OF SALMON CANNERIES OPERATED IN VARIOUS SECTIONS OF BRITISH COLUMBIA IN RECENT YEARS.

Year.	Fraser River.	Naas River.	Skeena River.	Rivers Inlet.	Outlying districts.	Total.
1910	23	4	12	7	12	58
1911	22	4	12	7	14	59
1912	18	4	12	7	16	57
1913	36	4	13	7	18	78
1914	21	5	13	7	17	63
1915	22	5	13	7	16	63
1916	23	5	14	8	23	73
1917	29	6	14	9	32	90
1918	16	7	15	9	36	83
1919	11	7	15	9	32	74

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM 1903 [a] TO 1919.

Districts and species.	1903	1904	1905	1906	1907	1908
Fraser River district:	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Chums	....	1,066	....	....	....	....
Cohos	25,728	45,667	30,836	34,413	35,766	24,198
Pinks	4,504	....	3,304	15,543	63,530	415
Sockeyes	204,809	72,688	837,489	183,007	59,815	63,126
Springs, red	2,084	9,482	5,507	6,503	3,448	1,427
Springs, white	....	....	....	1,020	557	18
Total	237,125	128,903	877,136	240,486	163,116	89,184
Skeena River district:						
Chums	....	35,329	....	....	....	....
Cohos	9,648	5,515	7,247	16,897	15,247	10,085
Pinks	20,045	....	7,523	38,991	25,217	45,404
Sockeyes	50,968	93,404	84,717	86,394	108,413	139,846
Springs, red	18,008	20,621	14,598	20,138	10,378	13,374
Springs, white	....	....	....	....	....	468
Total	98,669	154,869	114,085	162,420	159,255	209,177
Rivers Inlet district:						
Chums	....	61	....	....	....	....
Cohos	219	358	....	66	5,040	9,505
Pinks	180	....	....	....	700	479
Sockeyes	68,119	93,862	82,771	122,631	87,874	64,652
Springs, red	872	11	351	181	450	454
Total	69,390	94,292	83,122	122,878	94,064	75,090
Naas River district:						
Chums	....	31	....	....	....	....
Cohos	2,187	1,697	3,083	5,997	6,093	8,348
Pinks	....	....	1,840	3,450	5,957	6,612
Sockeyes	8,438	15,000	24,462	22,166	17,813	27,584
Springs, red	1,475	2,357	3,340	858	1,288	3,263
Springs, white	....	....	....	63	....	....
Steelheads	....	....	....	....	681	1,101
Total	12,100	19,085	32,725	32,534	31,832	46,908
Outlying districts:						
Chums	....	1,155	....	....	....	....
Cohos	14,136	13,114	3,292	11,759	25,754	29,781
Pinks	2,653	....	1,303	10,321	23,300	23,538
Sockeyes	36,383	48,272	51,234	45,481	40,159	59,815
Springs, red	3,218	6,204	4,563	3,581	7,595	6,915
Springs, white	....	....	....	....	2,382	2,245
Steelheads	....	....	....	....	2	36
Total	56,390	68,745	60,392	71,142	99,192	122,330
TOTAL BY SPECIES.						
Chums	....	37,642	....	....	....	....
Cohos	51,918	66,351	44,458	69,132	87,900	81,917
Pinks	27,382	....	13,970	[b] 68,305	[b] 118,704	[b] 76,448
Sockeyes	368,717	323,226	1,080,673	459,679	314,074	355,023
Springs, red	25,657	38,675	28,359	31,261	23,159	25,433
Springs, white	....	....	....	1,083	2,939	2,731
Steelheads	....	....	....	....	683	1,137
Grand total	473,674	465,894	1,167,460	629,460	547,459	542,689

[a] In 1901 in the Fraser River district 920,313 cases of sockeyes were packed, and in 1902 sockeyes were packed as follows: 293,477 cases in Fraser River district, 117,677 cases in Skeena River district, 68,819 cases in Rivers Inlet district, 20,953 cases in Naas River district, and 30,510 cases in outlying districts.

[b] Pinks and chums combined.

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM 1903 TO 1919—Continued.

District and species.	1909	1910	1911	1912	1913	1914
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Fraser River district:						
Chums	....	52,177	47,237	12,961	22,220	74,726
Cohos	21,540	27,855	39,740	28,574	11,648	38,639
Pinks	1,987	128	142,101	574	9,973	6,057
Sockeyes	542,248	133,045	58,487	108,784	684,596	185,483
Springs, red	1,428	1,018	7,028	14,655	3,573	9,485
Springs, white	....	8,925	6,751	8,373	49	14,000
Total	567,203	223,148	301,344	173,921	732,059	328,390
Skeena River district:						
Chums	....	....	70	504	....	8,329
Cohos	12,249	11,531	23,376	39,628	18,647	16,378
Pinks	28,120	13,473	81,956	97,588	66,045	71,021
Sockeyes	87,901	187,246	131,066	92,498	52,927	130,166
Springs, red	11,727	9,546	15,514	19,332	23,250	11,529
Springs, white	742	239	2,428	4,501	3,186	211
Steelheads	....	....	....	207	....	....
Total	140,739	222,035	254,410	254,258	164,055	237,634
Rivers Inlet district:						
Chums	....	....	288	3,845	....	5,023
Cohos	1,400	2,075	6,287	11,010	3,660	7,789
Pinks	....	19	5,411	8,809	2,097	5,784
Sockeyes	89,027	126,921	88,763	112,884	61,745	89,890
Springs, red	587	383	317	681	594	566
Springs, white	....	....	....	468	....	....
Total	91,014	129,398	101,066	137,697	68,096	109,052
Naas River district:						
Chums	....	351	5,189	3,245	2,987	25,569
Cohos	6,818	6,285	7,842	12,468	3,172	9,276
Pinks	3,589	895	11,467	12,476	20,539	25,333
Sockeyes	28,246	30,810	37,327	36,037	23,574	31,327
Springs, red	2,280	1,228	3,434	5,710	2,999	2,660
Springs, white	57	11	325	1,226	152	725
Steelheads	....	140	100	....	....	....
Total	40,990	39,720	65,684	71,162	53,423	94,890
Outlying districts:						
Chums	....	5,834	39,167	37,770	52,758	70,827
Cohos	19,911	26,636	42,457	73,422	32,695	48,119
Pinks	12,848	20,098	64,312	128,296	94,233	112,145
Sockeyes	93,019	87,893	67,866	94,559	149,336	99,830
Springs, red	2,196	7,138	12,458	21,967	7,017	8,668
Springs, white	....	301	201	3,524	229	1,484
Total	127,974	147,900	226,461	359,538	336,268	341,073
TOTAL BY SPECIES.						
Chums	....	58,362	91,951	58,325	77,965	184,474
Cohos	61,918	74,382	119,702	165,102	69,822	120,201
Pinks	*a* 46,544	34,613	305,247	247,743	192,887	220,340
Sockeyes	840,441	565,915	383,509	444,762	972,178	536,696
Springs, red	18,218	19,313	38,751	62,345	37,433	32,908
Springs, white	799	9,476	9,705	18,092	3,616	16,420
Steelheads	....	140	100	207	....	....
Grand total	967,920	762,201	948,965	996,576	1,353,901	1,111,039

a Pinks and chums combined.

PACK, BY DISTRICTS AND SPECIES, OF CANNED SALMON IN BRITISH COLUMBIA FROM 1903 TO 1919—Continued.

District and species.	1915	1916	1917	1918	1919
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Fraser River district:					
Chums	18,539	30,184	59,973	86,215	15,718
Cohos	34,114	27,676	30,735	43,871	54,866
Pinks	128,555	840	134,442	18,388	39,363
Sockeyes	89,040	27,394	123,614	16,849	29,628
Springs, red	15,388	11,096	10,197	15,192	15,223
Springs, white	3,532	9,217	18,916	24,853	3,592
Steelheads	31	33	111	635	328
Total	289,199	106,440	377,988	206,003	158,718
Skeena River district:					
Chums	5,769	17,121	21,516	22,573	31,457
Cohos	32,190	47,409	38,456	38,759	36,559
Pinks	107,578	73,029	148,319	161,727	117,303
Sockeyes	116,553	60,923	65,760	123,322	184,945
Springs, red	15,069	18,372	13,586	16,013	23,285
Springs, white	204	2,561	2,699	6,828	2,656
Steelheads	1,798	3,743	1,883	4,994	2,672
Total	279,161	223,158	292,219	374,216	398,877
Rivers Inlet district:					
Chums	5,387	20,144	16,101	6,729	7,089
Cohos	7,115	15,314	9,124	12,074	9,038
Pinks	2,964	3,567	8,065	29,542	6,538
Sockeyes	130,350	44,936	61,195	53,401	56,258
Springs, red	1,022	1,033	715	957	1,201
Springs, white	....	389	102	452	241
Steelheads	....	....	....	....	2
Total	146,838	85,383	95,302	103,155	80,367
Naas River district:					
Chums	11,076	11,200	24,938	40,368	24,041
Cohos	15,171	19,139	22,180	17,061	10,900
Pinks	34,879	59,593	44,568	59,206	29,949
Sockeyes	39,349	31,411	22,188	21,816	28,259
Springs, red	3,053	3,061	3,170	2,332	2,993
Springs, white	648	784	1,326	1,820	581
Steelheads	113	1,498	1,125	1,305	789
Total	104,289	126,686	119,495	143,908	97,512
Outlying districts:					
Chums	41,229	161,552	352,745	341,730	293,730
Cohos	58,366	77,181	64,814	87,359	88,630
Pinks	93,376	143,615	161,365	258,882	153,486
Sockeyes	100,750	50,125	67,091	61,071	70,355
Springs, red	17,202	17,669	20,962	31,041	39,554
Springs, white	1,986	2,544	4,603	7,866	11,225
Steelheads	985	712	901	926	702
Total	313,894	453,398	672,481	788,875	657,682
TOTAL BY SPECIES.					
Chums	82,000	240,201	475,273	497,615	372,035
Cohos	146,956	186,719	165,309	199,124	199,993
Pinks	367,352	280,644	496,759	527,745	346,639
Sockeyes	476,042	214,789	339,848	276,459	369,445
Springs, red	51,734	51,231	48,630	65,535	82,256
Springs, white	6,370	15,495	27,646	41,819	18,295
Steelheads	2,927	5,986	4,020	7,860	4,493
Grand total	1,133,381	995,065	1,557,485	1,616,157	1,393,156

MARKET PRICES FOR CANNED SALMON.

The manner of fixing the selling price at which the canner is willing to dispose of his canned product varies slightly in certain regions. In May or June, when the spring-packing season has sufficiently advanced so that a line can be gotten on the probable pack of chinook, the highest priced of the pack, the Columbia River canners agree upon a price, this usually being high or low, as the pack is small or large.

Since the Alaska Packers Association was formed, through a combination of a number of canneries operating in the Territory of Alaska, it has packed annually in recent years about one-fourth of the salmon canned. It also owns several canneries on Puget Sound, thus being quite a factor in that region also.

In the early days of the association the custom grew up amongst the smaller packers of Alaska and Puget Sound of waiting until the association fixed the prices on its own pack, when the others would generally fall into line with the same prices for their packs. This custom is still in vogue. At no time has it ever been compulsory on the part of any packer to adopt the same prices as the association. In fact, it has sometimes been the case that, while the small packer publicly quoted the association's opening prices, yet in secret he was shading it by 2½ to 5 cents per dozen on certain grades. In recent years this has frequently been the case and the big packers, who adhered to the opening prices, have had to sit idly by and watch their small competitors underselling them and getting the bulk of the business until they had finally disposed of their goods, when, necessarily, they would have to drop out of the market until the next season.

Occasionally the other packers do not like a certain quotation of the association and make one more nearly in consonance with their own views. This happened in 1913, when the association quoted 60 cents for chums, while the Puget Sound canners quoted 55 cents for this grade, and in 1915 when the association quoted 65 cents for chums and the Puget Sound interests 70 cents for the same grade, thus showing clearly the independence of the smaller packers.

Owing to a peculiar feature of the salmon marketing business, more depends upon the opening prices than appears on the surface to the uninitiated.

Shortly after the first of the year buyers throughout the world begin to take stock of their salmon supplies and shortly thereafter begin placing their "future" orders. These cover the quantity required of each grade, and when the buyer orders through a broker the orders are placed subject to a contract similar to the following:

The undersigned hereby authorizes ——— to book the number of cases of canned salmon specified below; said booking to be filed with packers for delivery from ——— (naming year) pack, subject to buyers' approval of opening prices when named; *the option being granted buyers of confirming the total number* of cases specified below; *confirming a smaller quantity*, or *declining any confirmation*.

——— furthermore agrees that *buyers shall have the option of increasing quantities* listed below, when he names opening prices for his packers, contingent upon his ability to secure at that time an increased allotment from his packers. In event ——— secures an increased allotment from his packers insufficient to meet all increases requested by his patrons, he will distribute such increase as he can secure among the dealers who have filed conditional contracts with him, according to the date order that said contracts have been received in his office.

Under this form of contract the packer is expected to be ready to fulfill the terms of same, except in case of a short pack, when the orders are generally prorated; i. e., all orders are proportionately reduced until they come within the compass of the pack. Should the buyer dislike the opening price he has the privilege of canceling the order. While this latter privilege may not, at first glance, look just to the packer, yet it is doubtful if any buyer would place a "future" order unless he was assured of a chance to cancel it should he feel that too high a sum was fixed in the opening prices.

Some canneries contract to sell their entire output to one buyer, and the price fixed is usually the opening prices for the year in question. In such cases the buyer and seller are both compelled to abide by the price, no matter how unjust one or the other may consider it.

The association does not announce its opening prices until late in August or early in September, when the greater part of the packing is over with and a good line on the total pack has been obtained, and it speaks well for the discernment of the officials of the association that their judgment as to prices should meet with the general approval as often as it does.

AMERICAN OPENING PRICES.

Below are shown the yearly opening prices on the various grades and sizes from 1890 to 1919. The most interesting part of this is the increase shown in the value of high-grade salmon. Columbia River chinook was quoted at $1.05 for 1-pound talls in 1897, and it gradually advances until in 1919 it is quoted at $3.15. Alaska red 1-pound talls in 1897 sold for 90 cents, the lowest during the period in question, advancing, with occasional recessions, until in 1919 it reached high-water mark of $3.25. In 1897 Puget Sound 1-pound tall sockeye sold for 80 cents, 10 cents below Alaska red. In 1898 it sold for 20 cents less than reds. In 1902 it sold for $1 as compared with 95 cents for Alaska red, and from that time on brought a higher price, being quoted at $3.15 in 1919 as compared with $2.35 for Alaska red. No sockeye 1-pound talls were packed in 1919.

Medium red or coho does not figure in the opening prices until 1908, when Puget Sound coho sold for 5 cents a dozen more than Alaska coho. Very shortly thereafter, however, both were classed together and sold for the same price. This grade has not had the wide fluctuations of the others, due mainly to the generally small pack made annually.

Pink salmon has been the football of the salmon market ever since the pack became of sufficient size to become a feature in it. The size of the pack has been steadily increasing, as the fish became better known, and while the price obtained has been excellent in certain years (in 1911 it sold at $1 per dozen, the highest point reached up to that time, usually the price has been low. In 1897 it was quoted at 65 cents. In 1915 the opening price was 75 cents, but as a matter of fact a large part of the pack really sold for 65 cents. The lowest point it reached was in 1903, when it was quoted at 50 cents a dozen. As a result of the demand created by the war pink salmon opened at 90 cents in 1916, $1.65 in 1917 and 1918, and $2.25 in 1919. The market collapsed under the last-named price, however, and is now (1920) not more than one-half of it.

It is only of recent years that chum salmon has become a factor in the market. Although sold for some time before then, chum salmon appears first in the regular opening prices in 1908, when it was quoted at 70 cents a dozen. In 1913 it was quoted at 55 cents while the opening price in 1915 was 70 cents on Puget Sound and 65 cents at San Francisco. During the war the opening prices on chums were materially increased, being 85 cents in 1916, \$1.60 in 1917, \$1.75 in 1918, and \$2.15 in 1919. As in the case of chums the market collapsed under the 1919 price, and some sales under \$1 were made in 1920.

The pack of Alaska and Puget Sound kings or springs has always been small, and while they have always been quoted at \$1 per dozen or better (in 1919 they were quoted at \$3.12½) they have always been slow sellers. It is extremely improbable that the canned pack will increase much in the future, as this fish is the best for mild curing, and as the mild curers are able to offer better prices for the raw fish than the canneries, they will always get the fish when desired.

American Opening Prices Per Dozen Cans Since 1890.

1890 to 1902.

Year and species.	Talls.
1890.	
Columbia River chinook	\$1.40
Alaska red	1.20
Alaska pink	.75
1891.	
Columbia River chinook	1.35
Alaska red	1.20
Alaska pink	.75
1892.	
Columbia River chinook	1.35
Alaska red	1.15
Alaska pink	.75
1893.	
Columbia River chinook	1.32½
Alaska red	1.17½
Alaska pink	.65
1894.	
Columbia River chinook	1.35
Alaska red	1.10
Alaska pink	.60
1895.	
Columbia River chinook	\$1.32½
Alaska red	1.15
Alaska pink	.80
1896.	
Columbia River chinook	1.25
Alaska red	1.10
Alaska pink	.75
1897.	
Columbia River chinook	1.05
Alaska red	.95
Puget Sound sockeye	.80
Alaska pink	.65
1898.	
Columbia River chinook	1.05
Alaska red	.97½
Puget Sound sockeye	.80
Alaska pink	.65
1899.	
Columbia River chinook	\$1.25
Alaska red	1.10
Puget Sound sockeye	1.10
Alaska pink	.67½
1900.	
Columbia River chinook	1.60
Alaska red	1.25
Puget Sound sockeye	1.10
Alaska pink	.75
1901.	
Columbia River chinook	1.50
Alaska red	1.25
Puget Sound sockeye	.95
Alaska pink	.75
1902.	
Columbia River chinook	1.35
Alaska red	1.00
Puget Sound sockeye	1.00
Alaska pink	.65

1903 to 1919.

Year and species.	Talls.	Flats.	Halves.
1903.			
Puget Sound sockeye	\$1.50	\$1.60	\$0.90
Columbia River chinook	1.35	1.45	.85
Alaska red	1.30		
Alaska pink	.50		
1904.			
Columbia River chinook	1.45	1.15	.90
Puget Sound sockeye	1.55	1.65	.95
Alaska red	1.30		
Alaska pink	.70		
1905.			
Columbia River chinook	\$1.45	\$1.55	\$0.90
Puget Sound sockeye	1.35	1.50	1.00
Alaska red	1.00		
Alaska pink	.70		
1906.			
Columbia River chinook	1.50	1.60	1.00
Puget Sound sockeye	1.45	1.60	1.00
Alaska red	.95		
Alaska pink	.75		

American Opening Prices Per Dozen Cans Since 1890—Continued.

1903 to 1919—Continued.

Year and species.	Tails.	Flats.	Halves.
1907.			
Columbia River chinook	$1.65	$1.75	$1.05
Puget Sound sockeye	1.60	1.75	1.10
Alaska red	1.15	......	......
Alaska pink	.80	......	......
1908.			
Columbia River chinook	1.65	1.75	1.05
Puget Sound sockeye	1.60	1.75	1.05
Puget Sound pink	.75	.80	......
Puget Sound coho	1.05	1.15	.75
Alaska red	1.15	......	......
Alaska king	1.05	......	......
Alaska coho	1.00	......	......
Alaska pink	.70	......	......
Alaska chum	.70	......	......
1909.			
Columbia River chinook, fancy	1.65	1.75	1.05
Puget Sound sockeye	1.35	1.50	1.00
Alaska red	1.15	1.35	.85
Alaska king	1.10	......	......
Alaska coho	1.05	1.20	.70
Alaska pink	.60	......	......
Alaska chum	.57½	......	......
1910.			
Columbia River chinook, fancy	1.75	1.90	1.10
Puget Sound sockeye	1.65	1.80	1.10
Alaska red	1.35	1.50	1.00
Alaska king	1.35	......	......
Alaska pink	.80	......	......
Alaska chum	.77½	......	......
Medium red and coho	1.25	1.40	.80
1911.			
Columbia River chinook, fancy	1.95	2.00	1.30
Puget Sound sockeye	1.95	2.00	1.30
Alaska red	1.60	1.75	1.12½
Alaska medium red	1.45	1.65	1.00
Alaska king	1.80	2.00	1.12½
Pink	1.00	1.15	.80
Chum	.95	1.05	.75
1912.			
Chinook	1.95	2.00	1.25
Sockeye	1.95	2.00	1.30
Alaska red	1.40	1.60	1.15
Alaska medium red	1.15	1.25	.80
Alaska king	1.40	1.60	1.15
Pink	.65	.65	.55
Chum	.62½	......	.50
1913.			
Chinook	1.95	2.00	1.25
Sockeye	1.50	1.65	1.05
Alaska red	1.15	1.35	.95
Alaska medium red	.85	1.00	.70
Alaska king	1.00	1.15	.90

Year and species.	Tails.	Flats.	Halves
1913			
Pink	$0.65	$0.80	$0.55
Chum	[a] .55	.70	.50
1914.			
Chinook	1.95	2.10	1.25
Sockeye	1.95	2.15	1.35
Alaska red	1.45	1.80	1.10
Medium red	1.15	1.35	.82½
Alaska king	1.40	......	1.10
Pink	.90	1.00	.70
Keta, or chum	.85	.95	.65
1915.			
Chinook	1.90	2.00	1.25
Sockeye	1.95	2.15	1.35
Alaska red	1.50	1.85	1.15
Medium red	1.15	1.30	.75
Alaska king	1.25	......	......
Pink	.75	.85	.57½
Keta, or chum	[b] .70	.80	.52½
1916. [c]			
Chinook	1.90	2.00	1.25
Sockeye	2.05	2.25	1.40
Alaska red	1.50	1.75	1.20
Medium red	1.30	1.45	.90
Alaska king	1.35	......	......
Pink	.90	1.10	.75
Chum	.85	......	.67½
1917.			
Chinook	2.90	3.00	1.75
Sockeye	2.90	3.00	1.75
Alaska red	2.35	2.60	1.65
Medium red	2.00	2.15	1.35
Alaska king	2.25	......	......
Pink	1.65	1.80	1.15
Chum	1.60	1.75	......
1918. [d]			
Chinook:			
Fancy	3.15	3.25	2.00
Standard	2.75	2.85	1.75
Bluebacks	......	......	2.00
Sockeye	[e] 3.15	[e] 3.25	2.00
Alaska red	2.35	2.50	1.65
Medium red:			
Alaska	2.25	2.40	1.60
Puget Sound, etc	2.40	2.50	1.60
Pink	1.65	1.80	1.15
Chum:			
Alaska	1.60	1.75	1.10
Puget Sound, etc	1.75	1.85	1.10
Steelhead	3.00	3.10	1.90
1919.			
Chinook	3.15	3.25	2.00
Sockeye	......	......	[f] 2.50
Alaska red	[g] 3.35	3.50	2.25
Tips and tails	3.10	......	......
Alaska king	[h] 3.12½	......	......
Medium red	3.00	3.15	2.00
Pink	2.25	2.40	1.40
Chum	[i] 2.15	2.30	1.25

[a] The opening price in San Francisco was 60 cents.
[b] The opening price in San Francisco was 65 cents.
[c] The Kelley-Clarke prices differed from these in the following particulars: Red tails, $1.60; red halves, $1.25; medium red talls, $1.35; medium red flats, $1.50; medium red halves, $1.00; pink talls, $1.00; Chum talls, 95c.; and King talls, $1.40.
[d] Maximum prices set by U. S. Food Administration.
[e] Pack of 1-pound talls and 1-pound flats taken for British Government at these prices.
[f] No price named by Alaska Packers Association or Deming & Gould Co.
[g] Alaska Packers Association and Northwestern Fisheries Co. quoted $3.25: others reduced to conform.
[h] Quoted by Alaska Packers Association only.
[i] Alaska Packers Association quoted $2.10.

BRITISH COLUMBIA OPENING PRICES.

The packers of British Columbia and the United States both sell a considerable portion of their high-grade salmon abroad, and the competition thus engendered compels a fairly close conformity in prices. On salmon sold in the domestic markets, however, the competition is not so keen; hence there is room for a considerable diversity of opinion as to values. Unlike the United States, there is a very small market in Canada for chum salmon, and it has only been in recent years that opening prices have been fixed on this grade.

BRITISH COLUMBIA OPENING PRICES SINCE 1902.[a]

[Prices are for full cases.]

Year and species.	Talls.	Flats.	Halves.
1902.			
Sockeye	$4.75	$4.90	
Red spring	4.00		
Coho	3.75		
Pink	2.50	2.50	
1903.			
Sockeye	4.65		
Red spring	4.00		
Coho	3.75		
Pink	2.60	2.50	
1904.			
Sockeye	5.75	6.25	
Red spring	5.25		
Coho	4.25		
Pink	2.75		
1905.			
Sockeye	5.00	5.30	
Red spring	4.50	5.00	
Coho	4.00		
Pink	2.60		
1906.			
Sockeye	5.50		
Red spring	5.25		
Coho	4.50	4.75	
Pink		3.00	
1907.			
Sockeye	5.50		
Red spring	5.50	5.50	
Coho	4.50	4.50	
Pink	3.00	3.00	
1908.			
Sockeye	6.10		
Red spring	5.75	5.75	
Coho	4.75	5.00	
Pink	3.25	3.25	
1909.			
Sockeye	5.25		$6.75
Red spring	5.10	5.60	
Coho	4.25		
Pink	2.75		
1910.			
Sockeye	6.50	7.00	8.25
Red spring	5.75	6.00	
Coho	5.00	5.50	6.50
Pink	3.25		
1911.			
Sockeye	7.75	8.00	10.00
Red spring	6.50		
Coho	6.00	6.25	7.50
Pink	$4.00	$4.25	$5.50
Chum	3.75		
1912.			
Sockeye	9.00	9.25	10.75
Red spring	7.75		9.25
Coho	7.25	7.25	7.50
Pink	3.00	3.00	4.50
Chum	2.75		
1913.			
Sockeye	6.00	6.25	7.75
Red spring	5.75	5.75	
Coho	4.25	4.50	
Pink	2.50	2.50	
1914.			
Sockeye	7.50	8.75	9.25
Red spring	6.75		
Coho	4.75		5.50
Pink	3.50		
1915.			
Sockeye	8.25	8.25	10.25
Red spring	6.75		
Coho	4.50	5.00	
Pink	3.25	3.50	4.75
Chum	2.75		
1916.			
Sockeye	9.00		11.00
Red spring	8.00		9.50
Coho	6.50		9.00
Pink	3.75		5.25
Chum	3.00	4.00	
1917.			
Sockeye	13.00		16.00
Red spring		12.00	13.00
Coho	10.00	11.00	12.50
Pink	8.00		9.25
Chum	6.65		
1918.			
Sockeye	14.50	15.00	16.00
Red spring	13.00	13.25	14.00
Coho	11.50	12.00	13.00
Pink	8.50	8.75	10.00
Chum	6.75		7.75
1919.			
Sockeye	16.00	16.50	17.50
Red spring			16.00
Coho	12.00	12.50	13.50
Pink		9.00	10.00
Chum	6.75		

[a] These opening prices have been furnished by H. Bell-Irving & Co. (Ltd.), of Vancouver, British Columbia, Canada, well known packers and handlers of canned salmon.

PICKLING INDUSTRY.

The salmon-pickling industry was so overshadowed by its giant brother, the canning industry, that statistical data, except for Alaska, were found in extremely fragmentary shape, and only that portion is shown relating to Alaska from the time of annexation to and including 1919.

PACK OF SALTED SALMON IN ALASKA, 1868 TO 1919.

Year.	Salmon.		Salmon bellies.		Dry-salted salmon.	
	Barrels.	Value.	Barrels.	Value.	Pounds.	Value.
1868	2,000	$16,000				
1869	1,700	13,600				
1870	1,800	14,400				
1871	700	6,300				
1872	1,000	9,000				
1873	900	7,200				
1874	1,400	11,200				
1875	1,200	9,600				
1876	1,800	14,400				
1877	1,950	15,700				
1878	2,100	16,800				
1879	3,500	28,000				
1880	3,700	29,600	300	$3,300		
1881	1,760	15,840				
1882	5,890	53,010				
1883	7,251	65,259				
1884	6,106	54,954				
1885	3,230	29,070				
1886	4,861	43,749				
1887	3,978	35,802				
1888	9,500	85,500				
1889	6,457	58,013				
1890	18,039	162,351				
1891	8,913	71,304				
1892	17,374	140,057	53	815		
1893	24,005	120,083				
1894	32,011	176,060				
1895	14,234	85,404				
1896	9,314	65,198	150	1,200		
1897	15,848	110,936	2,846	28,460		
1898	22,670	181,360	580	5,800		
1899	22,382	167,865	235	2,350		
1900	31,852	238,890	2,353	23,530	511,400	$10,228
1901	24,477	171,339	652	3,816		
1902	30,384	212,688	328	2,952		
1903	27,921	223,368	3,667	32,973	300,000	5,500
1904	13,674	89,209	208	1,950	966,812	16,180
1905	19,071	143,811	1,360	11,355	7,280,234	115,643
1906	17,283	126,194	1,338	13,644	1,107,680	16,969
1907	22,307	203,127	2,965	37,422	107,580	1,505
1908	34,337	293,377	4,736	59,330	20,800	416
1909	28,915	183,400	1,970	25,358	71,600	1,038
1910	12,779	111,634	1,626	19,007	22,178	554
1911	8,483	102,477	1,337	15,561	33,285	1,340
1912	34,602	305,928	37	606		
1913	37,881	272,726	451	6,523	21,282	1,235
1914	25,954	247,195	408	5,467	12,200	810
1915	12,058	157,457	571	13,610		
1916	17,259	205,706	475	6,961	44,552	2,408
1917	36,165	584,962	225	5,535	371,600	33,044
1918	56,837	1,078,456	53	1,425		
1919	8,110	195,447			212,244	17,601
Total	757,927	7,058,006	28,924	328,950	11,083,447	224,471

Alaska Pickled-Salmon Pack, 1906 to 1918, by Species, Quantity,[a] and Value.

Species.	1906		1907		1908		1909		1910	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
Whole salmon:										
Coho	539	$5,642	1,665	$16,406	692	$5,648	318	$2,485	160	$1,504
Chum	231	1,550	233	1,521	122	707	35	190	....	....
Humpback	2,446	13,852	4,248	29,374	2,346	17,935	1,557	9,405	330	1,998
King	1,007	8,058	964	10,684	660	6,813	441	3,798	352	3,399
Red	13,060	97,092	15,197	145,142	30,517	262,274	26,508	167,298	11,931	104,649
Total	17,283	126,194	22,307	203,127	34,337	293,377	28,859	183,176	12,773	111,550
Bellies:										
Coho	....	....	191	2,696	229	3,535	255	3,843	126	1,135
Chum	30	150	....	....	117	699	....	....	70	770
Humpback	1,273	13,188	1,800	21,080	2,447	28,140	738	7,438	616	6,135
King	22	185	84	1,002	48	720	35	175	6	128
Red	13	121	890	12,644	1,895	26,236	942	13,902	808	10,839
Total	1,338	13,644	2,965	37,422	4,736	59,330	1,970	25,358	1,626	19,007
Backs, etc.:										
Humpback	....	....	....	....	....	....	56	224	....	....
King	....	....	....	....	....	....	....	....	2	24
Red	....	....	....	....	....	....	....	....	4	60
Total	....	....	....	....	....	....	56	224	6	84
Grand total	18,621	139,838	25,272	240,549	39,073	352,707	30,885	208,758	14,405	130,641

Species.	1911		1912		1913		1914	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
Whole salmon:								
Coho	223	$2,149	1,165	$9,565	1,006	$6,452	365	$2,767
Chum	133	666	93	652	100	778	53	293
Humpback	1,122	11,238	4,236	28,304	2,724	18,181	482	2,954
King	600	8,095	225	2,442	135	1,410	269	2,588
Red	6,239	79,578	28,883	264,965	33,916	245,905	24,785	238,593
Total	8,317	101,726	34,602	305,928	37,881	272,726	25,954	247,195
Bellies:								
Coho	38	489	....	....	54	946	67	982
Chum	7	77	....	....	67	941	18	180
Humpback	676	5,122	37	606	324	4,546	229	2,620
King	2	30	....	....	....	....	2	13
Red	614	9,843	....	....	6	90	92	1,672
Total	1,337	15,561	37	606	451	6,523	408	5,467
Backs, etc.:								
Humpback	150	600	....	....	....	....	....	....
King	1	15	....	....	....	....	....	....
Red	15	136	....	....	....	....	....	....
Total	166	751	....	....	....	....	....	....
Grand total	9,820	118,038	34,639	306,534	38,332	279,249	26,362	252,662

[a] Barrels hold 200 pounds of fish; when of a different size they have been reduced to conform to this weight.

Alaska Pickled-Salmon Pack, 1906 to 1918, by Species, Quantity, and Value—Continued.

Species.	1915		1916		1917		1918	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
Whole salmon:								
Coho	1,763	$19,393	2,076	$22,287	1,798	$29,631	2,501	$47,152
Chum	325	2,925	495	4,057	1,722	21,899	6,080	84,878
Humpback	662	5,958	503	3,624	5,576	73,857	11,973	182,490
King	377	4,147	636	7,956	359	6,556	297	7,645
Red	8,931	125,034	13,549	167,782	26,710	453,019	35,977	756,191
Total	12,058	157,457	17,259	205,706	36,165	584,962	56,828	1,078,356
Bellies:								
Coho			27	500	11	326	10	180
Chum			285	3,556	73	1,362		
Humpback	133	2,660	61	882	110	2,885	26	650
King			2	23	7	150		
Red	438	10,950	100	2,000	24	812	17	595
Total	571	13,610	475	6,961	225	5,535	53	1,425
Backs, etc: Coho							9	100
Grand total	12,629	171,067	17,734	212,667	36,390	590,497	56,890	1,079,881

Pack of Salted Salmon in Alaska in 1919.[a]

Products.[b]	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.	Barrels.	Value.
Coho, or silver	706	$13,206	204	$3,024	292	$5,918	1,202	$22,148
Chum, or keta	70	2,080	27	135	41	555	138	2,770
Humpback, or pink	26	260	50	700	45	548	121	1,508
King, or spring	241	4,542	8	232	618	16,267	867	21,041
Red, or sockeye	12	355	587	12,380	5,183	135,245	5,782	147,980
Total	1,055	20,443	876	16,471	6,179	158,533	8,110	195,447

[a] From "Alaska Fisheries and Fur Industries in 1919," p. 50. By Ward T. Bower. Appendix IX, Report, U. S. Commissioner of Fisheries, 1919. Washington, 1920.
[b] Each barrel holds 200 pounds of fish.

MILD-CURING INDUSTRY.

The beginning of this industry on the Pacific coast is of comparatively recent date, and the following table is complete, with the possible exception of a few tierces, which may not have been reported for the coastal rivers of Oregon:

TIERCES OF MILD-CURED SALMON PACKED ON PACIFIC COAST FROM 1897 TO 1919.[a]

Year.	Alaska.	British Columbia.	Puget Sound, Wash.	Grays Harbor, Wash.	Willapa Harbor, Wash.	Columbia River (both sides).	Coastal rivers, Oreg.	Eel River, Calif.	Sacramento River, Calif.	Monterey Bay, Calif.	Total.
1897	....	....	....	....	....	400	....	....	....	....	400
1898	70	....	....	....	....	700	....	....	....	....	770
1899	130	....	....	375	....	1,250	....	....	....	....	1,755
1900	....	....	....	....	....	1,275	....	....	950	....	2,225
1901	67	....	600	....	....	3,000	....	....	3,100	....	6,767
1902	67	....	425	....	....	4,213	188	....	2,325	504	7,722
1903	8	....	824	....	....	6,725	....	....	3,600	354	11,511
1904	34	....	1,250	....	....	9,088	....	200	4,719	248	15,539
1905	189	1,175	3,000	....	....	9,805	415	....	2,979	310	17,873
1906	1,126	957	....	....	....	8,000	740	175	2,177	510	13,685
1907	1,657	1,993	2,060	20	100	6,070	740	140	4,102	582	17,464
1908	1,378	1,060	....	....	....	4,960	....	....	3,243	252	10,893
1909	2,292	1,560	2,109	75	29	5,540	560	80	5,111	911	18,267
1910	3,357	1,638	2,435	67	....	7,922	1,398	....	5,516	75	22,408
1911	3,164	1,965	2,745	100	30	8,185	1,247	110	2,011	160	19,717
1912	5,245	1,489	3,013	357	40	5,824	3,082	100	3,274	....	22,424
1913	7,443	3,150	3,923	250	50	5,746	2,381	....	4,789	550	28,282
1914	4,091	3,182	1,934	....	....	5,205	457	....	1,829	1,476	18,174
1915	2,966	1,119	2,235	....	....	4,078	333	3	1,630	942	13,306
1916	4,898	1,848	1,755	....	....	4,656	194	....	650	1,069	15,070
1917	3,563	429	1,063	....	....	1,886	....	....	1,508	300	8,749
1918	3,948	729	1,093	....	....	1,804	275	455	1,913	266	10,483
1919	5,376	1,173	2,423	....	....	3,328	148	[b] 1,326	2,355	1,055	17,184
Total	51,069	23,467	32,887	1,244	249	109,660	12,158	2,589	57,781	9,564	300,668

[a] The net weight of fish in a tierce is about 800 pounds. King, chinook, or spring salmon were used almost exclusively. From most places the data are complete from the time of the inception of the industry, but from a few minor places the data are somewhat fragmentary.
[b] Includes Fort Bragg, on Noyo River.

YUKON TERRITORY, CANADA.

Some salmon fishing is carried on in that section of the upper Yukon River which lies in Yukon Territory, Dominion of Canada. The species taken are principally king and dog, and these are sold mainly in a fresh condition. The following table shows the quantity taken and the value of same in certain years:

CATCH OF SALMON IN YUKON TERRITORY, CANADA, IN SPECIFIED YEARS.

Year.	Salmon.		Year.	Salmon.	
	Pounds.	Value.		Pounds.	Value.
1903	70,000	$5,600	1914	188,600	$18,860
1909	138,574	17,566	1915	157,000	15,700
1910	169,900	18,689	1916	143,500	14,350
1911	229,000	22,900	1917	....	....
1912	224,100	22,410	1918	....	....
1913	182,000	18,200	1919	....	....

TRADE WITH OUTLYING POSSESSIONS.

As a result of the war with Spain the United States in 1898 acquired possession of Porto Rico, Guam, and the Philippine Islands, while in the same year Hawaii became a part of this country at its own request, and in 1900 two islands of the Samoan group were acquired by a partition agreement with Great Britain and Germany. The trade with the Philippine Islands is shown to date in the tables of exports and imports to foreign countries, but the trade with the other possessions has been eliminated from these tables and shown separately ever since their annexation to the United States.

HAWAII.

The islands constituting this Territory, owing to their reciprocity treaty with this country for a number of years before annexation, purchased their supplies of salmon from the United States almost exclusively. In recent years the Territory has imported the following quantities of salmon from the mainland:

Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.	Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.
	Pounds.	Value.	Value.		Pounds.	Value.	Value.
1907	1,126,217	$89,286	$64,232	1914	1,418,941	$97,532	(a)
1908	965,029	89,025	67,143	1915	1,005,848	90,705	(a)
1909	1,440,410	121,716	73,848	1916	1,582,528	132,597	(a)
1910	1,381,398	113,526	72,194	1917	1,463,729	145,531	(a)
1911	1,231,264	119,872	76,572	1918	1,168,528	174,777	(a)
1912	1,850,567	194,385	57,495	1919	979,895	159,577	(a)
1913	1,841,874	173,202	(a)				

[a] Not shown separately.

PORTO RICO.

Of recent years the following shipments of domestic salmon have been made to this island:

Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.	Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.
	Pounds.	Value.	Value.		Pounds.	Value.	Value.
1907	604,627	$53,916	$2,893	1914	416,414	$41,726	(a)
1908	512,038	48,195	1,428	1915	588,889	56,527	(a)
1909	381,171	34,777	3,810	1916	860,873	60,453	(a)
1910	511,055	43,494	6,243	1917	881,360	70,427	(a)
1911	357,382	30,699	3,868	1918	378,266	52,737	(a)
1912	710,721	65,354	1,208	1919	468,501	68,532	(a)
1913	666,602	66,811	(a)				

[a] Not shown separately.

PHILIPPINE ISLANDS.

Of recent years the following shipments of domestic salmon have been made to these islands:

Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.	Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.
	Pounds.	Value.	Value.		Pounds.	Value.	Value.
1909	1,126,470	$74,792	$712	1915	4,159,580	$288,548	(a)
1910	5,425,404	396,604	2,089	1916	5,640,858	356,366	(a)
1911	3,069,118	225,885	3,542	1917	4,202,574	351,633	(a)
1912	5,096,810	422,001	2,437	1918	5,558,796	618,697	(a)
1913	10,122,820	590,128	(a)	1919	3,880,425	431,616	(a)
1914	5,034,252	266,369	(a)				

[a] Not shown separately.

ALASKA.

It seems like "carrying coals to Newcastle" to ship canned salmon to Alaska, from which Territory more than half the canned salmon of the world is produced, and yet a small business is done each year in this line, most of the product going to the mining camps and towns somewhat removed from the fishing sections.

The table below shows the shipments of such fish in recent years. After 1914 the shipments were lumped together with all other kinds of fish and thus prevented the listing of salmon separately.

Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.	Year ending June 30—	Canned salmon.		All other salmon, fresh or cured.
	Pounds.	Value.	*Value.*		Pounds.	Value.	*Value.*
1909	67,132	$7,123	$3,966	1912	134,320	$15,022	$4,218
1910	67,658	7,204	3,558	1913	43,346	5,074	(a)
1911	38,265	4,513	1,061	1914	42,945	5,278	(a)

a Not shown separately.

GUAM.

Since annexation, this country and Japan have been competing for the trade of this island, which, in earlier years, Japan controlled quite largely. During the last two years shown in the statement, however, the United States has secured the advantage. The table below shows the extent of the trade, which is made up almost entirely of salted or pickled salmon, only 900 pounds of fresh salmon, valued at $92, having been shipped by this country to Guam in 1908. Since 1909 all the fishery products imported have been lumped under one heading and it has been impossible to distinguish the salmon from the other species.

Year and country.	Pickled salmon.		Year and country.	Pickled salmon.	
	Pounds.	Value.		Pounds.	Value.
1905.			1908.		
United States	1,415	$71	United States	7,406	$623
Japan	16,526	1,221	Japan	6,130	465
1907.			1909.		
United States	13,604	1,086	United States	10,779	740
Japan	19,862	1,601	Japan	4,295	344

TUTUILA, SAMOA.

The customs statistics lump the imports of fish under one general heading, thus making it impossible to show separately the imports of salmon.

FOREIGN TRADE IN SALMON.

As we do not consume all of the salmon produced by our fisheries, it is necessary to find a foreign market for the surplus each season, but, as canned salmon has become one of the staples of the world, there is not much difficulty in this respect, especially since our only competitors are Canada, Siberia, and Japan. The two last named have not yet become important factors in the canned-salmon market, though they will as their fishing operations are extended. There is more competition in the pickled, fresh, and frozen markets, several European and Asiatic countries being large producers of these goods, as is Canada also, for a considerable proportion of which she is compelled to find an outside market.

The World War greatly disturbed the usual course of our foreign trade. Because of the need for foodstuffs a tremendous demand arose in Europe for our salmon, resulting in a decided increase in the quantities shipped there and, for a while, in a reduction of our exports in other directions. In time, however, the markets adjusted themselves to the changed conditions of trade.

EXPORTS OF DOMESTIC CANNED SALMON.

From the beginning of the industry a considerable proportion of the salmon canned has been exported, especially of the higher grades. In Europe the chief customer is Great Britain, followed closely in the closing years of the war by Italy. Great Britain does not, however, consume this quantity, for a considerable part of her importations are reexported. On the North American Continent and adjacent islands the best customers are Mexico, Cuba, Panama, and the British West Indies, in the order named. The heavy shipments to Canada since 1916 are mainly in transit shipments to Europe by Canadian steamship lines as our lines were overburdened with war shipments. In South America, Chile, Peru, Argentina, and Ecuador were the leading markets in 1918. In Asia, Hongkong and China import canned salmon, although neither buys great quantities. The islands of the Pacific and Indian Oceans are large consumers. British Australasia took 7,811,387 pounds, valued at $1,407,561 in 1918, and other good customers were the British East Indies and British, French, and German Oceania. In Africa the British and Portuguese possessions are the largest importers.

The movements of these products are naturally often influenced favorably or adversely as the tariffs of the various countries in which they are marketed are raised or lowered.

Some countries maintain excessively high tariffs, among these being Brazil, 30 cents per pound; Colombia, 8½ cents; Mexico, 4 cents; Guatemala, 6½ cents; Paraguay, 7 cents; Uruguay, 6 cents; Austria-Hungary, 8 cents, and Germany, 7 cents. Norway levies 6 cents a pound duty, but this is undoubtedly to protect her own salmon industry.

In but few of the tariff acts is canned salmon distinguished by name, being usually classed as "preserved fish," and as these are usually luxuries in many countries they bear an extra high duty as a result.

In addition to these high duties in some countries, especially in South America, there are various other charges, fees, etc., which materially enhance the value of the goods before they reach the consumer. C. H. Clarke, of the salmon brokerage firm of Kelley-Clarke Co., of Seattle, Wash., prepared and published a statement [a]

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[a] Pacific Fisherman, Vol. 13, No. 5, p. 11, 1915.

showing the comparative charges on 100 cases each of red Alaska and pink canned salmon from the time they leave Seattle up to the time they reach the hands of wholesalers in South America. This shows that the f. o. b. Seattle value of the red salmon was $500 and of the pink salmon $280. By the time these goods reached the hands of the Rio de Janeiro wholesalers the red salmon were worth $1,900.07, while the pink salmon were worth $1,677.87. At Montevideo, Uruguay, the red salmon were worth $1,436.01 and the pink salmon $1,213.81. The table is so interesting and instructive that it is reproduced entire herewith.

Comparative Charges on 100 Cases Each of Red Alaska and Pink Canned Salmon from Seattle, Wash., to Hands of Wholesalers in South America.

	Argentina (Buenos Aires).		Brazil (Rio de Janeiro).		Chile (Valparaiso).		Ecuador (Guayaquil)	
	Red.	Pink.	Red.	Pink.	Red.	Pink.	Red.	Pink.
F. o. b. Seattle value	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00
Strapping	5.00	5.00	5.00	5.00	....	....	....	....
Freight	104.75	104.75	114.50	114.50	45.00	45.00	45.00	45.00
Marine insurance, 5 per cent f. p. a	6.10	3.90	6.20	4.00	5.50	3.25	5.50	3.25
C. i. f. value	615.85	393.65	625.70	403.50	550.50	328.25	550.50	328.25
Consular fees in United States.	2.00	2.00	3.25	3.25	5.25	4.25	22.35	14.00
Customs duty	519.56	519.56	1,138.78	1,138.78	160.46	160.46	345.37	234.37
Analysis	2.12	2.12	6.47	6.47	....	....	....	....
Storage in customhouse	2.41	2.41	33.90	33.90	5.35	5.35	....	....
Handling in customhouse	7.24	7.21	....	....	2.51	2.51	....	....
Stamps and entry blanks	1.49	1.49	....	....	1.43	1.43	....	....
Statistics	....	....	.10	.10	....	....	....	....
Internal-revenue tax	....	....	7.77	7.77	....	....	....	....
Port tax	....	....	57.20	57.20	....	....	....	....
Customs brokerage	12.74	12.74	....	....	7.15	7.15	....	....
Wharfage, lighterage, cartage	7.64	7.64	26.90	26.90	3.65	3.65	19.30	19.30
Value ex customhouse	1,171.05	948.85	1,900.07	1,677.87	736.30	513.05	937.52	706.92

	Paraguay (Asuncion).		Peru (Callao).		Uruguay (Montevideo).		Venezuela (La Guayra).	
	Red.	Pink.	Red.	Pink.	Red.	Pink.	Red.	Pink.
F. o. b. Seattle value	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00	$500.00	$280.00
Strapping	5.00	5.00	....	....	5.00	5.00	5.00	5.00
Freight	134.75	134.75	37.50	37.50	104.75	104.75	54.60	54.60
Marine insurance, 5 per cent f. p. a	9.60	6.30	5.40	3.20	6.10	3.90	5.60	3.40
C. i. f. value	649.35	426.05	542.90	320.70	615.85	393.65	565.20	343.00
Consular fees in United States.	2.00	2.00	5.75	3.45	1.05	1.05	12.85	12.85
Customs duty	308.25	308.25	275.86	275.86	779.30	779.30	238.96	238.06
Analysis	....	....	....	....	....	....	....	....
Storage in customhouse	....	....	....	....	....	....	....	....
Handling in customhouse	....	....	....	....	16.15	16.15	....	....
Stamps and entry blanks	....	....	.58	.58	1.55	1.55	1.35	.97
Statistics	.37	.37	....	....	....	....	....	....
Internal-revenue tax	....	....	....	....	....	....	....	....
Port tax	....	....	....	....	....	....	....	....
Customs brokerage	....	....	4.86	4.86	15.50	15.50	5.00	2.80
Wharfage, lighterage, cartage	6.33	6.33	15.69	15.69	6.61	6.61	12.82	12.82
Value ex customhouse	966.30	743.00	845.64	621.14	1,436.01	1,213.81	836.18	611.40

The following table shows in summarized form the yearly exports of domestic canned salmon and the countries to which exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1918, inclusive:

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC CANNED SALMON.

SUMMARY, 1900–1915.[a]

Country receiving.	1900		1901		1902		1903	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Europe	18,941,109	$1,881,725	31,877,663	$3,234,862	30,683,551	$2,625,284	35,410,768	$3,125,197
North America	1,051,808	98,064	2,443,561	297,440	2,780,844	242,029	4,285,406	378,655
South America	1,868,225	192,918	1,577,013	160,862	1,291,998	107,907	1,756,214	121,918
Asia	654,126	67,941	853,434	86,571	1,597,346	120,674	1,759,294	134,783
Oceania	3,882,646	390,466	3,681,276	367,533	8,179,161	670,741	5,511,514	444,505
Africa	684,456	62,534	856,553	83,003	2,640,214	224,767	1,630,138	145,733

Country receiving.	1904		1905		1906	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Europe	33,591,896	$3,508,818	21,071,263	$1,877,509	32,061,402	$2,753,643
North America	2,446,023	204,363	1,565,773	132,134	2,069,357	171,946
South America	2,055,859	147,333	1,708,828	134,941	3,499,603	249,052
Asia	12,995,768	930,054	3,994,862	280,704	779,415	60,173
Oceania	3,898,606	341,849	5,257,446	467,928	6,340,346	509,257
Africa	936,126	92,181	1,468,383	142,253	1,194,291	103,872

Country receiving.	1907		1908		1909	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Europe	7,756,780	$791,436	13,321,086	$1,205,375	23,028,476	$2,207,194
North America	3,052,658	261,138	2,654,175	242,879	2,209,405	198,043
South America	5,659,690	414,774	5,571,000	410,743	1,461,662	123,502
Asia	1,419,391	105,364	1,004,571	86,908	1,386,702	119,582
Oceania	6,719,157	552,205	5,131,554	439,917	7,383,494	705,204
Africa	610,429	58,132	543,659	52,696	647,370	62,911

Country receiving.	1910		1911		1912	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Europe	44,765,898	$4,712,182	22,134,328	$2,408,708	19,545,720	$2,183,982
North America	2,224,516	191,551	1,979,950	190,637	3,411,176	332,692
South America	3,193,812	226,197	3,006,927	266,903	6,756,440	609,383
Asia	1,596,775	133,516	1,489,282	148,721	1,702,426	160,119
Oceania	11,568,824	998,219	9,699,624	991,540	11,220,515	1,255,149
Africa	510,871	52,593	290,688	30,633	787,479	79,238

Country receiving.	1913		1914		1915	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Europe	25,408,154	$2,705,254	62,862,328	$6,026,170	63,760,758	$7,110,728
North America	4,271,710	370,823	6,907,615	511,545	4,328,246	370,444
South America	4,134,771	292,367	3,472,438	233,675	1,301,962	107,783
Asia	3,593,538	254,209	2,875,995	180,402	1,135,793	97,662
Oceania	17,419,390	1,441,270	12,089,003	1,017,994	12,100,414	1,309,376
Africa	463,403	39,417	353,541	29,507	818,943	76,450

[a] Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 187–194. Washington, 1917.

Exports, by Countries Receiving, of Domestic Canned Salmon—Continued.

DETAILS, 1916 TO 1918.[a]

Country receiving.	1916		1917		1918	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
EUROPE.						
Belgium	....	....	1,115,792	$8,516	18,000	$2,525
Denmark	366,948	$29,255	89,405	9,650	....	....
France	3,447,022	377,597	985,582	153,927	7,937,490	1,167,737
Gibraltar	....	....	....	....	1,156,864	167,157
Greece	70,560	6,059	190,736	14,486	173,400	21,935
Iceland, and Faroe Islands	136	16	2,820	297	96	16
Italy	34,184	3,170	4,169,250	436,576	13,540,046	1,752,163
Malta, Gozo, etc	9,120	702	5,520	525	....	....
Netherlands	21,868	2,865	20,450	2,709	....	....
Norway	41,280	4,383	54,440	6,164	....	....
Portugal	20	2	60	7	794	178
Russia in Europe	....	....	240	18	....	....
Serbia and Montenegro	170	17	....	....	....	....
Spain	4,995	382	37,481	3,369	1,315	274
Sweden	60,122	6,666	14,100	1,800	....	....
United Kingdom:						
England	109,039,707	11,105,506	74,941,169	8,536,248	46,415,026	7,447,389
Scotland	1,067,590	111,381	1,131,832	139,718	848,295	129,652
Ireland	....	....	....	....	900	220
NORTH AMERICA.						
Bermuda	89,599	8,741	93,523	22,066	87,832	16,028
British Honduras	32,021	3,228	30,057	3,072	25,178	3,410
Canada	7,994,185	677,655	9,158,079	838,734	12,184,077	1,755,690
Central American States;						
Costa Rica	118,002	8,878	95,435	8,065	10,750	1,643
Guatemala	58,528	4,084	45,484	4,708	19,026	2,581
Honduras	37,695	3,651	26,168	3,080	10,536	1,612
Nicaragua	36,644	3,064	50,719	6,029	33,421	5,115
Panama	633,645	57,042	454,064	50,793	306,765	49,031
Salvador	21,404	1,826	18,368	2,134	6,691	1,144
Mexico	1,611,929	132,406	3,707,225	342,564	1,800,185	246,830
Miquelon, Langley, etc	957	100	3,026	377	60	8
Newfoundland and Labrador	700	37	2,640	286	....	....
West Indies:						
British—						
Barbados	60,361	5,767	73,610	8,643	97,722	18,121
Jamaica	228,973	19,017	180,965	18,347	86,503	14,170
Trinidad and Tobago	267,548	26,060	134,832	18,230	372,420	61,443
Other British	75,578	7,097	103,004	12,001	32,116	5,760
Cuba	927,129	87,479	1,619,236	149,492	1,632,073	210,167
Danish	11,582	1,063	34,598	4,100	23,629	4,633
Dutch	21,599	2,122	24,673	2,782	8,370	1,683
French	4,772	477	4,770	543	548	80
Haiti	3,586	361	4,297	486	1,793	349
Santo Domingo	85,722	7,048	231,413	22,859	100,417	14,148
SOUTH AMERICA.						
Argentina	273,900	23,429	191,618	19,043	353,103	61,428
Bolivia	14,579	1,466	122,092	11,724	211,978	24,478
Brazil	40,732	3,921	64,657	7,599	187,615	26,245
Chile	2,812,537	192,581	1,452,155	121,019	2,304,499	330,244
Colombia	136,254	11,514	126,861	22,575	75,477	11,479
Ecuador	245,149	16,009	276,654	25,302	215,456	28,360
Guiana—						
British	184,654	18,249	196,261	26,637	151,719	27,749
Dutch	87,398	8,048	39,050	3,888	35,143	5,812
French	26,128	2,371	17,909	1,910	26,560	3,825
Peru	523,580	36,361	434,329	37,447	1,150,276	158,794
Uruguay	23,464	1,841	5,258	590	6,630	1,509
Venezuela	195,618	16,234	297,125	28,158	181,236	26,834
ASIA.						
Aden	27,716	2,817	....	....	2,832	472
China	....	....	42,017	5,177	68,949	13,372
China, leased territory:						
Japanese	96	16	192	32	144	30
Chosen	1,632	172	2,520	456	1,062	207

[a] From Pacific Fisherman Yearbook for 1919, p. 93. Customs returns are for the fiscal year ending June 30 of the year noted.

Exports, by Countries Receiving, of Domestic Canned Salmon—Continued.

DETAILS, 1916 TO 1918—Continued.

Country receiving.	1916		1917		1918	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
ASIA—continued.						
East Indies:						
British—						
British India	1,117,839	$91,767	601,935	$62,264	1,349,057	$222,947
Straits Settlements	1,215,214	71,585	106,896	9,081	232,755	34,468
Other British	166,144	12,787	101,286	10,355	41,818	6,944
Dutch	727,006	81,121	374,832	42,693	405,326	66,240
French	4,712	615	6,816	1,340	240	69
Hongkong	47,558	5,170	74,585	9,570	86,203	14,678
Japan	1,348	141	2,604	340	4,590	883
Persia	24,960	1,892	9,600	800		
Russia in Asia	48	4				
Siam	1,392	219	2,880	533	6,048	1,012
OCEANIA.						
British:						
Australia and Tasmania	11,035,294	1,204,354	6,990,835	865,865	7,397,009	1,337,231
New Zealand	216,292	24,684	96,912	10,332	240,240	45,409
Other British	30,878	2,923	141,735	14,749	174,138	24,921
French	290,854	29,201	248,415	32,643	186,574	31,160
German	448,860	29,434	357,386	37,172	285,605	39,071
Philippine Islands	5,640,858	356,366	4,202,574	351,633	5,558,796	618,697
AFRICA.						
British Africa:						
West	100,310	7,860	613,545	62,925	480,414	72,960
South	620,555	56,255	1,421,021	157,853	1,293,714	161,423
East			25,608	2,543	57,275	8,938
Belgian Congo			1,750	331	2,293	463
Canary Islands	10,480	1,071	7,200	432	836	115
Egypt	105,800	9,534			261,673	42,335
French Africa			2,250	235	20,268	4,255
Italian Africa	110	10				
Liberia	3,624	366	2,810	258	9,448	1,499
Portuguese Africa	37,508	3,231	138,580	13,291	52,298	7,207
Spanish Africa	9,700	911	138,580	13,291	8,845	1,175
Total	152,943,962	15,032,497	117,962,807	12,963,425	110,060,480	16,570,834
RECAPITULATION.						
Europe	114,163,722	11,648,003	82,758,877	9,390,858	70,092,226	10,692,246
North America	12,322,259	1,056,904	16,196,177	1,565,409	16,840,112	2,413,649
South America	4,563,993	332,024	3,314,969	305,964	4,899,692	706,757
Asia	3,336,665	268,306	1,326,163	142,641	2,199,024	361,322
Oceania	17,659,036	1,646,962	12,037,857	1,312,394	13,842,362	2,096,439
Africa	898,298	80,298	2,328,764	246,159	2,187,064	300,371

In 1918 the practice of publishing customs figures for the calendar year instead of the fiscal year, as had prevailed previously, was inaugurated. The following tables show the exports of canned salmon, by countries, for the calendar years 1918 and 1919:

Exports, by Countries Receiving, of Canned Salmon, Calendar Years 1918 and 1919.

Country receiving.	1918		1919	
	Pounds.	Value.	Pounds.	Value.
EUROPE.				
Austria-Hungary			157,396	$33,394
Azores, and Madeira Islands			432	71
Belgium	18,072	$2,539	5,179,022	970,696
Denmark			1,082,434	181,178
Finland			68,000	13,010
France	11,458,346	1,270,675	15,917,105	2,525,449
Germany			833,793	147,783
Gibraltar	273,540	44,593	370,890	85,860
Greece			2,722,686	471,555
Iceland, and Faroe Islands			12,025	2,557
Italy	19,654,988	2,785,844	36,925,190	4,801,941
Malta, Gozo, etc			1,892	262
Netherlands			231,710	46,356
Norway			441,776	87,668
Portugal	662	193	200	38
Rumania			9,720	1,538
Russia in Europe			19,500	2,795
Serbia, Montenegro, and Albania			480	96
Spain			79,457	16,253
Sweden	164	40	88,012	17,158
Switzerland			12,184	2,414
Turkey in Europe			100,040	17,072
United Kingdom:				
England	43,515,880	6,742,494	66,524,438	12,788,932
Scotland	154,495	22,672	1,460,082	219,951
Ireland	1,320	286	1,459,360	197,677
NORTH AMERICA.				
Bermuda	35,144	6,288	53,429	6,940
British Honduras	8,560	1,181	58,194	9,409
Canada	4,077,166	620,195	9,587,861	1,467,611
Central American States:				
Costa Rica	5,310	818	98,155	16,049
Guatemala	10,492	1,374	74,407	12,599
Honduras	3,459	488	50,936	8,693
Nicaragua	11,586	1,866	125,179	21,095
Panama	172,206	30,485	141,733	25,441
Salvador	4,290	741	29,783	5,173
Mexico	347,384	54,709	4,917,900	703,262
Miquelon, Langley, etc			3,090	751
Newfoundland and Labrador			108	21
West Indies:				
British—				
Barbados	33,074	6,305	65,114	12,947
Jamaica	77,002	12,225	367,119	51,537
Trinidad and Tobago	153,207	24,923	143,691	27,023
Other British	10,148	1,983	37,935	7,717
Cuba	428,208	60,432	1,646,913	238,858
Dominican Republic	50,887	7,973	238,502	36,503
Dutch	3,206	701	17,678	4,603
French	184	24	10,456	2,422
Haiti	1,036	190	6,199	1,393
Virgin Islands of United States	20,059	4,221	22,498	4,447
SOUTH AMERICA.				
Argentina	255,950	51,437	403,019	76,052
Bolivia	94,076	8,765	84,559	13,087
Brazil	161,529	21,625	31,113	7,273
Chile	1,316,148	195,478	1,331,484	214,284
Colombia	31,816	5,493	275,050	47,078
Ecuador	40,358	5,895	368,939	55,947
Guiana:				
British	38,595	7,765	122,715	25,974
Dutch	13,769	2,380	68,581	14,336
French	5,456	778	36,562	7,007
Paraguay			240	55
Peru	290,337	41,262	1,180,989	185,839
Uruguay	6,240	1,441	47,412	9,932
Venezuela	129,457	19,907	383,120	63,321
ASIA.				
Aden	2,400	394	2,880	480
China	41,980	8,579	90,232	19,088

Exports, by Countries Receiving, of Canned Salmon, Calendar Years 1918 and 1919—Continued.

Country receiving.	1918		1919	
	Pounds.	Value.	Pounds.	Value.
ASIA—continued.				
China, leased territory: Japanese	48	$10	168	$43
Chosen	42	8	5,274	1,246
East Indies:				
British—				
British India	367,273	67,256	984,672	193,089
Straits Settlements	111,440	16,021	223,168	42,403
Other British	26,890	4,495	61,814	13,402
Dutch	124,502	17,692	427,298	71,132
French	240	69	2,412	692
Hongkong	41,424	7,839	116,912	22,628
Japan	25,968	3,259	12,038	1,940
Russia in Asia	....	....	192	52
Siam	4,800	760	2,122	558
Turkey in Asia	....	....	20,504	3,646
OCEANIA.				
British:				
Australia	1,149,888	215,715	5,777,713	1,293,194
New Zealand	26,592	4,835	61,533	13,919
Other British	67,674	9,872	93,423	16,115
French	116,535	19,203	225,429	42,303
German	153,840	20,394	80,577	12,966
Philippine Islands	5,291,182	579,410	2,371,736	279,408
AFRICA.				
Abyssinia	....	....	92	18
Belgian Kongo	2,354	477	14,990	3,251
British Africa:				
West	192,376	33,051	976,463	172,258
South	121,990	18,255	1,269,317	284,633
East	34,260	6,098	5,996	1,417
Canary Islands	....	....	59,790	8,025
Egypt	261,673	42,335	939,895	133,358
French Africa	17,136	3,572	32,989	7,208
German Africa	....	....	50,465	9,332
Liberia	2,633	539	8,218	1,761
Madagascar	....	....	48	8
Morocco	....	....	5,688	932
Portuguese Africa	2,788	485	31,868	6,839
Spanish Africa	....	....	36,266	7,009
Total	91,101,734	13,149,307	169,750,672	28,644,706

The following table shows in summarized form the customs districts from which canned salmon was exported for the years 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1919, inclusive. Up to 1910 about two-thirds of the total exports have gone from the port of San Francisco, while about one-fifth of the total passed through the port of Puget Sound, Wash. In 1910 the exports from Puget Sound exceeded those from San Francisco. In 1918, however, San Francisco assumed first place once more. The only other port through which any considerable quantity is shipped is New York City. It is usual now to load the salmon on steamers and sailing vessels at San Francisco and the Puget Sound cities to go direct to Europe.

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON.

SUMMARY, 1900 TO 1915.[a]

Customs district from which exported.	1900		1901		1902		1903	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Atlantic ports	3,820,656	$370,302	8,834,322	$947,729	4,538,073	$427,335	5,734,469	$611,868
Gulf ports	38,868	3,430	55,425	5,426	50,116	4,965	54,016	5,085
Mexican border ports	30,264	2,861	20,140	2,082	188,346	15,498	130,363	11,741
Pacific ports	23,168,445	2,314,541	32,337,112	3,270,524	42,357,217	3,539,231	44,391,379	3,716,926
Northern border and Lake ports	24,137	2,514	42,501	4,510	39,362	4,373	43,107	5,171

Customs district from which exported.	1904		1905		1906	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Atlantic ports	2,133,121	$214,332	2,693,503	$267,263	3,277,571	$318,321
Gulf ports	72,792	6,455	97,561	8,425	127,255	10,910
Mexican border ports	355,248	24,183	289,439	23,148	455,413	36,130
Pacific ports	53,362,492	4,979,565	31,957,252	2,734,269	41,906,406	3,469,472
Northern border and Lake ports	625	63	28,800	2,364	177,769	13,110

Customs district from which exported.	1907		1908		1909	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Atlantic ports	2,314,535	$227,779	2,334,663	$227,113	4,043,807	$409,933
Gulf ports	165,050	14,450	206,120	19,245	107,018	8,954
Mexican border ports	570,343	47,776	723,689	65,119	219,128	21,574
Pacific ports	22,160,349	1,892,398	24,961,173	2,126,995	31,705,144	2,971,984
Northern border and Lake ports	7,828	646	400	46	42,012	3,991

Customs district from which exported.	1910		1911		1912	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Atlantic ports	3,003,430	306,122	1,564,485	$166,971	2,506,989	$257,792
Gulf ports	118,559	9,554	159,359	15,194	109,045	12,029
Mexican border ports	254,717	21,503	213,226	20,393	415,259	38,455
Pacific ports	60,450,190	5,974,196	36,663,729	3,834,584	40,391,058	4,312,116
Northern border and Lake ports	33,800	2,883	....	....	1,405	171

Customs district from which exported.	1913		1914		1915	
	Pounds.	Value	Pounds.	Value.	Pounds.	Value.
New York	1,935,881	$189,959	2,404,220	$207,924	5,316,456	$512,549
New Orleans	....	....	182,717	19,787	261,709	28,682
El Paso	....	....	120,140	9,045	176,390	12,348
San Francisco	31,687,774	3,277,841	38,844,912	3,600,636	35,321,058	4,209,914
Oregon	624,000	83,000	124,512	9,391	671,452	64,517
Washington	19,827,745	1,434,451	45,876,703	4,138,449	41,064,868	4,183,410
All other districts	1,215,566	118,089	197,716	14,061	634,183	60,663

[a] Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III, Report U. S. Commissioner of Fisheries, 1916, pp. 194-198. Washington, 1917.

Exports, by Customs Districts, of Canned Salmon—Continued.

DETAILS, 1916 TO 1918.

Customs district from which exported.	1916		1917		1918	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Georgia	....	....	156,000	$37,052	96	$24
Maine and New Hampshire	2,583,306	$274,432	1,186,871	160,399	3,336	621
Maryland	517,800	47,603	1,884,672	168,537	1,208,142	149,080
Massachusetts	1,314,778	130,701	2,447,156	279,184	789,629	159,052
New York	24,257,388	2,339,629	23,993,032	2,607,602	49,034,077	7,690,025
Philadelphia	111,578	8,680	2,445,373	237,540	302,740	40,431
Porto Rico	9,813	578	3,060	384	6,106	839
Virginia	2,589,040	211,848	5,969,268	551,269	489,242	82,563
Florida	4,252	350	9,971	672	7,262	1,623
Galveston	3,211	159	30,096	3,467	16,457,201	2,124,530
Mobile	7,635	851	7,055	686	6,505	838
New Orleans	1,125,031	109,238	8,003,488	967,410	1,720,839	223,676
Sabine	4,867	428	8,244	1,233	5,411	1,325
Arizona	134,358	10,263	170,372	15,005	97,046	12,228
Eagle Pass	37,922	3,496	95,077	7,783	....	....
El Paso	117,715	8,876	196,331	15,878	105,630	12,547
San Antonio	....	....	....	....	401,610	47,445
Laredo	252,826	16,637	367,324	33,159	....	....
Alaska	87,371	6,319	3,094,290	267,489	5,396,783	691,897
Hawaii	78	15	137,328	13,959	56,044	8,195
Oregon	657,121	60,257	303,888	36,105	....	....
San Francisco	53,221,608	5,845,811	32,390,693	3,910,592	18,278,622	3,153,508
Southern California	33,455	2,463	35,133	3,758	30,009	4,327
Washington	60,520,904	5,461,097	30,549,747	3,034,487	13,783,070	1,874,726
Buffalo	850	107	5,437	722	250	25
Dakota	....	....	66,825	5,906	2,630	437
Duluth and Superior	....	....	171	39	15	1
Michigan	1,949,086	207,808	3,354,350	427,810	1,814,899	284,746
Montana and Idaho	3,389,969	283,727	987,925	166,323	1,248	222
St. Lawrence	....	....	100	28	61,990	5,901
Vermont	12,000	1,124	63,530	8,957	18	2
Total	152,943,962	15,032,497	117,962,807	12,963,425	110,060,480	16,570,834

In 1918 was inaugurated the practice of publishing customs figures for calendar years instead of, as previously, for the fiscal year ending June 30. The following tables show the exports of canned salmon by customs districts for the calendar years 1918 and 1919:

Exports, by Customs Districts, of Canned Salmon, Calendar Years 1918 and 1919.

Customs district from which exported.	1918		1919	
	Pounds.	Value.	Pounds.	Value.
Georgia	99	$25	....	....
Maine and New Hampshire	96	24	130,994	$27,831
Maryland	1,705,877	220,669	2,385,585	411,895
Massachusetts	517,456	84,118	331,296	58,267
New York	46,490,264	7,500,562	85,463,019	13,977,432
Philadelphia	305,414	42,261	2,593,197	322,858
Porto Rico	1,711	394	7,458	1,262
Virginia	303,650	44,586	1,203,496	211,701
Florida	....	....	171,653	20,673
Galveston	15,169,801	1,942,094	11,156,255	1,357,799
Mobile	3,567,735	482,945	1,654,115	219,879
New Orleans	542,161	80,586	10,060,979	1,613,503
Sabine	3,033	833	16,439	3,354
Arizona	30,063	4,319	118,946	17,726
El Paso	21,290	2,891	320,836	41,491
San Antonio	46,914	7,373	855,588	116,612
Alaska	72	12	1,594,476	188,038
Hawaii	48,428	7,052	49,232	7,718
Oregon	....	....	244,600	56,680

EXPORTS, BY CUSTOMS DISTRICTS, OF CANNED SALMON, CALENDAR YEARS 1918 AND 1919—Continued.

Customs district from which exported.	1918		1919	
	Pounds.	Value.	Pounds.	Value.
San Francisco	4,490,375	$749,095	19,596,548	$4,359,336
Southern California	34,045	5,159	125,793	21,856
Washington	16,422,108	1,764,105	27,911,740	4,930,335
Buffalo	501	75	863,795	140,568
Dakota	2,541	437	90,206	19,841
Duluth and Superior			13,460	2,996
Michigan	1,345,300	200,873	1,057,458	199,096
Montana and Idaho			1,527,576	281,707
St. Lawrence	52,800	8,819	163,063	26,108
Vermont			42,869	8,144
Total	91,101,734	13,149,307	169,750,672	28,644,706

EXPORTS OF DOMESTIC FRESH AND CURED SALMON.

The following table shows in summarized form the value of the exports of fresh and cured salmon, by countries to which exported, for the period 1900 to 1915, inclusive, and in detailed form for the years 1916 to 1919, inclusive. As with the canned salmon, the greater part of these exports go to European countries, Germany, under ordinary conditions, taking by far the largest quantity. A small portion of this is salmon caught in Atlantic waters.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON.

SUMMARY, FISCAL YEARS 1900 TO 1915.[a]

Country receiving.	1900	1901	1902	1903	1904	1905
Europe	$340,643	$344,368	$496,637	$760,197	$1,094,950	$1,748,039
North America	87,964	60,416	132,704	67,225	36,408	25,809
South America	1,702	901	3,063	1,690	1,822	3,438
Asia	3,324	15,037	25,843	5,393	1,382	30,170
Oceania	101,388	5,982	35,863	34,835	28,063	25,085
Africa	255	24	325	12	864	114

Country receiving	1906	1907	1908	1909	1910
Europe	$1,776,086	$1,794,885	$1,587,535	$1,225,948	$1,468,015
North America	36,943	23,204	27,263	28,383	29,688
South America	2,600	2,351	517	1,365	5,242
Asia	92,861	19,384	3,962	3,640	318
Oceania	18,914	38,721	28,767	28,935	28,079
Africa	60	198		289	1,268

Country receiving.	1911	1912	1913	1914	1915
Europe	$1,511,181	$1,587,973	$2,055,109	$2,074,499	$1,375,123
North America	24,880	20,350	34,741	86,087	20,336
South America	384	142	3,409	933	618
Asia	3,933	107	1,398	2,428	1,362
Oceania	32,334	21,575	25,699	31,330	27,420
Africa	424	4	2,210	32	

[a] Detailed statistics for 1900 to 1915, inclusive, may be found in "Pacific Salmon Fisheries," by John N Cobb, Appendix III, Report, U. S. Commissioner of Fisheries, 1916, pp. 198-201. Washington, 1917

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—Continued.

DETAILS, FISCAL YEARS 1916 TO 1918.

Country receiving.	1916	1917	1918
EUROPE.			
Denmark	$193,124	$33,874	
France	2		$3,900
Greece	2,898	1,844	
Iceland, and Faroe Islands	365	237	
Italy		6,418	10
Netherlands	10,961	4,614	
Norway	194,868	134,676	
Spain	316		
Sweden	145,613	27,346	
United Kingdom—England	147,955	155,089	130,747
NORTH AMERICA.			
Bermuda	688	1,002	600
British Honduras	115	1	5
Canada	12,872	79,676	55,976
Central American States:			
Costa Rica	169	14	
Guatemala	75	61	18
Honduras	149	112	5
Nicaragua	249	97	81
Panama	6,364	2,973	2,308
Salvador	117	76	3
Mexico	9,909	3,388	3,186
Newfoundland and Labrador	15		
West Indies:			
British—			
Barbados	944	564	12
Jamaica	3,689	806	122
Trinidad and Tobago	102	1,635	
Other British	1,352	801	26
Cuba	6,563	2,274	2,578
Danish	257	902	379
Dominican Republic	967	1,875	448
Dutch	574	382	52
French	61	65	
Haiti	525	435	290
SOUTH AMERICA.			
Argentina	111	140	9
Bolivia	87	129	35
Brazil	424	537	112
Chile	735	39	243
Colombia	1,164	435	869
Ecuador	263	45	31
Guiana:			
British	940	158	
Dutch	380	817	6
French	407	230	25
Peru	929	742	
Uruguay	95		
Venezuela	2,998	779	362
ASIA.			
China	23	111	95
China, leased territory—Japanese		100	
Chosen	7		4
East Indies:			
British—			
British India	102	22	22
Straits Settlements			50
Other British	9		
Dutch	1,735		438
French		35	
Hongkong	43	9	
Japan	22	56	286
Russia in Asia	243		
OCEANIA.			
British:			
Australia	31,815	21,058	155
New Zealand	81	23	
Other British	61	86	73
French	1,285	1,039	235
German	442	1,062	1,363
Philippine Islands	252	1,071	135

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—Continued.

DETAILS, FISCAL YEARS 1916 TO 1918—Continued.

Country receiving.	1916	1917	1918
AFRICA.			
British Africa:			
West		$376	$152
South	$1,642	877	
Canary Islands	87	1,140	
Egypt		479	
Liberia	6		
Portuguese Africa	1,251	47	
Spanish Africa	701		
Total	790,198	492,879	205,446
RECAPITULATION.			
Europe	696,102	364,098	134,657
North America	45,756	97,139	66,089
South America	8,533	4,051	1,692
Asia	2,184	333	895
Oceania	33,936	24,339	1,961
Africa	3,687	2,919	152

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919.[a]

Country receiving.	1918		1919	
	Barrels.[b]	Value.	Barrels.[b]	Value.
EUROPE.				
Azores, and Madeira Islands			2	$62
Belgium			1	35
Denmark			10,044	466,359
Germany			2,307	41,538
Greece			109	3,879
Netherlands			270	15,995
Norway			2,514	123,069
Spain			1	29
Sweden			2,178	105,010
United Kingdom:				
England	419	$17,800	2,210	124,152
Scotland			101	2,830
NORTH AMERICA.				
Bermuda			37	662
British Honduras			1	20
Canada	66	1,300	272	5,031
Central American States:				
Costa Rica			3	66
Guatemala	5	138	5	199
Honduras	1	6		
Nicaragua			3	59
Panama	31	817	28	846
Mexico	5	104	2	36
West Indies:				
British—				
Barbados	7	176	301	11,380
Jamaica	1	17	18	390
Trinidad and Tobago	6	115	659	18,148
Other British	3	59	9	243
Cuba	17	452	31	1,008
Danish	18	350		
Dominican Republic	54	1,180	35	1,004
Dutch	2	20	13	213
French	2	46	19	547
Haiti	24	497	20	652
Virgin Islands of United States			20	454

[a] Included in "All others" in previous years. [b] Barrel holds 200 pounds of fish.

EXPORTS, BY COUNTRIES RECEIVING, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—Continued.

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919—Continued.

Country receiving.	1918		1919	
	Barrels.	Value.	Barrels.	Value.
SOUTH AMERICA.				
Colombia	1	$20	2	$36
Guiana:				
British	14	369	10	270
Dutch	15	386	101	2,726
French	35	865	35	1,186
Peru	....	....	3	72
Venezuela	2	42	1	50
ASIA.				
China	9	210	3	86
Japan	....	....	93	1,864
OCEANIA.				
British:				
Australia	1,058	23,704	736	16,292
New Zealand	1	28	....	....
Other British	2	35	3	70
French	44	937	29	692
German	75	1,645	19	413
Philippine Islands	3	63	....	....
AFRICA.				
British South Africa	....	....	1	32
Liberia	2	20	7	69
Total	1,922	51,401	22,256	947,694
RECAPITULATION.				
Europe	419	17,800	19,737	882,958
North America	242	5,277	1,476	40,878
South America	67	1,682	152	4,340
Asia	9	210	96	1,950
Oceania	1,183	26,412	787	17,467
Africa	2	20	8	101

The following table gives a summary, by customs districts, of the exports of domestic fresh and cured salmon from 1900 to 1915, inclusive, and a detailed statement of the same for the years 1916 to 1919, inclusive. The greater part of the shipments pass through the New York City customs district.

Exports, by Customs Districts, of Domestic Pickled, Fresh, etc., Salmon.

SUMMARY, FISCAL YEARS 1900 TO 1915.[a]

Customs district from which exported.	1900	1901	1902	1903	1904	1905
Atlantic ports	$346,924	$330,890	$503,439	$767,397	$1,103,034	$1,757,832
Gulf ports	....	5	143	30	124	159
Mexican border ports	1,192	535	1,857	1,227	1,160	997
Pacific ports	185,644	92,698	188,177	99,018	56,167	66,772
Northern border and Lake ports	1,516	2,610	819	1,680	3,004	6,895

Customs district from which exported.	1906	1907	1908	1909	1910	1911	1912
Atlantic ports	$1,781,476	$1,797,411	$1,590,778	$1,230,542	$1,479,656	$1,514,599	$1,586,319
Gulf ports	14	276	7,226	49	74	1,542	....
Mexican border ports	788	424	167	25	202	18	202
Pacific ports	139,606	73,927	44,313	50,834	50,521	46,167	33,190
Northern border and Lake ports.	5,580	6,705	5,560	7,110	2,187	10,813	10,440

Customs district from which exported.	1913	1914	1915	Customs district from which exported.	1913	1914	1915
New York	$2,060,068	$2,067,366	$1,377,840	San Francisco	$26,030	$29,880	$28,777
Alaska	20,995	16,932	6,630	All other districts	8,119	21,418	9,592
Puget Sound	7,354	59,713	2,020				

DETAILS, FISCAL YEARS 1916 TO 1918.

Customs district from which exported.	1916	1917	1918
Maine and New Hampshire	$16	$22,480	$37
Massachusetts	2,925	14,764	32,002
New York	732,782	360,348	106,636
Porto Rico	47	635	57
Florida	60	....	210
Mobile	48	5	5
New Orleans	610	166	408
Sabine	33	....	950
Arizona	1,736	374	501
Eagle Pass	....	454	....
El Paso	....	276	24
San Antonio	....	....	1,123
Laredo	16	100	....
Alaska	5,203	29,348	14,529
Hawaii	16	15	7
San Francisco	33,648	23,804	6,907
Southern California	80	255	191
Washington	1,155	4,779	19,825
Buffalo	394	2,939	6,450
Dakota	706	2,233	1,942
Duluth and Superior	13	42	251
Michigan	8,845	12,695	11,910
Montana and Idaho	....	5,567	49
St. Lawrence	1,300	7,167	1,258
Vermont	565	4,433	174
Total	790,198	492,879	205,446

[a] A more detailed statement for 1900 to 1912 may be found in "Pacific Salmon Fisheries," by John N. Cobb, Appendix III, Report U. S. Commissioner of Fisheries, 1916, pp. 202-203. Washington, 1917.

EXPORTS, BY CUSTOMS DISTICTS, OF DOMESTIC PICKLED, FRESH, ETC., SALMON—Continued.

DOMESTIC PICKLED SALMON, CALENDAR YEARS 1918 AND 1919.

Customs district from which exported.	1918		1919	
	Barrels.	Value.	Barrels.	Value.
Maine and New Hampshire			120	$2,220
Massachusetts			2	65
New York	657	$23,346	21,041	919,375
Porto Rico	1	23		
Philadelphia			44	3,500
New Orleans	2	39	7	163
Alaska	40	770	4	100
San Francisco	1,185	26,443	797	17,724
Southern California	3	58	2	36
Washington	20	458	100	2,017
Dakota	6	91	125	2,112
Duluth and Superior	2	60		
Michigan	3	53	4	168
Montana and Idaho			1	34
St. Lawrence	3	60	9	180
Total	1,922	51,401	22,256	947,694

EXPORTS, BY COUNTRIES RECEIVING, OF ALL OTHER SALMON, CALENDAR YEAR 1919.

Country receiving.	Value.	Country receiving.	Value.
Belgium	$1,230	Virgin Islands of United States	$241
Denmark	75,095	Bolivia	2
France	6,444	Brazil	2,194
Iceland, and Faroe Islands	200	Chile	190
Netherlands	617	Colombia	182
Norway	43,840	Dutch Guiana	238
Spain	16	French Guiana	135
Sweden	2,430	Peru	10
United Kingdom—England	251,730	Venezuela	49
Bermuda	25	China	286
Canada	421,498	British Straits Settlements	29
Guatemala	96	Other British East Indies	3
Honduras	5	Dutch East Indies	749
Nicaragua	21	French East Indies	5
Panama	646	Japan	6,214
Salvador	26	Russia in Asia	67
Mexico	13,884	Siam	3
Barbados	4,000	Australia	4,840
Jamaica	108	French Oceania	134
Trinidad and Tobago	16	German Oceania	36
Other British West Indies	15	Philippine Islands	1,513
Cuba	1,643	British West Africa	381
Dominican Republic	525	French Africa	450
Dutch West Indies	110		
French West Indies	255	Total	842,464
Haiti	38		

EXPORTS, BY CUSTOMS DISTRICTS, OF ALL OTHER SALMON, CALENDAR YEAR 1919.

Customs district.	Value.	Customs district.	Value.
Maine and New Hampshire	$72,305	Southern California	$315
Massachusetts	18,986	Washington	13,861
New York	218,204	Buffalo	5,964
Philadelphia	44,625	Dakota	4,250
Porto Rico	199	Duluth and Superior	44
Florida	4	Michigan	13,591
New Orleans	4,049	Montana and Idaho	12,283
Sabine	29	Ohio	123
Arizona	65	St. Lawrence	29,252
El Paso	5	Vermont	2,831
San Antonio	13,365		
Alaska	347,068	Total	842,464
San Francisco	41,046		

IMPORTS OF FRESH SALMON.

For some years it was the custom of the canneries on Puget Sound, when fish were scarce on the American side and abundant on the Canadian side, to import fresh salmon to fill out the domestic supply and the Canadian canneries would do the same when the conditions were reversed. In 1904 the Canadian Government prohibited the export of fresh sockeye salmon to Puget Sound for packing purposes, and in 1910 an effort was made to have Congress retaliate by enacting a similar law for this side of the line, but the bill failed of passage.

The table below shows the yearly imports of fresh salmon from British Columbia:

IMPORTS OF FRESH SALMON FROM BRITISH COLUMBIA, CANADA, FOR A SERIES OF YEARS.[a]

Year.	Pounds.	Value.	Year.	Pounds.	Value.	Year.	Pounds.	Value.
1890	4,660	$241	1897	93,454	$2,681	1904	40,610	$1,025
1891	4,950	170	1898	11,580	278	1905	1,015	35
1892	6,288	301	1899	58,002	4,101	1906	3,457,738	64,408
1893	64,811	3,639	1900	19,404	855	1907	113,224	4,131
1894	3,872	219	1901	27,072	2,050	1908	8,880	795
1895	14,000	1,403	1902	22,353	739	1909	41,073	2,346
1896	11,799	419	1903	6,860	343	1910	198,251	10,116

[a] After 1909 all imports of fresh salmon are listed under "Fish, fresh."

After 1911 the imports of fresh salmon from both coasts of Canada and from Newfoundland were lumped together, and are shown in the table below. Fully nine-tenths, if not more, of this salmon came from the Province of British Columbia in Canada, and the greater part of this was canned in the canneries on Puget Sound, Wash.

Fiscal year ending June 30—	Pounds.	Value.	Fiscal year ending June 30—	Pounds.	Value.	Fiscal year ending June 30—	Pounds.	Value.
1911	1,122,286	$114,123	1914	3,262,828	$245,791	1917	19,769,660	$599,442
1912	1,520,687	135,416	1915	10,676,296	383,697	1918	14,408,294	957,169
1913	2,089,781	180,513	1916	24,026,481	501,115	1919	15,571,451	928,552

The following table shows, by customs districts, the imports of fresh salmon during the calendar year 1918:

IMPORTS, BY CUSTOMS DISTRICTS, OF FRESH SALMON, CALENDAR YEAR 1918.

Customs district.	Pounds.	Value.	Customs district.	Pounds.	Value.
Maine and New Hampshire	449,244	$82,721	Dakota	532,772	$56,472
Massachusetts	4,965	318	Duluth and Superior	18,100	1,728
New York	12,400	3,536	St. Lawrence	247,833	26,918
Philadelphia	4,500	495	Vermont	336,306	37,216
Washington	11,479,858	421,713			
Buffalo	20	2	Total	13,085,998	631,119

During the calendar year 1919, imports of fresh salmon amounted to 752,480 pounds, valued at $101,121, and during the calendar year 1920, to 676,359 pounds, valued at $125,863.

IMPORTS OF CURED SALMON.

Below are shown the imports into this country of foreign-cured salmon, the product of the Pacific salmon fisheries, from 1886 to 1909, inclusive.

IMPORTS OF FOREIGN PICKLED PACIFIC SALMON, 1886 TO 1909.[a]

Year.	British Columbia.		Japan.		Hongkong.		Russia, Asiatic.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1886	5,600	$224							5,600	$224
1887	200	4							200	4
1888	86,000	4,031							86,000	4,031
1889	18,200	860							18,200	860
1890	600	36							600	36
1891	200	5							200	5
1893	5,478	291							5,478	291
1894	149,410	17,592			1,200	$29	11,875	$298	162,485	17,919
1895	6,550	250			600	13			7,150	263
1896	6,530	474							6,530	474
1897	6,890	156							6,890	156
1898	4,145	188			30	2	9,870	266	14,045	456
1899	15,875	1,554							[b] 16,032	[b] 1,560
1900	162,558	11,061	600	$41					163,158	11,102
1901	165,243	11,225							165,243	11,225
1902	175,411	13,794	606	28					176,017	13,822
1903	161,549	11,756	360	18					161,909	11,774
1904	282,210	23,319	1,400	52					283,610	23,371
1905	282,027	25,584	3,015	133					285,042	25,717
1906	35,475	1,730	5,510	175					40,985	1,905
1907	6,393	322	680	31					7,073	353
1908	13,230	631	4,185	174					17,415	805
1909	30,710	1,523	3,537	148					34,247	1,617
1910	111,645	5,505								

[a] After 1909 all imports of salmon, pickled or salted, are included under "All other cured or preserved."
[b] Includes 157 pounds, valued at $6, from China.

Since 1910 all imports of pickled salmon have been lumped together and it has been impossible to distinguish the imports of Pacific salmon from those imported from Atlantic districts. The table below shows the total imports, almost all of which comprise salmon from the Province of British Columbia in the Dominion of Canada.

Fiscal year ending June 30—	Pounds.	Value.	Fiscal year ending June 30—	Pounds.	Value.	Fiscal year ending June 30—	Pounds.	Value.
1911	695,878	$62,769	1914	1,114,927	$84,503	1917	945,394	$81,776
1912	417,938	33,901	1915	1,162,341	104,451	1918	739,759	74,042
1913	344,530	28,650	1916	1,010,844	70,837	1919	859,276	117,352

EXPORTS OF CANADIAN CANNED SALMON.

EXPORTS OF CANNED SALMON FROM CANADA, 1916–1919.

[Fiscal year ended Mar. 31.]

Destination.	1916	1917	1918	1919
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Australia	4,789,094	3,365,149	2,236,742	3,750,194
Barbados				1,642
Bermuda	11,480	10,934	9,132	25,884
Bolivia		9,600		120,000
British Guiana		48		96
British India	298,200	101,344	2,400	55,950
British South Africa	52,800			48,000
British West Indies	28,643	116,112	48,238	
Chile		14,400		614,016
China	11,976	1,440	101	2,540
Cuba				1,048,800
Dutch East Indies	343,632	319,344	47,768	28,800
Ecuador				2,400
Fiji	928,752	860,400	736,616	354,196
France	3,905,461	5,521,100	13,529,569	2,869,658
French Oceania		14,400	48,000	
Greenland, Iceland, etc			200	
Hongkong	18,240		7,300	15,550
Italy		60	3,109,694	5,454,670
Jamaica				576
Japan				192
Newfoundland			120	48,000
New Zealand	1,338,050	1,339,282	1,689,652	1,623,496
Other British East Indies				36,000
Other British Oceania	91,056	105,360	6,000	12,000
Other British West Indies				8,646
Panama		4,700		
Peru		21,600		
Russia in Europe				48,600
Siam	14,400	124,848		24,096
St. Pierre and Miquelon	2,394	1,351	1,869	4,784
Straits Settlements	2,064,736	1,060,018	292,800	412,810
Switzerland	192			
Trinidad and Tobago				240
United Kingdom	35,225,051	34,772,879	21,117,314	29,265,108
United States	18,725	567,758	893,639	1,936,753
Total	49,142,882	48,332,127	43,777,154	47,813,697

SALMON CULTURE.[a]

The artificial culture of salmon on the Pacific coast has developed into a large and constantly expanding industry. The United States Bureau of Fisheries operates a number of large and well-equipped hatcheries, while the State governments of California, Oregon, and Washington, the Dominion of Canada and the Province of British Columbia, and certain private companies have built and maintain a large number of hatcheries, some of these being among the largest in the world.

OBTAINING THE SPAWNING FISH.

The eggs used for artifical propagation are obtained from salmon taken on their way upstream to the natural spawning grounds. In order to arrest the ascent of the fish a rack is usually built across the stream. Where this is not feasible a trap is sometimes constructed for the purpose of catching the fish. Sometimes the racks have slat traps attached in which some fish are caught.

[a] Since this revision was completed there has appeared an excellent work on this subject, entitled "Artificial Propagation of the Salmons of the Pacific Coast," revised and enlarged by Henry O'Malley. Appendix II, Report, U. S. Commissioner of Fisheries, 1919, 32 pp., 9 pls. Washington, 1920.

A number of methods have been employed for taking the fish as they are grouped below the rack and seeking for an opening, but the most practicable has been found to be by means of drag or haul seines swept across the area just below the rack. When the pocket or bunt is brought close to shore the workmen pick out the ripe fish and turn the others back to remain until they reach this stage. The ripe fish are placed in pens or live boxes made for this purpose, the males and females being kept separate. These live boxes are usually on the under side of a floating platform, and are accessible through hinged covers set in the plank flooring. Projecting beyond this platform is usually another, upon which the actual work of stripping the fish and caring for the pans is performed.

At a few places where the fish are caught before they have reached the ripe stage, notably Karluk, the fish are placed in a pound or corral and held until they become ripe. This method is resorted to only in case of necessity.

The surest sign of ripeness in a female is the separation of the eggs in the ovaries, but the experienced spawn taker can, from the general appearance of the fish, usually tell whether she is ripe or not, according to Bower: [a]

> An interesting experiment was conducted at the Afognak station last season [1910] to determine the degree of ripeness producing the best quality of eggs. The loss on the lot taken from females which were dead ripe—eggs flowing very freely—was less than 1 per cent, while with another lot, where the females were ordinarily ripe upon testing in the usual manner, the loss was about 5 per cent. This shows the need of caution in having fish fully ripe before stripping, if the highest degree of efficiency is to be expected.

TAKING THE EGGS.

As the eggs of the females confined in pens are likely to be injured within the fish, stripping is usually done every day.

When ready for spawn taking, one man lifts a female from the live box by means of a small dip net, while another man lifts out a male in the same manner. They are held suspended in the net until their violent struggles are over, when it is easy to handle them.

For many years, and even yet at many hatcheries, the method of taking salmon spawn has been by pressing the eggs out by steady downward pressure on the belly of the fish. The milt from the male is obtained in the same way.

Where the force is large and the fish rather small the quickest way is for one to hold the fish in one hand and press out the eggs or milt with the other. When the fish are large, or the working force is small, a strait-jacket is used. This is a sort of trough made about the average length of the salmon and hollowed out to fit its general shape. A permanent cleat is set across the lower end, while at the upper end is a strip with a buckle. The fish is slid into the trough, the tail going below the cleat, where it is securely held, and the head buckled in at the upper end with the strap. In this condition the fish is unable to do any harm by its struggles and the eggs can be pressed out at leisure.

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[a] Fish Culture in Alaska, by Ward T. Bower. *In* Alaska Fisheries and Fur Industries in 1911, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, p. 70. Washington, 1912.

FIG. 40.—STRIPPING SALMON WITH AID OF STRAIT JACKET.

FIG. 41.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SHOWING RACKS TO PREVENT SALMON FROM GOING UPSTREAM, AND PEN FOR HOLDING SPAWNING FISH.

FIG. 42.—BONNEVILLE SALMON HATCHERY OF THE OREGON FISH AND GAME COMMISSION, SHOWING REARING PONDS.

A more modern method in use at many hatcheries, which has been well described by Mr. Bower,[a] is as follows:

The long-followed process of taking Pacific salmon eggs by hand expression has been superseded in the last few years by the method of incision, a method discovered and developed by the late Cloudsley Rutter in connection with his study of the life history of the salmon of the Sacramento River. This consists simply of making a cut in the abdominal walls from the throat or near the pectoral fins to the vent, the fish just previously having been killed by a blow on the back of the head. When making the cut the knife is either shielded by a guard or is so held between the thumb and forefinger as to allow not more than half an inch of the blade to project, thus precluding the possibility of injuring any of the eggs. Immediately following the incision the eggs flow in a mass into the spawning pan beneath. The operator's fingers are inserted into the abdominal cavity gently to assist in removing any eggs that may be enfolded in the organs or that may merely adhere to the walls of the cavity. Fertilization is accomplished in the usual manner.

Care must be exercised not to tear loose from the ovaries any eggs that do not come freely when the organs are moved from side to side by the fingers. Eggs thus torn loose are immature, and if taken it becomes necessary to eliminate them subsequently in the hatchery. It is preferable also to have the fish either in a vertical position or with the head considerably higher than the tail, that gravity may assist the flow of eggs.

It was at first thought necessary—and the practice still obtains at some stations—to bleed the fish either by cutting off the head or tail before making the incision. Experimentation, however, has conclusively demonstrated that no advantage results from this procedure, as the few drops of blood that may occasionally fall into a pan of eggs result in no harm. The extra labor involved in bleeding may therefore be dispensed with entirely.

When taken by the method of incision the eggs are of greatly improved quality; there is no straining or rupture of good eggs as is inevitably the result when heavy hand pressure is exerted; no unripe eggs are torn from the ovaries; and at the same time there is no waste of good eggs left enfolded in the organs, as is certain to be the case in stripping by hand. The improvement in quality is from 5 to 10 per cent and the saving in labor, too, is of noteworthy consideration.

The taking of Pacific salmon eggs by incision marks so distinct an advance in fish culture that it is no longer permissible to continue the obsolete method of stripping by hand.

FERTILIZING THE EGGS.[b]

In impregnating the eggs the main object is to bring the milt and the eggs together as quickly as possible after they have left the fish. By some persons a little water is considered desirable to give greater activity to the milt, but if left more than a minute in the water there is a decided loss of fertilizing power. The eggs do not suffer so quickly from immersion in water. The absorbing property which they possess when they first leave the parent fish, and which attracts to the micropyle the spermatozoa, lasts several minutes, but it is not prudent to leave the eggs in the water a moment longer than is necessary before adding the milt.

The addition of the water is not essential to a good impregnation; in some instances better results are secured without the use of water and, after all, if the main object is secured, of bringing the milt and the eggs together with the slightest possible delay after they leave the fish, it makes very little difference whether water is used or not. The milt retains its fertilizing power several days when kept from air and water, and impregnation can be effected between fishes widely separated by merely forwarding the milt properly sealed. At Baird impregnation by the dry method, which has always been followed there, has resulted in the fertilization of about 90 per cent of the eggs so treated.

The Russian or dry method of impregnating eggs consists simply in taking both the eggs and the milt in a moist pan. It may be urged as an objection to this method that the eggs will be injured by striking against the pan, but it is a fact that although the same eggs would be destroyed by the concussion a week later, or even 24 hours later, they do not suffer in the least from it at the moment of extrusion from the fish.

It was at one time considered an important question whether the eggs or milt should be taken first, but with the dry method it makes no difference, as, either way, both eggs and milt remain operative long enough for all practical purposes of impregnation.

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[a] Fish Culture in Alaska, by Ward T. Bower. *In* Alaska Fisheries and Fur Industries in 1911, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, pp. 80, 81. Washington, 1912.

[b] A Manual of Fish-culture, Based on the Methods of the U. S. Commission of Fish and Fisheries, revised edition, pp. 10–12. Washington, 1900.

Various methods of treating the eggs in the pan after impregnation has taken place have been tried. Some operators leave the eggs in the pans as first taken with the milt for two or three minutes and then add water, after which they are left to stand in the pan until they separate, when they are washed clean, taken to the hatching house, and placed in the troughs. Others pour the contents of the several pans—eggs, milt, and all—into a large can after the eggs become impregnated, and when the eggs separate the contents of the can are poured into the hatching troughs, trusting to the current in the troughs to wash the milt from the eggs. At Baird water is poured on the eggs a few moments after they become impregnated, after which they are left perfectly quiet until they separate, which, in water of the temperature of the McCloud River in September, 52° to 53°, takes about an hour. The pans, in the meanwhile, are put in a trough filled with river water to keep them from becoming too warm. After the eggs separate they are carefully washed and are carried in buckets to the hatching house, where they are measured and placed in the hatching trays.

Mr. Bower[a] has the following to say as to the loss by concussion and the proper method of preventing same:

Coincident with the absorptive period in salmon eggs is an adhesive stage varying with the temperature from one to two hours, when the eggs are exceedingly sensitive. This is the so-called period of water hardening. Under no circumstances should the eggs be handled during this stage, nor should they be subjected to the slightest concussion. Repeated tests have demonstrated conclusively that even allowing the buckets containing the eggs to stand on the same platform where spawning operations are being carried on results in considerable loss.

To guard against this, the buckets should either stand on the bottom of the stream or else on a platform in every way independent of and having absolutely no connection with the main platform. To some this may seem like a small and irrelevant consideration, but strict observance is certain to reduce the loss by at least 2 or 3 per cent. During the process of water hardening the buckets should be partly submerged to properly regulate the temperature.

Due caution must be observed not to move the eggs until water hardening is complete. After a little experience the operator can readily tell, upon carefully inserting the hand and finding the eggs free and hard and no longer soft and velvety, even toward the bottom of the bucket, that they may be moved to the hatchery without fear of loss.

HATCHING APPARATUS AND METHODS.[b]

The hatching apparatus generally employed on this coast is pretty much of the same pattern and is described as follows:[c]

The hatching apparatus generally employed on the Pacific coast in salmon propagation consists of a combination of troughs and baskets. The troughs in common use are the so-called "Williamson troughs," which are 16 feet long, 12 or 16 inches wide, and 6½ inches deep. The troughs are arranged in pairs, and usually two or three pairs are placed end to end on different levels. The fall of water in each trough is 1½ inches. The troughs are divided by double partitions of wood or metal into compartments just enough longer than the baskets to enable the latter to be raised and lowered and to be tilted slightly. The essential feature of these troughs is that at the lower end of each compartment a partition, extending entirely across the trough, reaches from the bottom almost to the top, and another similar partition at the upper end of the compartment reaches from the top almost to the bottom of the trough, each set of partitions being about an inch apart. The water is consequently forced to flow under the upper partition and over the lower partition, and to do this it must necessarily ascend through the tray of eggs. The troughs are provided with canvas covers stretched upon light frames and made sunlight proof by saturation with asphaltum varnish, and their interiors are thickly coated with asphaltum.

The egg receptacles are wire trays or baskets about 12 inches wide, 24 inches long, and deep enough to project an inch or two above the water, which is 5 or 6 inches deep in the troughs in which they are placed. Into each of these baskets 2 gallons of salmon eggs, equivalent to about 30,000, are poured at a time. The eggs suffer no

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[a] Fish Culture in Alaska, by Ward T. Bower. *In* Alaska Fisheries and Fur Industries in 1911, by B. W. Evermann. U. S. Bureau of Fisheries Document No. 766, pp. 81, 82. Washington, 1912.

[b] At some of the Alaska hatcheries quite large baskets, some holding as many as 103,000 red salmon eggs are used.

[c] A Manual of Fish-culture, Based on the Methods of the U. S. Commission of Fish and Fisheries, revised edition, pp. 12, 13. Washington, 1900.

injury whatever from being packed together in this manner, the water being supplied in a way that forces it through the eggs, partially supporting and circulating through them. The meshes are too small to permit the eggs to pass through, although the fry are able to do so.

The advantages of this apparatus and method are:

(1) The top of the tray or basket is out of the water and always entirely dry; consequently in handling it the hands are kept dry.

(2) By tilting one end of the tray up or down a little or by lifting it entirely and settling it gently back again in its place the bad eggs will be forced to the top; thus a feather is not required in picking over the eggs and the injuries very often inflicted with it are avoided.

(3) The top of the tray being above water, the eggs can never run over the top nor escape in any way, which is a great advantage over the shallow form of tray.

(4) There is economy of space; 30,000 to 40,000 eggs can be placed in each basket, provided a sufficient quantity of water is available. Two troughs 16 feet long and 1 foot wide will by this method carry about 500,000 salmon eggs. The deep trays may be filled at least half full of eggs, and thus 10 times as many eggs can be hatched in the same space and with the same supply of water as by the old method. A good but gentle circulation is continually maintained through the eggs.

(5) The deep-tray system is admirably adapted to getting rid of mud that has collected on the eggs, for all sediment accumulating about them can be easily removed by gently moving the tray up and down a few times in the water; but if the deposit of mud on the troughs becomes so excessive as to be unmanageable, a false bottom of wire cloth or perforated zinc can be placed in the troughs at a suitable distance above their real bottom, leaving a space of about 1 or 1½ inches between the wire cloth and the trough bottom. By this means the mud that comes into the trough will sift down into the space below the wire cloth entirely out of the way of the fish, the movements of the fish themselves helping very much to produce this result. Should the accumulation of mud in the space below the false bottom of the trough become too great, it can easily be sluiced out in various ways.

When quinnat salmon eggs are simply to be matured for shipment, hatching trays with one-fourth or one-fifth inch square mesh will answer the purpose, but when the eggs are to be hatched in them, every alternate strand of wire running lengthwise, or, better still, every second and third thread, should be left out in order to form an oblong mesh through which the newly hatched fry, after separating themselves from the unhatched eggs, can escape from the hatching trays into the trough below.

At Baird eggs kept in water averaging about 54° F. hatch in 35 days. The allowance of 5 days' difference in the time of hatching for each degree of change in the water temperature is approximately correct.

For the first few days the eggs of the quinnat salmon are very hardy, and at this time they should be thoroughly picked over and the dead ones removed as far as possible before the delicate stage during the formation of the spinal column comes on, so that during that critical period they may be left in perfect quiet. As soon as the spinal column and the head show plainly, the eggs are hardy enough to ship, but when there is time enough it is better to wait a day or two until the eye-spot is distinctly visible, after which time the eggs will stand handling and may be safely shipped if properly packed.

HANDLING EGGS IN HATCHERY.[a]

At some of the Bureau's stations where salmon eggs are handled it was the custom until a few years ago to "bury" the eggs or leave them undisturbed (aside from picking once the day after spawning) for two or three weeks after putting them in the baskets. The result was that they were in some instances literally buried under and in such a mass of mud and sediment that many eggs were killed. Discontinuance of the practice resulted in a very appreciable improvement.

When the water is so turbid as to cause a heavy deposit of sediment, it is better to go over the eggs occasionally, even through the critical stages of development, or until the line of the fish is well formed. Of course the eggs must be handled with utmost caution at all times, but owing to their extreme sensitiveness during the two or three days following the closing of the blastopore and until a perceptible curve shows in the tail, they should be left entirely untouched. It soon becomes easy to determine the stage of an egg's development by holding it up to the light between the thumb and forefinger. In the absence of cautious and skilled operatives and unless the water is roily for an extended period, it is undoubtedly better to let the eggs

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[a] Fish Culture in Alaska, by Ward T. Bower. *In* Alaska Fisheries and Fur Industries in 1911. U. S. Bureau of Fisheries Document No. 766, pp. 81, 82. Washington, 1912.

remain undisturbed until the curvature of the tail is visible to the unaided eye. The accumulation of a moderate coating of sediment which readily washes off is not injurious. In a few instances it has become necessary to handle the eggs during the tender stage to arrest the spread of fungus, but where the water supply is reasonably well adapted to fish-cultural purposes such a course is rarely if ever necessary.

REMOVAL OF DEAD EGGS BY THE USE OF SALT SOLUTION.

Among the most noteworthy advances in the fish-cultural methods during the last few years has been the use of salt as an aid in the removal of dead eggs. The development of this process has extended over a period of several years, but it is more during the last year or so through the efforts of L E. Baldridge, of the Yes Bay station, that it has reached a high degree of efficiency.

Compared with the time-honored process of picking by hand, there are marked advantages in using the salt solution, and chief among these is the great saving of labor. It is estimated that if the eggs happen to be of not more than mediocre quality it would take at least 20 pickers to remove as many dead eggs as could two men using the salt solution. Moreover, the operation is much more thoroughly performed in the latter process than is possible in picking by hand.

Another advantage of using the solution is that it is possible thoroughly to clean the eggs. This greatly reduces any loss through contamination and infection resulting from the decomposition and fungous growths which inevitably follow the long-continued presence of dead eggs that in the hand-picking method frequently escape attention. Even when utmost care is taken to pick out all dead eggs, fungoused masses will occasionally appear. This condition is rarely observed when the salt solution has been used, and it undoubtedly means that in the aggregate many eggs are saved. Still another point in favor of the solution, it is generally believed, is that it acts as a tonic or stimulant to the good eggs while at the same time as a deterrent to the growth of fungus. Again, in picking by hand there is apt to be loss by movement of the eggs during delicate stages of development; and the oft-repeated insertion of egg tweezers, which are bound to touch other eggs, undoubtedly at times results in injury.

Recent experience has demonstrated that the solution may be applied effectively to eggs freshly taken as well as those in more advanced stages of development.

The principle of the salt bath is simply that the specific gravity of the good eggs is greater than that of the bad eggs, hence upon being placed in the salt solution the good eggs sink and the bad remain afloat and are easily removed. It is vitally essential to the success of the undertaking that the solution be of the proper strength, and it is for this reason that the beginner is apt to become discouraged. If the solution is too weak all the eggs, both good and bad, will sink, while if it is too strong all will remain afloat. The margin of the proper density is so narrow that in the operation it is necessary every few minutes to strengthen the solution by adding more salt or brine, otherwise the small amount of fresh water which adheres to a basket of eggs as it is lifted from the hatching trough into the solution will affect unfavorably the results when treating succeeding baskets. Experience and careful observation, however, will soon make it possible for the operator accurately to judge when to add a bit of the stock solution. It is a convenience, of course, to have a salinometer at hand when preparing the solution. It is commonly the practice as an aid in preparing the solution to test it occasionally with a few eggs.

Highly successful results in using the solution with red salmon eggs have been attained at the Yes Bay station, and a detailed description is accordingly given of the methods pursued at that place.

The chief item of equipment consists of a water-tight wooden tank 4 feet long, 2½ feet wide, and 10 inches deep for holding the solution in which the eggs are immersed. Before each basket is immersed it is necessary that the surface of the solution be perfectly quiet, for any ripple or current will tend to disturb the buoyant effect of the solution upon the eggs. Therefore it was found of great convenience last winter to use a floating frame made of half-inch material 6 inches wide fastened together vertically and at right angles, thus forming open squares about 6 inches either way. After each basket of eggs is lifted from the salt bath this frame is placed in the solution to stop all motion of the water, being pushed down until it is almost submerged and held firmly against the side of the tank for a few seconds. Upon being carefully withdrawn the solution is quiet and the next basket of eggs may be immersed without further delay.

Another piece of equipment is a feather fan with which gently to push the floating dead eggs away from over the submerged basket into which the good eggs have settled. Unless the dead eggs are quickly moved they too will sink. A feather fan made by fastening eagle feathers to a thin strip 8 inches long by 1½ inches wide works much more satisfactorily for this purpose than a wing. An ordinary hand scaff net about 12 by 14 inches in size for removing dead eggs from the tank, a dipper, and a bucket complete the outfit. Wood and metal surfaces in all equipment should be well coated with asphaltum or some similar preparation.

At Yes Bay as soon as five or ten million eggs are far enough advanced to stand light concussion the baskets are lifted out of the troughs and the eggs are stirred thoroughly with the hand, which causes practically all of the unfertile or empty eggs to turn white. As soon as the line of the fish shows plainly when held up to the light and there is a distinct curvature to the tail, the eggs are sufficiently well advanced in development to stand stirring. After this process the baskets are returned to the troughs and allowed to remain three days, for when first turned the unfertile eggs are about as heavy as the good eggs and consequently would sink if the salt solution were applied at once.

On the fourth day after stirring, everything being in readiness, five or six baskets are removed from a trough and set on top to drain. After a few moments a basket is grasped at each end and is lowered into the tank containing the solution until the liquid comes through the eggs. A light shake is then given to level up the eggs in the basket. Next, slowly and very gently, the basket is lowered until the brine comes almost to its rim and is held perfectly still for a moment. All the eggs in the basket will rise, but soon the good eggs will begin to sink, and presently, if it is a basket of poor eggs, the surface will be completely covered with bad eggs. Now, without the slightest jar, the basket is lowered far enough below the surface to permit an egg to float over the rim. The bad eggs will immediately start toward the edges of the tank. After a few seconds the basket is gently lowered until it rests upon the bottom. The remaining dead eggs are then brushed away from over the basket by means of quick, short, and light strokes of the feather fan, long, sweeping strokes are to be carefully avoided. One end of the basket is then gently raised until it is above the surface of the brine and the basket is drawn toward the end of the tank and out from under the floating dead eggs. At the same time the fan is used with the other hand to aid in moving any of these floating eggs to one side. The fan is then dropped and the lower end of the basket is grasped and the whole is quickly raised out of the solution. The basket is set at an angle on the tank for a moment to drain and is then carried to the hatching trough. The attendant lifts out another basket to drain along with the four or five others originally removed and returns to the tank of brine with the basket that has been draining the longest.

While this is being done the other operator skims the dead eggs off the surface of the brine and places the frame described above in the tank for a moment to stop all motion of the solution. After five or six baskets have been treated, any eggs that have settled to the bottom of the tank are removed, as they absorb and weaken the brine. It is necessary, as earlier mentioned, to add a little fresh brine after handling each basket. The eggs should be as clean as possible, as the solution will not be effective when it contains much sediment. A 1-inch hole with plug in one corner of the tank is convenient for drawing off any deposit of this character. Should failure occur in treating a basket of eggs, as, for example, if by sudden jar they are all caused to sink, or if the brine is too weak or too strong, the basket must be put back in the hatching trough, as it will not respond to treatment again the same day.

At Yes Bay last winter a large portion of the 72,000,000 eggs were thoroughly cleaned up at one handling. Two men ran as many as 10,000,000 eggs through the salt bath in a single day. It is customary on the day after treating the eggs to have them gone over so that if any dead eggs remain they may be picked out by hand. This, however, requires very little time, as but few dead eggs are found. No alarm need be felt if the eggs seem to shrink as a result of the immersion, for they will soon resume their normal size upon being replaced in fresh water.

The use of the salt solution has been extended lately to the handling of lake trout eggs in Michigan and Minnesota, and there appears to be no reason why it is not equally well adapted to the eggs of other salmonoids. Certainly its many advantages commend further experimentation in this direction.

The eggs of the salmon hatch very gradually at first, only a small proportion coming out the first day, but the number increases daily until the climax is reached, when large numbers of young burst their shells in a single day. As at this time the vast number of discarded shells are apt to clog up the guard screens at the outlets of the troughs, great care and vigilance is necessary to prevent this by thoroughly cleansing them frequently.

The hatched fish easily slip through the oblong mesh in the bottom of the trays into the space below. They should be assisted in doing this by gently raising and lowering the tray at intervals, care being taken not to raise them out of the water.

After they are all hatched out and in the bottom of the troughs about the only danger to guard against is that of suffocation. They frequently crowd together in heaps and dig down under one another until some of them die for want of running water, which is less than an inch away from them. The best remedy is to thin them out.

John Pease Babcock, Assistant to the Commissioner of Fisheries of the Province of British Columbia, in 1910 advanced a novel suggestion that freshly fertilized eggs buried immediately under sand and gravel would produce strong healthy fry at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies. The interesting account of his experiments is reproduced entire:[a]

In writing of the propagation of salmon and trout, some authorities state that considerable loss is occasioned in natural propagation by many of the eggs becoming embedded in sand and gravel; that all the eggs so embedded are lost.

Observation and experiment in the propagation of Pacific salmon and trout for a considerable period lead me to advance the theory that in natural propagation only those eggs which become embedded beneath several inches of sand and gravel produce alevins which live to attain the fry stage; and that those eggs which are not covered by several inches of sand and gravel are either consumed by active aquatic enemies or destroyed by vegetable molds, commonly termed "fungus."

My experiments have demonstrated that the burial of freshly fertilized eggs of the *nerka* and other Pacific salmon does not smother them; that eggs so treated not only live but hatch; and that if they are covered to a sufficient depth the alevins produced survive and possess the instinct and power to work their way gradually to the surface; that if buried beneath 5 or 6 inches of sand and gravel such eggs will hatch, and the young will work their way up through the sand and gravel to the surface, and that by the time they emerge, have absorbed their sacs and are then exempt from the attacks of vegetable molds.

Eggs buried under 1 or 2 inches of sand and gravel produce alevins that work their way up to the surface before the sac is absorbed, and upon reaching the surface are subject to attack by vegetable molds, and a very large percentage are thus destroyed, as well as by the more developed forms of aquatic life.

Eggs buried to a depth of 3 inches produce alevins that work their way to the surface so gradually that by the time they reach the surface their sacs are so nearly absorbed that many, but not all, resist the effects of fungus. Alevins from eggs buried beneath less than 4 inches of sand are liable to reach the surface while the sac is so thinly covered that few, if any, survive the effects of fungous growth.

The spawning beds of Pacific coast streams from California to Alaska (to which my observations have been confined), where the salmon spawn in numbers are, during and after the spawning period, covered with more or less vegetable molds. These molds are particularly common in the beds of streams where great numbers of salmon have spawned and died. Every experienced fish culturist knows that most waters carry great numbers of spores of fungi, and how difficult it is to prevent eggs and alevins from being attacked and injured by their growth. I believe that in natural propagation fungous growths destroy more salmon eggs and alevins than all other causes combined. The vegetable molds of Pacific streams are not active beneath the surface of the beds of streams. Salmon eggs cast therein, if even thinly covered with sand, are not injured by them. These molds do not affect the fry that have nearly or entirely absorbed their sacs, but they are deadly if permitted to attach themselves to either the eggs or the alevins.

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[a] Some Experiments in the Burial of Salmon Eggs—Suggesting a New Method of Hatching Salmon and Trout. By John Pease Babcock. Transactions, American Fisheries Society, 1910, pp. 393–395. Washington, 1911.

This method has been carried out on a considerable scale by A. Robertson, a Dominion of Canada hatchery superintendent located on the Fraser River, and the results published in "Hatching Salmon Fry in Gravel," Pacific Fisherman, Seattle, Wash., Vol. 17, No. 6, June, 1919, p. 38, illus.

My experiments along this line lead me to express the opinion that by the burial of freshly fertilized salmon eggs under 6 or 7 inches of sand and gravel strong healthy fry can be produced at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies.

I trust that this short statement of my experiments in the burial of salmon eggs may be deemed of sufficient economic importance to stimulate fish culturists generally in experimenting along similar lines. Those who do will perhaps experience some difficulty at first in the covering of a large number of eggs. Experimenters will find that after preparing suitable beds of sand and small gravel the eggs can be evenly laid and held until covered, if the surface of the bed is first thickly indented with cells a little deeper than the eggs. This can be readily accomplished by stamping the bed with a board covered with projections or pegs of suitable size.

My experiments suggest that in the near future most of the buildings and hatching apparatus now used in the propagation of salmon and trout will be dispensed with; that after the eggs have been expressed and fertilized, instead of being placed in wire baskets in hatcheries, they will be buried beneath the sand and gravel of the beds of natural or prepared streams, and that with the exception of watchmen to protect them, little or no other labor will be required.

FEEDING AND PLANTING THE FRY.

For some time the fry remain at the bottom of the trough, but when the yolk sac is nearly absorbed they rise from the bottom and begin swimming. As a rule the fry are planted about the time the yolk sac is absorbed, thus obviating the necessity for feeding them. Some experts advise planting young red salmon when the umbilical sac is about two-thirds absorbed, which is the time when the fish begin to swim up freely. With the temperatures prevailing at the Alaska hatcheries, this means that the fry must be held at least four or five weeks after hatching.

PACKING EGGS FOR SHIPMENT.

In packing salmon eggs for shipment it is the custom at the Bureau of Fisheries' hatcheries to use a packing box made of one-half inch pine, 2 feet square and 1 foot deep.[a]

At the bottom is placed a thick layer of moss, then a layer of mosquito netting, then a layer of eggs, then mosquito netting again, then successive layers of moss, netting, eggs, netting, and so on to the middle of the box. Here a firm wooden partition is fastened in and the packing renewed above in the same manner as below. The cover is then laid on the top, and when two boxes are ready they are placed in a wooden crate, made large enough to allow a space of 3 inches on all sides of the boxes. This space is filled with hay to protect the eggs against changes of temperature, and, the cover being put on the eggs, they are ready to ship. In the middle of the crate an open space about 4 inches in depth is left, between the two boxes of eggs, for ice. As soon as the crates arrive at the railway station this space, as well as the top of the crate is filled in with ice. Recent experiments show that salmon eggs can be packed and safely transported to considerable distances when they are first taken.

REARING SALMON FRY.

For many years it was the custom to plant the fry as soon as they had absorbed the yolk sac, a period of about 30 days. A few thousands were sometimes raised to the fingerling, yearling, or adult stage, more as a curiosity than anything else. No particular difficulty was experienced in raising these fish, but the expense entailed in feeding them for a prolonged period, and the impossibility of doing so unless large ponds were constructed at great expense for the pur-

[a] A Manual of Fish-culture, Based on the Methods of the United States Commission of Fish and Fisheries, revised edition, p. 14. Washington, 1917.

pose of holding them during the feeding period, prevented the general adoption of the rearing system.

For some years certain fish culturists and others had contended that the planting of fry just after they had absorbed the umbilical sac was an economic mistake, claiming that at this age they were weak and comparatively sluggish in their movements, and would fall easy prey to their numerous fish, bird, and other enemies. The late Robert D. Hume, who built and operated a hatchery on the lower Rogue River, also one on the upper Rogue River, which the United States Bureau of Fisheries operated for some years, was one of the first to take up the rearing of salmon fry on any scale.

In time these objections bore weight, and a few years ago the construction of ponds in which fry could be held and fed until they had reached a size which would insure them at least an even chance for their lives was undertaken all along the coast except in British Columbia, with the result that to-day there is a pond capacity for about one-half of the total capacity of the various hatcheries.

Most of the nursery ponds have been constructed near the hatcheries and usually comprise oblong trenches dug in the earth and walled with cement and stone.

In Oregon the State authorities found that the best results in pond rearing were obtained by using creek or natural ponds, which were made by placing dams across the small streams in the vicinity of the hatcheries. When first taken from the hatching troughs the fry are placed in the artificial ponds until the danger from spring freshets in the small streams is over. They are then transferred to the natural ponds, where the continual flow of fresh water, and the logs, rocks, etc., which provide shade and shelter, afford more natural conditions, and in which the natural food of the fry supplements the artificial food provided by man.

A big advantage in connection with the use of natural ponds is the comparatively small expense involved in providing for them as compared with the large expense involved in the construction of cement ponds.

The young fry show when they are ready to feed by dar ing to one side or the other when small particles of food are dropped in the water and float past them. For the first few weeks they should be fed regularly and as often as six times a day, and the earlier in the day the feeding begins and the later it continues at night the better. Two hours after feeding they will be found to be ravenously hungry, and as they grow much faster for frequent feeding great care should be taken to see that they are well fed. If not fed sufficiently they will bite at one another and cause more or less mortality among themselves.

FOOD.

In feeding salmon fry almost every conceivable food has been utilized. By universal consent liver is conceded to be the best food for the fry, as it can be ground finer than other foods and the blood which it contains is highly nutritious. At many places, however, it is impossible to secure liver, while its cost when available is generally prohibitive.

The food used is generally that most available and which experience has shown that the fry like and upon which they thrive.

In Oregon [a] it has been found that the extremely young fry thrived on a mixture of ground dried salmon and mush (composed of middlings and other wheat products). Milk curds from near-by creameries also proved satisfactory. The older fish are fed on ground smelt, lampreys, spent salmon, both dried and salted, and offal from the canneries, some loose and some packed in 1-gallon cans. An excellent food is broken-up ice-cream cones. This latter food also has the advantage of not sinking to the bottom and thus polluting the water: and because it floats at the surface the surplus can be lifted out with a dip net.

SALMON SOLD AFTER STRIPPING.

For many years it was the custom after the eggs had been stripped from the salmon to either give the carcasses to the Indians or to bury them. In 1917, under stress of the great demand for fish caused by the war, L. H. Darwin, fish and game commissioner of Washington, after an analysis by chemists had shown that the flesh was wholesome food, offered for sale, at a low rate, these spawned-out fish. The offer was accepted by several of the cities of the State, some of which established municipal markets at which these salmon, as well as other food products, were offered for sale at prices ruling lower than those in the commercial markets. It is probable that the economic utilization of these salmon will be permanent, and will prove a source of considerable profit to the States which sell them.

SALMON HATCHERIES ON THE PACIFIC COAST.

Below is shown a list of the salmon and steelhead-trout hatcheries operated on the Pacific coast during the year 1919:

U. S. BUREAU OF FISHERIES.

Alaska:
- Afognak.
- Yes Bay.

California:
- Baird.
- Battle Creek.
- Hornbrook.
- Mill Creek

Oregon:
- Clackamas.
- Applegate.
- Snake River.
- Rogue River.
- Upper Clackamas.

Washington:
- Baker Lake.
- Birdsview.
- Brinnon.
- Darrington.
- Duckabush.
- Illabott Creek.
- Quilcene.
- Big White Salmon.
- Little White Salmon.

STATE OF CALIFORNIA.

Sisson.
Brookdale.
Price Creek.
Ukiah.

STATE OF OREGON.

Wallowa River.
McKenzie River.
Salmon River.
Bonneville.
Santiam River (eyeing station).
Klaskanine.
Willamette River (eyeing station).
Eagle Creek.
Snake River (Idaho).
Tillamook.
Yaquina.
Siuslaw.
Umpqua.
South Coos.
Coquille.
Alsea.
Rogue River.

[a] Rearing and Feeding Salmon Fry in Oregon. By R. E. Clanton. Transactions, Pacific Fisheries Society, 1914, p. 91-94. Seattle, 1915.

STATE OF WASHINGTON.

Chambers Creek.
Chehalis.
Chehalis No. 2.
Chinook.
Dungeness.
Ellwah.
Green River.
Green River No. 2.
Nasel River.
Nisqually.
Nooksack.
Nooksack River, Middle Fork.
Nooksack River, South Fork.
North River.
Pilchuck.
Puyallup River.
Samish.
Skagit River.
Skokomish.
Skykomish.
Snohomish.
Stillaguamish.
Kalama.
Lewis River.
Pateros-Methow.
Tahuya (eyeing station).
Wenatchee.
Tilton River.
Wind River.
Humptulips.
Willapa.
Willapa No. 2.

DOMINION OF CANADA.

Granite Creek.
Pemberton.
Harrison Lake.
Stuart Lake.
Skeena River.
Babine Lake.
Rivers Inlet.
Fraser River.
Anderson Lake.
Kennedy Lake.
Cowichan Lake.

PROVINCE OF BRITISH COLUMBIA.

Seton Lake.

BRITISH COLUMBIA PACKERS ASSOCIATION.

Nimpkish Lake.

ALASKA (PRIVATE HATCHERIES).

Alaska Packers Association:
 Fortmann.
Northwestern Fisheries Co.:
 Quadra.
 Hetta.
North Pacific Trading & Packing Co.:
 Klawak.

GENERAL STATISTICS.

Distribution of fry, etc.—In the next table is shown by years and species the distribution in Pacific coast waters of fry, fingerlings, yearlings, and adults from 1873, when the first hatchery began operation, to 1919, inclusive. The figures on fingerlings, yearlings, and adults are not as complete as could be wished, this being due to certain of the State fish commissions not separating them from the fry in the published results.

The table shows the enormous total of 7,990,416,264 fry and 275,093,097 fingerlings, yearlings, and adults as having been deposited in local waters since the inception of the work on this coast. Of these nearly one-half were sockeye, or red salmon, followed by chinook, or spring, coho, or silver, dog, steelhead trout, and humpback salmon in the order named.

This table does not show the large number of eggs, fry, etc., shipped from the coast hatcheries to other sections of the country and to various foreign countries. These appear in the tables shown under the various States, Provinces, and Territories.

FIG. 43.—UNITED STATES SALMON HATCHERY, YES BAY, ALASKA.

FIG. 44.—UNITED STATES SALMON HATCHERY, AFOGNAK, ALASKA.

FIG. 45.—ALASKA PACKERS ASSOCIATION FORTMANN HATCHERY, NAHA STREAM, ALASKA; THE LARGEST HATCHERY IN THE WORLD.

FIG. 46.—CHEHALIS HATCHERY, WASHINGTON FISH AND GAME COMMISSION, SATSOP, WASH.

Distribution of Salmon in the Pacific Coastal Streams of North America, in Specified Years.

Year.	Chinook, king, or spring.		Coho, or silver.		Chum.		Humpback, or pink.	
	Fry.	Fingerlings, yearlings, and adults.	Fry.	Fingerlings, yearlings, and adults.	Fry.	Fingerlings, yearlings, and adults.	Fry.	Fingerlings, yearlings, and adults.
1873	520,000							
1874	850,000							
1875	2,250,000							
1876	2,000,000							
1877	2,550,000							
1878	2,582,620							
1879	5,376,500							
1880	4,059,290							
1881	4,974,790							
1882	3,991,750							
1884	600,000							
1886	150,000							
1887	200,000							
1888	2,590,000							
1889	8,168,000							
1890	5,250,475							
1891	9,269,000							
1892	4,299,000	25,000						
1893	10,825,950							
1894	8,427,900		280,000					
1895	6,458,000		910,000	560,000				
1896	25,581,033	807,150						
1897	31,146,095		298,137					
1898	73,684,076							
1899	56,773,351		189,000					
1900	33,974,064		13,925,104		10,301,760			
1901	36,563,138	1,668	20,047,935		16,478,280			
1902	73,852,120		41,436,123		9,937,390			
1903	75,558,389		34,460,291		10,012,390			
1904	161,530,963		23,894,026				521,797	
1905	143,714,117		30,743,492					
1906	167,745,494	122,980	47,356,449	300	3,268,800		969,990	
1907	124,578,390		44,426,380		6,120,000		4,224,255	
1908	135,447,179	2,165,797	54,108,557		4,342,350		31,920,662	
1909	88,188,707	16,949	50,648,674		7,805,000		10,000	
1910	97,361,532	225	45,863,952		8,607,500		2,251,340	
1911	80,570,265	11,700	52,869,759		13,435,750		460,150	
1912	101,810,515	1,405,860	66,087,446	116,300	4,684,950		34,205,460	
1913	112,008,886		79,313,839		35,792,440		1,888	
1914	133,271,477	2,571,711	67,682,576		16,623,984		39,685,814	
1915	149,666,221	9,875,745	92,926,831		63,088,372		7,867,484	
1916	151,649,595	26,070,128	56,647,147	5,543,712	63,390,798	1,000,000	15,842,627	2,915,000
1917	96,975,725	27,060,581	17,828,235	4,663,560	26,133,925	7,014,580	4,953,000	7,449,030
1918	133,102,069	22,384,610	55,697,111	10,148,815	82,020,140		22,159,186	4,736,000
1919	67,908,011	58,007,670	32,207,426	3,286,580	26,772,025	4,524,560	5,426,000	369,958
Total.	2,438,054,687	150,527,774	929,848,490	24,319,267	408,815,854	12,539,140	170,499,653	15,469,988

Distribution of Salmon in the Pacific Coastal Streams of North America, in Specified Years—Continued.

Year.	Sockeye, red, or blueback.		Steelhead trout.		Total.	
	Fry.	Fingerlings, yearlings, and adults.	Fry.	Fingerlings, yearlings, and adults.	Fry.	Fingerlings, yearlings, and adults.
1873					520,000	
1874					850,000	
1875					2,250,000	
1876					2,000,000	
1877					2,550,000	
1878					2,582,620	
1879					5,376,500	
1880					4,059,290	
1881					4,974,790	
1882					3,991,750	
1884					600,000	
1885	1,800,000				1,800,000	
1886	2,625,000				2,775,000	
1887	4,414,000				4,614,000	
1888	5,807,000				8,397,000	
1889	4,419,000				12,587,000	
1890	6,640,000				11,890,475	
1891	3,603,800				12,872,800	
1892	6,000,000				10,299,000	25,000
1893	6,274,000				17,099,950	
1894	8,504,000		353,500		17,565,400	
1895	11,681,000				19,049,000	560,000
1896	15,868,000		107,808		41,556,841	807,150
1897	18,374,440		262,000		50,080,672	
1898	20,916,000		650,000		95,250,076	
1899	15,761,000		8,625		72,731,976	
1900	29,590,000		2,061,560		89,852,488	
1901	19,901,253		1,709,326		94,699,932	1,668
1902	72,679,000		3,243,948		201,148,581	
1903	89,398,789		4,509,641	37,033	213,939,500	37,033
1904	70,710,200		4,207,920		260,864,906	
1905	119,963,200		3,805,675		298,226,484	
1906	232,037,442		6,725,965	24,383	458,104,140	147,663
1907	228,018,450		5,629,493		412,996,968	
1908	230,528,455		5,837,671		462,184,874	2,165,797
1909	239,251,146		8,193,778		394,097,305	16,949
1910	396,215,795		11,368,446		561,668,565	225
1911	257,463,497		14,995,717		419,795,138	11,700
1912	324,325,768		12,710,382	177,790	543,824,521	1,699,950
1913	242,146,069		16,654,906		485,918,028	
1914	261,365,781		11,719,558		530,349,190	2,571,711
1915	198,910,010	8,369,830	22,942,900		535,401,818	18,245,575
1916	256,582,879	15,292,732	18,952,136	3,480,092	563,065,182	54,301,664
1917	215,853,504	12,305,953	15,241,720	1,887,950	376,986,109	60,381,654
1918	155,043,461	12,705,285	18,480,440	3,520,420	466,502,407	53,495,130
1919	62,397,320	14,299,960	17,755,206	135,500	212,465,988	80,624,228
Total	3,835,069,259	62,973,760	208,128,321	9,263,168	7,990,416,264	275,093,097

Output of United States Bureau of Fisheries hatcheries.—The next table shows by years and species the combined output of the various hatcheries of the United States Bureau of Fisheries on this coast. The greater part of the egg output was to various State hatcheries on the Pacific coast, more particularly those belonging to the State of California. The total figures show that since the Bureau began operations on this coast it has distributed 1,173,825,343 eggs, 2,063,076,832 fry, and 281,317,294 fingerlings, yearlings, and adults.

Output of Pacific Coast Salmon Hatcheries Owned by the U. S. Bureau of Fisheries, 1872 to 1919.

Year.	Chinook, king, or spring.			Coho, or silver.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1872	30,000					
1873	1,400,000					
1874	4,155,000	850,000				
1875	6,250,000	1,750,000				
1876	5,065,000	1,500,000				
1877	4,983,000	2,000,000				
1878	7,810,000	2,500,000				
1879	4,250,000	2,300,000				
1880	3,800,000	2,000,000				
1881	4,300,000	3,100,000				
1882		3,991,750				
1883		776,125				
1889 [a]	3,450,000	6,000,000				
1890	2,554,000	2,860,475				
1891	3,688,000	5,678,525				
1892	2,902,000	1,647,900				
1893	3,530,000	5,290,100				
1894	7,500,000	651,500			280,000	
1895	3,699,000	500,000			690,000	560,000
1896	2,798,500	3,547,850	557,150			
1897	18,232,590	9,828,095			298,137	
1898	30,605,000	39,950,698				
1899	32,618,000	9,366,366				
1900	7,411,000	14,287,264			146,824	
1901	11,615,036	7,987,107	1,668		302,041	
1902	19,446,410	29,340,308			424,530	
1903	16,160,177	23,845,956	250	680,800	81,812	
1904	75,217,354	35,006,988			3,984,645	
1905	96,055,765	21,620,292		107,000	9,321,513	
1906	115,648,145	20,797,543	123,118	239,180	6,445,574	300
1907	78,587,705	17,567,092		760,000	3,636,952	
1908	68,520,550	24,998,185	2,165,797	296,000	13,420,714	57,932
1909	38,859,265	20,177,286	16,949	272,000	9,470,925	
1910	38,306,709	15,682,064	225	275,000	10,888,025	
1911	37,314,514	16,659,684	211,700	2,391,900	6,210,296	
1912	36,837,550	31,040,893	1,405,860	52,000	12,955,824	
1913	58,296,873	33,415,423		202,000	13,952,963	
1914	31,032,645	48,895,607	5,582,796	95,840	24,619,456	27,258
1915	25,751,005	53,612,056	9,604,985	111,200	24,018,355	267,662
1916	20,622,340	57,870,714	22,982,655	198,500	8,124,334	1,469,507
1917	7,191,200	16,404,404	27,858,026		4,403,700	4,662,960
1918	18,074,900	6,028,918	63,176,244		980,300	10,504,115
1919	12,782,500	389,002	34,088,150		7,544,020	1,291,730
Total	967,351,733	601,720,170	167,775,573	5,681,420	162,200,940	18,841,464

Year.	Chum.		Humpback, or pink.			Sockeye, red, or blueback.		
	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1900							10,683,000	
1901							3,834,453	
1902							3,371,000	
1903							3,731,789	
1904				176,597			3,855,000	
1905							7,819,281	10,600
1906			2,000	969,990		880,000	9,923,680	9,500
1907							58,835,055	
1908			502,000	6,764,762		75,000	69,883,305	
1909				10,000		100,000	93,408,496	
1910				1,731,740			146,081,595	
1911	911,650		100,000	460,150			100,490,900	
1912	2,495,000		3,271,740	2,566,325		2,000,000	91,422,273	
1913	19,479,000			1,880		2,000,000	78,724,900	
1914	8,672,735		13,260,000	37,648,422	4,355	6,020,000	53,071,574	120,000
1915	35,504,707		14,500,000	7,153,500	119,480	155,000	46,282,691	8,416,405
1916	21,500,944	1,000,000	7,000,000	6,166,400	2,915,000	3,100,000	90,988,566	2,666,308
1917	14,403,300	7,014,580		165,000	7,499,030	2,000,000	84,152,825	2,145,953
1918	9,892,145			2,132,831	3,736,000	18,000,000	67,591,200	12,705,285
1919	4,544,000	4,524,560	10,062,000	5,426,500	369,958	101,981,000	48,393,000	25,959,960
Total.	117,403,481	12,539,140	48,697,740	71,314,097	14,643,823	136,311,000	1,072,544,583	52,033,411

[a] Operations suspended from 1884 to 1888, both inclusive.

OUTPUT OF PACIFIC COAST SALMON HATCHERIES OWNED BY THE U. S. BUREAU OF FISHERIES, 1872 TO 1919—Continued.

Year.	Steelhead trout.			Total.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1872	....	....	....	30,000	....	....
1873	....	....	....	1,400,000	....	....
1874	....	....	....	4,155,000	850,000	....
1875	....	....	....	6,250,000	1,750,000	....
1876	....	....	....	5,065,000	1,500,000	....
1877	....	....	....	4,983,000	2,000,000	....
1878	....	....	....	7,810,000	2,500,000	....
1879	....	....	....	4,250,000	2,300,000	....
1880	....	....	....	3,800,000	2,000,000	....
1881	....	....	....	4,300,000	3,100,000	....
1882	....	....	....	....	3,991,750	....
1883	....	....	....	....	776,125	....
1889 [a]	....	....	....	3,450,000	6,000,000	....
1890	....	....	....	2,554,000	2,860,475	....
1891	....	....	....	3,688,000	5,678,525	....
1892	....	....	....	2,902,000	1,647,900	....
1893	....	....	....	3,530,000	5,290,100	....
1894	75,000	308,500	....	7,575,000	1,240,000	....
1895	....	852,500	332,000	3,699,000	2,042,500	892,000
1896	175,000	107,808	....	2,973,500	3,655,658	557,150
1897	50,000	257,000	....	18,282,590	10,383,232	....
1898	60,000	650,000	....	30,665,000	40,600,698	....
1899	159,000	12,125	....	32,777,000	9,378,491	....
1900	415,000	125,000	....	7,826,000	25,242,088	....
1901	246,000	65,850	25,000	11,861,036	12,189,451	26,668
1902	481,000	130,250	....	19,927,410	33,266,088	....
1903	480,000	702,700	285,848	17,320,977	28,362,257	286,098
1904	225,000	93,205	11,090	75,442,354	43,116,435	11,090
1905	464,400	537,205	....	96,627,165	39,298,291	10,000
1906	358,000	1,834,485	40,383	117,127,325	39,971,272	173,301
1907	250,000	1,190,305	....	79,597,705	81,229,404	....
1908	487,725	1,089,596	....	69,881,275	116,156,562	2,223,729
1909	483,725	1,670,371	....	39,714,990	124,737,078	16,949
1910	300,000	3,511,226	....	38,881,709	177,894,650	225
1911	660,000	3,826,439	....	40,466,414	128,559,119	211,700
1912	905,000	4,289,415	294,090	43,066,290	144,769,730	1,699,950
1913	1,330,000	4,272,225	....	61,828,873	149,850,391	....
1914	729,000	4,022,438	....	51,137,485	176,930,232	5,734,409
1915	877,000	5,262,973	1,048,317	41,394,205	171,834,282	19,456,849
1916	1,490,000	841,600	3,676,805	32,410,840	185,432,558	34,710,275
1917	3,237,600	2,013,510	1,891,450	12,428,800	121,542,739	51,071,999
1918	1,070,000	103,000	6,854,785	37,144,900	86,728,394	96,976,429
1919	775,000	....	1,148,000	125,600,500	66,296,522	67,382,358
Total	15.783,450	37,769,726	15.607,768	1,173,825,343	2,062,952,997	281,441,179

[a] Operations suspended from 1884 to 1888, both inclusive.

ACCLIMATIZING PACIFIC SALMON IN OTHER WATERS.

For many years efforts have been made by the United States Bureau of Fisheries and various State fish commissions to introduce Pacific coast salmon in eastern waters. In the early history of fish culture chinook fry were planted in almost every imaginable stream along the Atlantic seaboard, in various streams in the Mississippi Valley, and also in tributaries of the Great Lakes. In most cases, owing to the unsuitability of the water, the experiment was doomed to failure from the start. In the case of a few streams where results might have been obtained, the plantings were at long intervals and the fish were too small to protect themselves, while no effort was made by the State authorities to protect them.

The most successful results with plants of chinook salmon have been obtained in Lake Sunapee, N. H., where it is now a not uncommon thing for anglers to catch chinook with rod and reel.

In 1912 about 10,000 chinook fingerlings from Columbia River eggs furnished by the United States Bureau of Fisheries were planted by the Massachusetts Fish Commission in Lake Quinsigamond, and during July, 1914, about 20 months after they were hatched, over 600 salmon, according to a member of the commission, were caught, ranging from 1½ to 5 pounds each.

Other plants have been made since in Lake Quinsigamond and other lakes and ponds, with fairly satisfactory results, and the ultimate outcome of the experiment is awaited with much interest.

The most successful effort in this line was initiated by the United States Bureau of Fisheries in the fall of 1913, when it transferred from its hatcheries on the Pacific coast to those in Maine 13,240,000 humpback-salmon eggs. These were followed by a second shipment of 7,022,000 eggs in the fall of 1914, a third shipment of about 7,000,000 eggs in the fall of 1915, and others each year since. These eggs were hatched out and the fry planted in various selected New England streams where the conditions seemed favorable.

Early in August, 1915, a female humpback salmon 22½ inches long and weighing 4 pounds 3 ounces was taken at the Bangor waterworks in the Penobscot River. Shortly after a male fish of about the same size was taken in this river at Orland Dam. A little later agents of the Bureau captured 20 alive near Bangor, and about 3,000 eggs were obtained and fertilized.

In Dennys River, in Maine, during the period between August 15 and September 24, local fishermen caught a number. Since then they have been running regularly each season into certain of these streams.

The chinook salmon has also been acclimatized in the waters of New Zealand. They were first introduced in 1900, and eggs were imported for six years in succession. A considerable annual run now enters those rivers in which the salmon were planted.

In 1908 the United States Bureau of Fisheries initiated an effort to establish a run of sockeye salmon in Grandy Creek, a stream in the immediate vicinity of the Birdsview (Wash.) hatchery of the Bureau, and one which had not been visited by this species. The first fish, numbering 64,000, were planted in the creek in 1908. Four years afterwards, in September, 1912, the first sockeye salmon entered the hatchery trap in Grandy Creek, and from them 222,000 eggs were secured. In 1916 the water in the creek was too low to permit the ascent of salmon until September 26, when its level was slightly raised by local rains, and a few fish immediately entered it and were taken in the hatchery trap. The eggs secured from the small number available amounted to 24,500. The 1920 run is being awaited with much interest.

In 1916 L. H. Darwin, commissioner of fish and game for the State of Washington, began an experiment looking to the stocking, with sockeye salmon, of the Samish River, a stream debouching in Puget Sound, and in which this species had not hitherto been found. The parent fish were obtained from traps and transported alive in crates to the Samish State hatchery, where they were held until ripe and then stripped and fertilized. After hatching, the fry were planted in the stream. A few returned in 1920.

CALIFORNIA.

HISTORY.

The first fish-cultural station on the Pacific coast was located on McCloud River, a stream of the Sierra Nevada Mountains emptying into Pit River, a tributary to the Sacramento, 323 miles nearly due north of San Francisco. The site on the west bank of the river, about 3 miles above the mouth, was chosen after investigation of a number of places on the Sacramento, by Livingston Stone, one of America's pioneer fish culturists, and the station was named Baird, in honor of the then Commissioner of Fisheries, Prof. Spencer F. Baird. Although the season had nearly passed when the station was sufficiently advanced to handle eggs, 50,000 eggs were secured, and while 20,000 were lost, owing to the excessive heat, the remaining 30,000 were shipped east, all of which were eventually lost but 7,000 fry, which were planted in the Susquehanna River, in Pennsylvania.

The main object of the hatchery the first few years was to secure eggs to ship to the East for the purpose of introducing Pacific salmon in the waters of that section. The commission early made an agreement with the State of California, however, under which the latter at first paid part of the expense, and the commission hatched and planted a portion of the take in the McCloud River. Later, part of the eggs were turned over to the State, which hatched and planted the salmon in local waters.

In 1881 the station buildings were washed away in a freshet, but were immediately rebuilt. From 1884 to 1887, both inclusive, all operations were suspended.

In 1889 a hatchery was established at Fort Gaston, on the Army reservation in the Hoopa Indian Reservation in Humboldt County, but it was not put into operation until 1890. As the reservation was abolished on July 1, 1892, the commission took complete charge of the plant, and in 1893 established a tributary station on Redwood Creek. The same year Korbel station was established about one-half mile above Korbel, on Mad River, in Humboldt County. Owing to the lack of money this station was closed in the fiscal year 1896, but was reopened during the fiscal year 1897.

That same year the commission erected, on ground owned by the State, a hatchery at Battle Creek, in Tehama County, and also took charge of and operated the hatchery erected at this place by the State fish commission the previous year. Under the terms of an agreement the commission was to deliver to the State as many eyed spawn as the latter could hatch at Sisson, its own station.

Owing to their inaccessibility, the Fort Gaston hatchery and its substations were abandoned in 1898. The same year an experimental station was established at Olema, Bear Valley, in Marin County, whence eggs were transferred from Baird station, hatched out here, and planted in Olema Creek in order to see if they could not be domesticated here, where they had not been found previously.

During the fiscal year 1902 a substation was established on Mill Creek, a stream which has its source in the foothills of the Sierra Mountains, in the northeastern part of Tehama County, and empties into the Sacramento River from the east about a mile above the town of Tehama. The eggs are retained here until eyed and then shipped to other hatcheries.

FIG 47.—UNITED STATES BUREAU OF FISHERIES HATCHERY AT BAIRD, CALIF.; THE FIRST FISH-CULTURAL STATION ON THE PACIFIC COAST.

FIG. 48.—MOUNT SHASTA HATCHERY OF THE CALIFORNIA FISH AND GAME COMMISSION, AT SISSON, CALIF.

As stated above, the State aided the work of the United States Fish Commission in a financial way and also by hatching and distributing the eggs turned over to its care. In 1885 the State legislature passed a bill authorizing the establishment of a hatchery of its own, and the same year such a station was built upon Hat Creek about 2½ miles above its junction with Pitt River, a tributary of the Sacramento River. As the work of the first few seasons developed that the location was unsuitable, the hatchery was removed in 1888 to Sisson, in Siskiyou County. It is now known as the Mount Shasta hatchery. The work of this hatchery was to handle the eggs turned over to it by the United States Fish Commission. It was almost doubled in size in 1917.

In 1895 another hatchery was built by the State near the mouth of Battle Creek, a tributary of the Sacramento River. In 1896 and 1897 this hatchery was operated jointly by the State and the United States Fish Commission while awaiting the appropriation of money by the commission to purchase it from the State.

In the fall of 1897 a hatchery was established by the State at Grizzly Bluff, on Price Creek, a tributary of Eel River, in Humboldt County, and in 1902 this hatchery made the first plant in the State of steelhead trout fry. In 1916 it was moved to a point on Eel River near Fort Seward.

Santa Cruz County has had a hatchery at Brookdale for a number of years. In 1911 it was leased to the State and operated by the latter during the seasons of 1911 and 1912. In 1913 the State gave up the lease and entered into a contract to purchase the eggs produced from this hatchery. The price agreed upon was that the State commission was to pay $1.50 per thousand for the eyed steelhead eggs, up to the number of 2,000,000, and $1 per thousand for all eggs up to 3,000,000, provided that the eggs were collected and eyed by a skilled fish culturist and would pass inspection before they were accepted. In 1916 the State leased the plant for a term of years.

A hatchery was established by the United States Bureau of Fisheries at Hornbrook, on Klamath River, in 1913. At first this hatchery was devoted to rainbow-trout work, but later the collection and distribution of silver and chinook salmon was taken up.

During the fall of 1911 the State established an experimental station at Sacramento in order to carry on a series of experiments to determine whether the eggs of the quinnat salmon could be successfully hatched and the fry reared near the city of Sacramento. Of the fish hatched at this station 50,000 were marked.

Nearly all of the fry that were liberated in the Sacramento River were floated in a screen cage by boat into the middle of the stream and there released. N. B. Scofield took 500 in a floating box down the river, where they were held and fed for several weeks in brackish and salt water. They were apparently not affected by the changes in the salinity of the water.

Experiments were carried on until the summer of 1913, when they were abandoned due to the killing of the embryos by the mineral substances in the water used at the station.

During the fiscal year 1912 the Mill Creek hatchery of the United States Bureau of Fisheries was operated by the California Commission.

Some years ago the town of Ukiah, Mendocino County, established a hatchery 1 mile from the town, and on Russian River.

For some years it was operated as a trout station, but eventually became an important steelhead hatchery. It was not operated in 1913. In 1914 the State Fish Commission collected steelhead eggs at the Eel River dam of the Snow Mountain Water & Power Co., and having secured permission from the town of Ukiah, hatched them out in its hatchery.

As the Hornbrook hatchery on Klamath River was on private property, the United States Bureau of Fisheries in 1915 removed the buildings from the old location on the south side to property owned by the Government on the north side of the river.

In 1915 new hatchery buildings were erected at the Mill Creek hatchery.

OUTPUT.

The following tables show separately the quantity of salmon eggs, fry, fingerlings, yearlings, and adults distributed by the United States Bureau of Fisheries and by the State since the inception of the work. The large quantity of eggs shown by the Bureau represents largely the eggs supplied to the State, which hatched and distributed them, and eggs sent to other States and to foreign countries.

OUTPUT OF HATCHERIES IN CALIFORNIA OWNED BY THE UNITED STATES BUREAU OF FISHERIES.

Year ending June 30—[a]	Chinook.			Silver.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1872	30,000					
1873	1,400,000					
1874	4,155,000	850,000				
1875	6,250,000	1,750,000				
1876	5,065,000	1,500,000				
1877	4,983,000	2,000,000				
1878	7,810,000	2,500,000				
1879	4,250,000	2,300,000				
1880	3,800,000	2,000,000				
1881	4,300,000	3,100,000				
1882		3,991,750				
1883		776,125				
1889 [b]	3,450,000	1,500,000				
1890	1,554,000	84,000				
1891	2,988,000	777,000				
1892	2,902,000	315,500				
1893	3,530,000	1,190,100				
1894	7,500,000	438,500			280,000	
1895	3,676,000	500,000			690,000	560,000
1896	6,170,800	715,700				
1897	18,232,590	3,056,701			298,137	
1898	30,605,000	15,643,300				
1899	27,665,000	3,275,110				
1900	2,925,000	3,533,950				
1901	3,934,036	889,570				
1902	17,580,410	2,115,560				
1903	11,275,777	1,618,066				
1904	64,598,354	2,350,130				
1905	96,025,765	7,561,380				
1906	107,905,945	3,496,267	138			
1907	73,376,315	2,512,250				
1908	64,990,550	4,780,855				
1909	32,278,265	3,590,078				
1910	30,539,467	2,286,257				
1911	33,364,514	3,666,061		2,289,900		
1912	20,697,550	7,243,325				
1913	17,092,873	2,195,100		100,000	17,320	
1914	25,373,645	5,598,349	3,849,991	95,840	2,536,460	
1915	20,716,005	5,015,400	8,086,139		971,740	226,162
1916	19,622,340	9,940,950	11,938,224		2,169,050	
1917	7,027,300	800,000	14,628,300		50,000	11,000
1918	14,421,900		10,689,400			
1919	11,802,500		10,287,800			
Total	825,864,901	117,457,334	59,479,992	2,485,740	7,012,707	797,162

[a] The calendar year was used up to 1889.

[b] The hatchery was closed from 1884 to 1888.

OUTPUT OF HATCHERIES IN CALIFORNIA OWNED BY THE UNITED STATES BUREAU OF FISHERIES—Continued.

Year ending June 30 —[a]	Steelhead trout.			Total.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1872				30,000		
1873				1,400,000		
1874				4,155,000	850,000	
1875				6,250,000	1,750,000	
1876				5,065,000	1,500,000	
1877				4,983,000	2,000,000	
1878				7,810,000	2,500,000	
1879				4,250,000	2,300,000	
1880				3,800,000	2,000,000	
1881				4,300,000	3,100,000	
1882					3,991,750	
1883					776,125	
1889 [b]				3,450,000	1,500,000	
1890				1,554,000	84,000	
1891				2,988,000	777,000	
1892				2,902,000	315,500	
1893				3,530,000	1,190,100	
1894	75,000	308,500		7,575,000	1,027,000	
1895		852,500	332,000	3,676,000	2,042,500	892,000
1896	175,000	107,808		6,345,800	823,508	
1897	50,000	257,000		18,282,590	3,611,838	
1898	60,000	650,000		30,665,000	16,293,300	
1899				27,665,000	3,275,110	
1900				2,925,000	3,533,950	
1901				3,934,036	889,570	
1902				17,580,410	2,115,560	
1903				11,275,777	1,618,066	
1904				64,598,354	2,350,130	
1905				96,025,765	7,561,380	
1906				107,905,945	3,496,267	138
1907				73,376,315	2,512,250	
1908				64,990,550	4,780,855	
1909				32,278,265	3,590,078	
1910				30,539,467	2,286,257	
1911				35,654,414	3,666,061	
1912				20,697,550	7,243,325	
1913				17,192,873	2,212,420	
1914				25,469,485	8,134,809	3,849,991
1915				20,716,005	5,987,140	8,312,301
1916				19,622,340	12,110,000	11,938,224
1917				7,027,300	850,000	14,639,300
1918				14,421,900		10,689,400
1919				11,802,500		10,287,800
Total	360,000	2,175,808	332,000	828,710,641	126,645,849	60,609,154

[a] The calendar year was used up to 1889.   [b] The hatchery was closed from 1884 to 1888.

OUTPUT OF HATCHERIES OWNED BY THE STATE OF CALIFORNIA.

Year.	Chinook.		Silver fry.	Steelhead fry.	Total.	
	Eggs.	Fry.[a]			Eggs.	Fry.
1873		520,000				520,000
1874		850,000				850,000
1875	[b] 250,000	2,250,000			250,000	2,250,000
1876		2,000,000				2,000,000
1877		2,200,000				2,200,000
1878		2,500,000				2,500,000
1879		2,300,000				2,300,000
1880		2,225,000				2,225,000
1881		2,420,000				2,420,000
1882		3,991,750				3,991,750
1884		600,000				600,000
1886		150,000				150,000
1887		200,000				200,000
1888		1,290,000				1,290,000
1889		2,168,000				2,168,000
1890		1,320,000				1,320,000
1891		2,798,000				2,798,000
1892		2,651,000				2,651,000
1893		3,941,650				3,941,650
1894		7,776,400				7,776,400
1895		3,435,000				3,435,000
1896		15,283,183				15,283,183
1897		18,123,000				18,123,000
1898		31,476,388				31,476,388
1899		21,234,000				21,234,000
1900		2,536,000				2,536,000
1901		3,239,000				3,239,000
1902		16,852,040		301,000		17,153,040
1903		20,040,487		120,000		20,160,487
1904		63,632,000		90,000		63,722,000
1905		87,000,000		108,000		87,108,000
1906		105,815,920		243,000		106,058,920
1907		71,267,000		352,000		71,619,000
1908		60,619,000		170,000		60,789,000
1909		28,000,000		517,000		28,517,000
1910		28,469,745		637,800		29,107,545
1911		29,657,263	2,060,910	1,858,100		33,576,273
1912		18,909,445		2,177,958		21,087,403
1913		16,277,227	25,000	1,983,500		18,285,727
1914		25,290,615	12,500	3,171,083		28,474,198
1915		33,313,150	1,417,000	8,582,500		43,312,650
1916		19,339,738		5,213,170		24,552,908
1917		6,853,000		6,699,420		13,552,420
1918		14,439,000		4,483,000		18,922,000
1919		11,970,000	178,000	4,950,000		17,098,000
Total	250,000	797,224,001	3,693,410	41,657,531	250,000	842,574,942

[a] The greater part of the output of chinook fry was from eggs supplied by the U. S. Bureau of Fisheries hatcheries in California.
[b] All were lost.

DISTRIBUTION.

The following table shows, by streams and species, the distribution in California of the salmon eggs, fry, fingerlings, yearlings, and adults, from the hatcheries of the United States Bureau of Fisheries and the State. This far from represents the work of the hatcheries, as large quantities of eggs were sent to other States and foreign countries.

Distribution of Salmon in the Waters of California.

Year.	Klamath River and tributaries.				Redwood Creek and tributaries.			
	Chinook.		Silver.			Silver.		
	Fry.	Yearlings.	Fry.	Yearlings and adults.	Chinook fry.	Fry.	Yearlings and adults.	Steelhead fry.
1890	90,000							
1891	30,000				25,000			
1892	147,600	25,000			142,500			
1893	487,200				170,000			
1895			300,000	160,000		140,000	400,000	
1896					65,700			107,808
1897					280,250	124,750		202,000
1898	16,000				1,260,000			650,000
1903	40,000							
1911			2,060,910					
1913			17,320					
1914	2,155,100		2,548,960					
1915	5,820,000		1,098,000					
1916	7,733,135		2,169,050					
1917	1,728,000	368,000	50,000	11,000				
1918	3,675,000							
1919	1,148,000		178,000					
Total	23,070,035	393,000	8,422,240	171,000	1,943,450	264,750	400,000	959,808

Year.	Mad River and North Fork.			Eel River.		Russian River.	Skaggs Springs.	Marin County creeks.
	Chinook fry.	Silver fry.	Steelhead fry.	Chinook fry.	Steelhead fry.	Chinook fry.		
1881						15,000	15,000	
1894		280,000	308,500					
1895		470,000						
1897	145,365	173,387	60,000					635,000
1898				7,857,388				1,970,000
1899				8,202,000				900,000
1900				885,000				
1902				2,069,500	301,000			
1903				5,257,947	120,000			
1904				5,200,000	90,000			
1905				8,100,000				
1906				9,265,920	243,000			
1907				7,570,000	352,000	25,000		25,000
1908				6,154,000				
1909				5,500,000	349,000			
1910				5,969,745	334,800			
1912	100,000			3,103,660				
1913	100,000			1,386,500				
1914	225,000			3,723,000				
1915	350,000			2,618,150				
1917	400,000			91,000				
1918	250,000			844,000				
1919	250,000			682,000				
Total	1,820,365	923,387	368,500	84,479,810	1,789,800	40,000	15,000	3,530,000

DISTRIBUTION OF SALMON IN THE WATERS OF CALIFORNIA—Continued.

Year.	Sacramento River and tributaries.					San Francisco Bay streams.	Smith River.	Santa Ynez River.	Monterey Bay and tributaries.
	Chinook.			Silver fry.	Steelhead fry.	Chinook fry.			
	Eggs.	Fry.	Yearlings, fingerlings, and adults.						
1873	20,000	520,000							
1874		850,000							
1875	[a] 250,000	2,000,000							
1876		2,000,000							
1877		2,200,000							
1878		2,500,000							
1879		2,300,000							
1880		2,225,000							
1881		[b] 2,300,500				20,000			30,000
1882	80,300	3,991,750							
1884		600,000							
1886		150,000							
1887		200,000							
1888		1,290,000							
1889		3,668,000							
1890		1,404,000							
1891		3,520,000							
1892		2,676,500							
1893		4,474,750							
1894		8,214,900			45,000				
1895		3,935,000							
1896		15,683,183	250,000						
1897		19,264,086							
1898		33,998,300							
1899	85,200	16,307,110							
1900		5,184,950							
1901		4,128,570							
1902		16,898,100							
1903		16,359,606							
1904		60,782,130							
1905		94,561,380			108,000				
1906		100,038,552							900,000
1907		66,209,250			135,000				1,200,000
1908		59,245,855			170,000				800,000
1909		26,090,000			168,000				
1910		24,786,257			303,000				
1911		33,323,324							
1912		22,949,110							
1913		16,691,167				294,660			
1914		24,637,864	838,906				100,000		
1915		[c] 28,688,000	9,053,635	1,194,762				42,000	
1916		26,800,604	5,538,224				300,000	25,000	
1917		5,875,000	14,260,300					25,000	
1918		9,470,000	10,689,400				100,000	25,000	
1919		9,840,000	10,287,000					25,000	
Total	435,500	788,832,798	50,917,465	1,194,762	929,000	314,660	500,000	142,000	2,930,000

[a] All were lost.
[b] Includes 15,000 chinook fry planted in San Gregorio River and 15,000 chinook fry planted in Pescadero Creek.
[c] Includes the following plants in Santa Barbara county streams: Bear Creek, 4,000; Maguelito Creek, 2,000; and Salispuedes Creek, 2,000.

DISTRIBUTION OF SALMON IN THE WATERS OF CALIFORNIA—Continued.

Year.	Monterey Bay and tributaries.	Ventura River.	Truckee River.	Total.					
				Chinook.			Silver.		
	Silver fry.	Chinook fry.		Eggs.	Fry.	Yearlings, fingerlings, and adults.[a]	Fry.	Adults and yearlings.	Steelhead fry.[b]
1873				20,000	520,000				
1874					850,000				
1875			250,000	250,000	2,250,000				
1876					2,000,000				
1877					2,200,000				
1878					2,500,000				
1879					2,300,000				
1880					2,225,000				
1881			10,000		2,390,500				
1882				80,300	3,991,750				
1884					600,000				
1886					150,000				
1887					200,000				
1888					1,290,000				
1889					3,668,000				
1890					1,494,000				
1891					3,575,000				
1892					2,966,600	25,000			
1893					5,131,950				
1894					8,214,900		280,000		353,500
1895					3,935,000		910,000	560,000	
1896					15,748,883	250,000			107,808
1897					20,324,701		298,137		262,000
1898					45,101,688				650,000
1899				85,200	25,409,110				
1900					6,069,950				
1901					4,128,570				
1902					18,967,600				301,000
1903					21,657,553				120,000
1904					65,982,130				90,000
1905					102,661,380				108,000
1906					110,204,472				243,000
1907	80,000				75,029,250		80,000		487,000
1908	80,000				66,199,855		80,000		170,000
1909	[c]54,000				31,590,000		42,000		518,200
1910					30,756,002				637,800
1911					33,323,324		2,060,910		1,858,100
1912					26,152,770				2,177,958
1913	25,000				18,472,327		42,320		1,983,500
1914					30,840,964	838,906	2,548,960		3,171,083
1915	71,000	25,000			37,543,150	9,053,635	2,363,762		8,582,500
1916		25,000			34,883,739	5,538,224	2,169,050		5,213,170
1917		25,000			8,144,000	14,628,300	50,000	11,000	6,699,420
1918		25,000			14,389,000	10,689,400			
1919		25,000			11,970,000	10,287,000	178,000		4,950,000
Total	310,000	125,000	260,000	435,500	908,003,118	51,310,465	11,103,139	571,000	38,684,039

[a] Of recent years it has been impossible to show the total number of yearlings, fingerlings, and adults planted, as the State reports do not distinguish them from the fry. Those shown in 1914–1919 were reared by the U. S. Bureau of Fisheries.

[b] After 1911 the practice of showing waters in which steelheads were planted was abandoned as the number of streams was becoming unwieldy.

[c] Includes 1,200 steelhead fry, which in "Total" column are included under "Steelhead fry."

OREGON.

HATCHERIES ON COASTAL STREAMS.

Rogue River.—In 1877 R. D. Hume, who had been packing salmon on this river for some years, erected a hatchery at Ellensburg. In 1888 the Oregon Legislature appropriated a sum of money for the enlargement and support of this hatchery, Mr. Hume to retain complete control. As the location is on tidewater, it is necessary to catch the parent fish and hold them until they are ready to spawn, and in order to do this Mr. Hume had an excavation 32 by 62 feet and 11 feet deep made in the bank of the river. This was lined with concrete 1 foot thick, which, when filled with water, made a pond 30 by 60 feet and 10 feet deep. Over the entire pond he constructed a building which could be closed up so as virtually to exclude the light. It is supposed that retaining the fish in a dark place aids in keeping them in good physical condition until ready to spawn. After the death of Mr. Hume in 1908 this hatchery was taken over and operated by the State.

In 1897 Mr. Hume built and equipped a hatchery on the upper Rogue River at the mouth of Elk Creek, about 26 miles from the town of Central Point, in Jackson County, and, in pursuance of an understanding with the United States Fish Commission, the latter operated then and still continues to operate this plant.

In 1900 the Government established an auxiliary station for the collection of steelhead trout eggs on Elk Creek, about 10 miles above the main station. In 1905 a substation was operated at Grants Pass, while during the fiscal year 1908 and in subsequent years substations were operated at Findley Eddy, on the Rogue River, Illinois River, and Applegate Creek, tributaries of the Rogue.

Many of the eggs gathered at the upper Rogue River stations were shipped to Mr. Hume's hatchery, on the lower river, and there hatched out and planted.

Coquille River.—The State formerly had a hatchery on this river, but it was abandoned during the winter of 1902–3. In the winter of 1904–5 a substation was established on one of the tributaries of the Coquille River, about 6 miles from the South Coos River hatchery, and was used in hatching eggs brought to it from the latter place. A station was built on the north fork of the Coquille River in 1910.

Coos River.—A hatchery was built by the State in 1900 on the South Coos River, about 20 miles from the town of Marshfield.

Umpqua River.—In 1900 the State built a hatchery on the north fork of the Umpqua River, near the town of Glide and about 24 miles east of Roseburg. In 1901 a station was established farther up the north fork, at the mouth of Steamboat Creek. After working here two years the station was moved a couple of miles farther up the stream. In 1907 work was resumed again at the original station near Glide, as winter freshets had seriously damaged the upper station. A permanent station was built in 1910.

Siuslaw River.—In 1893 the State erected a hatchery on Knowles Creek, a tributary of the Siuslaw River, about 20 miles above the mouth of the river. It was turned over to the United States Fish Commission to operate, but no fish came up to the hatchery because the fishermen lower down stretched their nets entirely across the river, In 1897 and 1898 the United States Fish Commission operated a hatchery owned by a Mr. McGuire and located close to Mapleton, about 2 miles below the head of tidewater.

In 1902 the State established an experimental station at the Bailey place, near Meadow post office. In 1907 a permanent station was established by the State on Land Creek fork of the Siuslaw River.

Alsea River.—In 1902 the State established a station on the Willis Vidito place, near the town of Alsea. In 1907 an experimental station was established on this river at the mouth of Rock Creek, about 14 miles above the head of tidewater. In 1910 an experimental station was established between Alsea and tidewater.

Yaquina River.—In 1902 the State established a hatching station on the Big Elk River, a tributary of Yaquina River, about 3 miles above its confluence with the main river. This station was made permanent the next year.

Tillamook Bay.—In 1902 the State established a station on Wilson River, a tributary of Tillamook Bay, and about 8 miles above tidewater. In 1906 the station was removed to the Trask River, a tributary of Tillamook Bay.

DISTRIBUTION.

The following table shows the distribution of fry and fingerlings in the coastal streams of the State by the Government and the State:

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON.

Year ending June 30—	Tillamook Bay and tributaries.			Yaquina River.			Alsea River.		
	Chinook fry.	Silver-side fry.	Steel-head fry.	Chinook fry.	Silver-side fry.	Steel-head fry.	Chinook fry.	Silver-side fry.	Steel head fry.
1898	19,994								
1901				213,500					
1903	251,875			557,700			67,750		
1904	799,300			3,144,380	985,220				
1905				1,407,470	3,009,075	780,500	1,000,000	1,000,000	
1906				816,608	4,178,000	1,033,150	806,938	1,785,351	
1907	312,700	2,648,000		1,919,508	1,955,793	376,215			
1908	2,124,000	1,629,000		2,193,043	909,855		199,700	812,300	
1909		4,896,000	569,690	485,500	1,006,309				
1910	624,800	3,506,990	2,309,770	324,038	28,815				
1911	1,818,245	1,080,000	1,196,000	582,785	2,637,550	621,015	495,950	30,300	
1912	646,300	1,578,131	761,000	148,992	1,554,602	7,145	287,645	997,455	
1913	1,747,530	422,886	848,229	727,567	3,288,650		87,935	424,925	
1914	487,692	1,112,392	660,588						
1915	2,833,428		213,900						
1916	[a]1,982,724	[a]130,130					[a]646,431		
1917	2,143,430	183,800	495,090				1,373,100	1,649,830	1,495,315
1918	1,442,400	534,600					869,370	1,107,483	
1919	705,656	2,097,442	384,370				1,151,720	1,872,473	1,753,104
Total.	17,940,074	19,819,371	7,438,637	12,521,091	19,553,869	2,818,055	6,986,539	9,680,117	3,248,419

[a] All fingerlings.

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON—Continued.

Year ending June 30—	Siuslaw River.			Umpqua River.		Coos Bay and tributaries.		
	Chinook fry.	Silverside fry.	Steelhead fry.	Chinook fry.	Steelhead fry.	Chinook fry.	Silverside fry.	Steelhead fry.
1897	180,000							
1898	440,275							
1899	2,700,000							
1901	213,500			730,000		235,000		
1902	112,000	214,800		1,136,000		2,416,350		
1903	389,239			1,596,213				
1904	822,567			1,399,860		4,079,274		
1905	435,162	311,900		2,654,925		3,877,172		
1906	1,826,531	1,296,732	397,355	4,903,700		2,744,000		
1907	608,949	1,030,486		4,685,900		4,014,400		
1908	729,130	1,127,293		2,378,853		3,000,000		
1909	191,267	1,092,540	98,243	4,093,848		2,084,500	1,032,000	222,000
1910	273,352	25,289		5,686,273		1,683,738		
1911	594,702	20,693	227,580	2,541,236	293,996	2,374,200		
1912	715,758	504,429	72,097	1,053,516		1,767,170	2,317,370	
1913	255,028	627,312	106,717	903,704	181,085	1,281,120	962,528	
1914	1,062,546	476,273	17,735	1,882,985	80,000	1,331,217	2,973,390	
1915	1,472,410		257,850	1,333,171		1,212,805	1,551,645	192,625
1916	[a] 972,395			[a] 1,216,518		[a] 2,236,229	[a] 2,492,217	
1917	984,945	153,662		918,622	65,200	2,370,000	1,089,500	
1918	529,904	147,475		1,402,700		1,208,840	1,193,960	
1919	743,057			3,259,258		1,932,210	2,416,680	
Total	16,252,717	7,028,884	1,177,577	43,777,282	620,281	39,848,225	16,029,290	411,625

Year ending June 30—	Coquille River.		Rogue River and tributaries.			
			Chinook.			
	Chinook fry.	Silverside fry.	Fry.	Yearlings, fingerlings, and adults.	Silverside fry.	Steelhead fry.
1877			50,000			
1898			1,910,045			
1900			2,156,945			
1901	235,000		2,967,058		128,000	65,850
1902			4,750,763		424,530	20,250
1903	3,084,577		3,480,300		680,800	
1904	1,000,000		9,023,428			8,073
1905	2,210,000		4,758,653		1,250,432	531,000
1906	2,978,700		47,500	75,000		12,625
1907	2,840,000		5,880,290		1,375,000	105,300
1908	2,450,000	226,600	6,597,027	170,051	158,000	937,680
1909		1,185,800	771,710		643,000	878,847
1910			1,430,292			89,850
1911	500,000	980,770	1,364,248		501,081	2,592,665
1912	196,855	1,672,850	9,574,340		2,355,885	[b] 1,313,890
1913	496,680	962,528	4,169,150		3,198,346	2,795,075
1914	491,580	1,331,910	3,752,483		[c] 7,832,000	1,376,308
1915	495,333	1,365,815	4,747,623	9,309	2,336,359	[d] 3,908,699
1916	[a] 1,465,321	[a] 1,451,858	2,515,500	2,517,892	[e] 198,103	[f] 3,083,092
1917	1,100,500	674,293	171,500	1,758,800	[g] 399,700	[h] 561,955
1918	1,219,628	1,098,650		900,750	366,500	2,810,700
1919	1,491,210	1,469,440		1,032,950	592,150	807,000
Total	22,255,384	12,420,514	70,118,855	6,464,752	22,439,886	21,898,859

[a] All fingerlings.
[b] Includes 177,790 fingerlings, yearlings, and adults.
[c] Includes 860,903 fingerlings, yearlings, and adults.
[d] Includes 27,258 fingerlings.
[e] Includes 9,153 fingerlings.
[f] Includes 2,583,092 fingerlings; all were planted by U. S. Bureau of Fisheries.
[g] Includes 6,000 fingerlings.
[h] Includes 128,600 fingerlings.

DISTRIBUTION OF SALMON IN THE COASTAL STREAMS OF OREGON—Continued.

Year ending June 30—	Total.				Grand total, all species.
	Chinook.		Silverside fry.	Steelhead fry.	
	Fry.	Yearlings, finger-lings, and adults.			
1877	50,000				50,000
1897	180,000				180,000
1898	2,370,314				2,370,314
1899	2,700,000				2,700,000
1900	2,156,945				2,156,945
1901	4,594,058		128,000	65,850	4,787,908
1902	8,415,113		639,330	20,250	9,074,693
1903	9,427,654		680,800		10,108,454
1904	20,268,809		985,220	8,073	21,262,102
1905	16,343,382		5,571,407	1,311,500	23,226,289
1906	14,123,977	75,000	7,260,083	1,443,130	22,902,190
1907	20,261,747		7,009,279	481,545	27,752,571
1908	19,671,753	170,051	4,863,048	937,680	25,642,532
1909	7,626,825		9,855,649	1,768,780	19,251,254
1910	10,022,493		3,561,094	2,399,620	15,983,207
1911	10,271,366		5,250,394	4,931,256	20,453,016
1912	14,390,576		10,980,722	2,154,132	27,525,430
1913	9,668,714		9,887,175	3,931,106	23,486,995
1914	9,008,503		13,725,965	2,134,631	24,869,099
1915	12,094,770	9,309	5,253,819	4,573,074	21,930,972
1916	2,515,500	11,037,510	4,272,308	3,083,092	20,908,410
1917	9,062,097	1,758,800	4,150,785	2,617,560	17,589,242
1918	6,672,842	900,750	4,448,668	2,810,700	14,832,960
1919	9,283,111	1,032,950	8,448,185	2,944,474	21,708,720
Total	221,180,549	14,984,370	106,971,931	37,616,453	380,753,303

The following tables show separately the total output of the hatcheries in Oregon owned by the United States Bureau of Fisheries and of those owned by the State:

OUTPUT OF HATCHERIES IN OREGON OWNED BY THE U. S. BUREAU OF FISHERIES.

Year ending June 30—	Chinook.			Silverside.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1889		4,500,000				
1890	1,000,000	2,776,475				
1891	700,000	4,901,525				
1892		1,332,400				
1893		4,100,000				
1894		213,000				
1895	23,000					
1896		[a]2,832,150	[b]557,150			
1897		4,922,634				
1898		16,915,512				
1899	27,000	4,300,200				
1900	1,800,000	4,126,367			146,824	
1901	1,100,000	1,669,857	1,668		128,000	
1902	1,866,000	11,587,061			424,530	
1903	4,884,400	5,453,860	250	680,800		
1904	3,113,000	15,270,675				
1905	30,000	9,822,636			1,250,432	
1906	28,200	2,454,371	122,980			300
1907	1,661,390	8,542,104				
1908	2,045,000	7,844,827	627,856		158,000	57,932
1909	3,531,000	5,021,655	2,763		1,799,915	
1910	3,953,992	4,220,197	225			
1911	600,000	5,686,168	200,000		1,659,681	
1912	8,000,000	12,837,840	750,765		2,355,885	
1913	21,491,000	11,291,023			3,198,346	
1914	1,075,000	12,156,818	602,300		8,441,642	27,258
1915	37,000	10,434,517	531,351	76,200	2,373,559	
1916	1,000,000	9,916,900	3,556,161	196,000	488,950	9,153
1917	163,900	634,500	7,364,500		393,700	92,100
1918	3,000	3,843,700	11,284,150		8,000	385,300
1919	20,000		5,325,450			594,350
Total	58,152,882	189,608,972	30,927,569	953,000	22,827,464	1,166,393

[a] All but 17,000 of these were from eggs received from the California stations.
[b] All raised from eggs received from the California stations.

OUTPUT OF HATCHERIES IN OREGON OWNED BY THE U. S. BUREAU OF FISHERIES—Continued.

Year ending June 30—	Steelhead trout.			Total.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1889	....	....	....	....	4,500,000	....
1890	....	....	....	1,000,000	2,776,475	....
1891	....	....	....	700,000	4,901,525	....
1892	....	....	....		1,332,400	....
1893	....	....	....	....	4,100,000	....
1894	....	....	....	....	213,000	....
1895	....	....	....	23,000	....	....
1896	....	....	....	....	2,832,150	557,150
1897	....	....	....	....	4,922,634	....
1898	....	....	....	....	16,915,512	....
1899	159,000	12,125	....	186,000	4,312,325	....
1900	415,000	99,000	....	2,215,000	4,372,191	....
1901	246,000	65,850	25,000	1,346,000	1,863,707	26,668
1902	481,000	20,250	....	2,347,000	12,031,841	....
1903	400,000	262,700	62,033	5,965,200	5,716,560	62,283
1904	....	23,205	11,090	3,113,000	15,293,880	11,090
1905	50,000	534,000	....	80,000	11,607,068	....
1906	10,000	1,294,485	40,383	38,200	3,748,856	163,663
1907	50,000	105,300	....	1,711,390	8,647,404	....
1908	263,725	952,680	....	2,308,725	8,955,507	685,788
1909	51,468	1,374,308	....	3,582,468	8,195,878	2,763
1910	....	2,074,188	....	3,953,992	6,294,385	225
1911	....	2,914,789	....	600,000	10,260,638	200,000
1912	....	2,005,100	294,090	8,000,000	17,198,825	1,044,855
1913	....	2,795,075	....	21,491,000	17,284,444	....
1914	....	2,230,008	....	1,075,000	22,828,468	629,558
1915	752,000	3,254,275	910,652	865,200	16,062,351	1,442,003
1916	450,000	500,000	2,785,805	1,646,000	10,905,850	6,351,119
1917	2,687,600	34,500	467,450	2,851,500	1,062,700	7,924,050
1918	750,000	....	3,372,165	753,000	3,851,700	15,041,615
1919	525,000	....	843,000	545,000	....	6,762,800
Total	7,290,793	20,551,838	8,811,668	66,396,675	232,988,274	40,905,630

OUTPUT OF HATCHERIES OWNED BY THE STATE OF OREGON.

Year	Chinook fry.	Silverside fry.	Steelhead trout fry.	Soekeye fry.	Total
1877	50,000	....	....	....	50,000
1878	79,620	....	....	....	79,620
1879	1,876,500	....	....	....	1,876,500
1880	1,834,290	....	....	....	1,834,290
1881	2,554,290	....	....	....	2,554,290
1888	1,300,000	....	....	....	1,300,000
1889	4,500,000	....	....	....	4,500,000
1890	990,000	....	....	....	990,000
1891	[a] 792,000	....	....	....	792,000
1895	2,500,000	....	....	....	2,500,000
1896	2,500,000	....	....	....	2,500,000
1899	2,700,000	....	....	....	2,700,000
1900	2,500,000	....	200,000	....	2,700,000
1901	7,562,000	....	245,000	....	7,807,000
1902	11,220,550	7,957,000	256,327	....	19,433,877
1903	18,502,072	3,288,600	300,850	....	22,091,522
1904	[b]48,730,791	3,974,185	143,849	....	52,848,825
1905	16,393,249	5,509,085	1,495,735	....	23,398,069
1906	[c]27,404,596	7,503,655	1,859,696	....	36,767,947
1907	[d]25,156,732	6,446,628	376,245	....	31,979,605
1908	[e]21,209,394	5,359,709	....	....	26,569,103
1909	[f]20,108,990	9,212,649	1,403,129	....	30,724,768

[a] Eggs from which hatched obtained from U. S. Bureau of Fisheries.
[b] 6,826,540 eggs obtained from U. S. Bureau of Fisheries.
[c] 7,714,000 eggs obtained from U. S. Bureau of Fisheries.
[d] 3,550,000 eggs obtained from U. S. Bureau of Fisheries.
[e] 3,020,000 eggs obtained from U. S. Bureau of Fisheries.
[f] 6,581,000 eggs obtained from U. S. Bureau of Fisheries.

OUTPUT OF HATCHERIES OWNED BY THE STATE OF OREGON—Continued.

Year.	Chinook fry.	Silverside fry.	Steelhead trout fry.	Sockeye fry.	Total.
1910	[a]24,169,365	3,631,827	2,364,120	....	30,165,312
1911	[b]19,762,229	4,749,319	4,018,598	[c]1,488,327	30,018,473
1912	[d]18,077,971	9,580,497	1,358,742	[e]1,957,825	30,975,035
1913	[e]26,623,268	9,879,666	1,136,031	[f]1,937,134	39,576,099
1914	[g]21,945,746	5,893,965	758,233	[e]1,978,140	30,576,084
1915	[h]27,532,168	2,917,460	4,793,208	....	35,242,836
1916	[i]27,120,254	[j]4,215,705	3,180,709	[k]2,399,000	[l]36,915,668
1917	27,615,600	4,183,000	4,804,743	[e]1,526,024	[l]38,129,367
1918	28,169,125	4,556,207	1,633,580	[k]2,731,823	[l]37,030,735
1919	33,732 431	9,140,769	4,004,754	[m]3,199,800	[l]50,077,754
Total	475,153,231	107,999,926	34,333,549	17,218,073	634,704,779

[a] 6,465,300 eggs obtained from U. S. Bureau of Fisheries.
[b] 3,950,000 eggs obtained from U. S. Bureau of Fisheries.
[c] 1,500,000 eggs obtained from U. S. Bureau of Fisheries.
[d] 8,000,000 eggs obtained from U. S. Bureau of Fisheries.
[e] 2,000,000 eggs obtained from U. S. Bureau of Fisheries.
[f] 2,491,000 eggs obtained from U. S. Bureau of Fisheries.
[g] 1,000,000 eggs obtained from U. S. Bureau of Fisheries.
[h] Eggs from which hatched obtained from U. S. Bureau of Fisheries.
[i] All but 490,000 were fingerlings.
[j] All but 41,500 were fingerlings.
[k] 3,000,000 eggs obtained from U. S. Bureau of Fisheries.
[l] Most of the output comprised of fish 4 to 9 months old.
[m] 3,174,800 from eggs obtained from Alaska, and 25,000 from dwarf sockeye eggs obtained from Montana.

COLUMBIA RIVER AND TRIBUTARIES.

The first fish-cultural work upon the Columbia River and in Oregon was at Clackamas, on the Clackanas River, a tributary of the Willamette River, which empties into the Columbia River about 180 miles from its mouth.

This hatchery was built in 1876 by the Oregon & Washington Fish Propagating Co., which operated it until 1880. In 1887 the State provided for and there was appointed a State fish commission. Almost the first work of the commission was to spend $12,000 appropriated by the legislature to put in repair and operate this hatchery. On July 1, 1888, it was informally turned over to the United States Commission of Fish and Fisheries, which paid over the purchase price, took formal possession in the following winter, and has operated it ever since, with the exception of several years when the building of dams stopped the progress of salmon to the hatchery. During this period a temporary station for the collection of eggs was established on Sandy River, about 15 miles away, and on Salmon River, a tributary of Sandy River, both tributaries of the Columbia River. Some eggs were also brought in from the California hatcheries and hatched at the Clackamas station. In 1901 the hatchery was moved about 4 miles down the river and has since been operated as both a rearing and a collecting station. In 1901 the State established another hatchery on the Clackamas River about 30 miles below the main station and between the north and south forks. In 1904 all were turned over to the United States. In 1915 the hatchery was moved again. In 1907 an experimental station for the collection of eggs of the early variety of chinook salmon was established by the State of Oregon on the Clackamas River below the Portland Railway, Light & Power Co.'s dam at Cazadero, but this was later operated by the United States Bureau of Fisheries. The building of a dam having cut off this station, another was established in 1913 at a point 30 miles distant from Portland.

In 1889 the State established a hatchery in the cannery of F. M. Warren, at Warrendale, in Multnomah County, on the Columbia River, which was operated in that year and in 1890.

In 1895 some of the Oregon salmon packers combined and organized the Columbia River Packers' Propagating Co., which established a hatchery on the upper Clackamas River at the junction of the Warm Springs and the Clackamas and operated it in 1895 and 1896. The Government operated it in 1897 and 1898, after which it was turned over to the State and moved to the opposite side of the river.

In 1898 the collection of steelhead-trout eggs was first undertaken on the northwest coast by the State of Oregon on Salmon River, a tributary of the Columbia River, and met with fair success. In March, 1899, the Government sent a party to the falls of the Willamette River, near Oregon City, to collect steelhead eggs, and also operated for this purpose at its substation on the Salmon River, but the latter effort met with failure, as the rack was washed away. This station was turned over to the State on June 15, 1899.

In 1901 the State of Oregon did some experimental work at Swan Falls, on Snake River, the boundary for a considerable distance between Oregon and Idaho. During the winter and early spring of 1902 the State also worked Tucannon River, which is a tributary of Snake River, for steelhead, but met with poor success. Snake River was worked again in 1902 at the foot of Morton Island, which is situated 2 miles above Ontario, in Malheur County. Title to the necessary property was secured from the War Department in 1903 and permanent buildings were erected. It was closed for some years and finally abandoned in 1911.

In 1901 the State of Oregon established an experimental hatchery in Wallowa County, on the Grande Ronde River, at the mouth of a small tributary called the Wenaha River, which enters the main stream about 50 miles from its mouth. A permanent station was established in the canyon about 1½ miles below the Wallowa bridge on the Wallowa River, a tributary of the Grande Ronde River, in 1903.

In 1902 the State of Oregon erected a permanent plant on Salmon River at its junction with Boulder Creek. This plant was closed in 1911.

In the same year the State established an experimental station on the McKenzie River, a tributary of the Willamette River, about one-half mile above Vida post office. This experimental work was resumed in 1905 at a point 2 miles below Gate Creek. The hatchery was permanently established at a spot about 30 miles from Eugene and near the town of Leaburg a year or two later.

In 1903 a hatchery was built by the State of Oregon on the Snake River near the town of Ontario, in eastern Oregon.

In 1906 an experimental station was established by the State on Breitenbush Creek, a short distance above its junction with the Santiam River, a tributary of the Willamette River, but the plant was destroyed, very shortly after its establishment, by a forest fire. An experimental station was reestablished here in 1909, but a heavy freshet raised the river so high that the penned fish escaped around the rack.

In 1909 the State of Oregon built at Bonneville, on Tanner Creek, a tributary of the Columbia River, a large central hatchery capable of handling 60,000,000 eggs, it being the intention of the State to hatch at this plant the eggs collected at other stations.

In the same year a temporary hatchery was located on the Santiam River by the State of Oregon.

During 1910 the State of Oregon received 1,500,000 red salmon eggs from the Yes Bay (Alaska) hatchery of the United States Bureau of Fisheries, and yearly since they have received a consignment from the same source, as will be noted in the statistical tables. These were hatched out in the Bonneville hatchery and planted in the Columbia River.

The State of Oregon built a hatchery on the Klaskanine River, a tributary of Youngs River, near Olney, in Clatsop County, in 1911. In the same year an eyeing station for spring chinooks was opened by the State on the Willamette River, near Lowell.

The first entrance of Washington (then a Territory) into fish-cultural operations was in 1879, when the State fish commissioner paid the Oregon & Washington Fish Propagating Co., which was operating the hatchery on the Clackamas River, $2,000 for salmon fry deposited in that river. In 1893 the State legislature established a hatchery fund which was to be supplied by licenses from certain lines of the fishery business. In 1895 its first hatchery in the Columbia River Basin was built on the Kalama River, about 4 miles distant from its junction with the Columbia, and in Cowlitz County. Shortly after this hatchery was built it was discovered that it was above where the salmon spawned, and a second hatchery was built 1¼ miles below the first named, as the rugged mountainous character of the country made transportation between the two sites difficult. Of recent years a road has been constructed along the river bank, and it is probable that the upper buildings will be abandoned entirely.

Another station for the collection and eyeing of eggs was established on the Chinook River, a small stream which empties into Baker Bay near the mouth of the Columbia.

During the fiscal year 1897 the United States Fish Commission established a station on Little White Salmon River, a stream which empties into the Columbia, on the Washington side, about 14 miles above the Cascades. During the fiscal year 1901 an auxiliary station was operated on Big White Salmon River, while fishing was carried on in Eagle and Tanner Creeks, in Oregon, the eggs obtained from these creeks being brought to the Little White Salmon hatchery.

In 1899 the State of Washington built and operated hatcheries on the Wenatchee River, a tributary of the Columbia River, about 1½ miles from Chiwaukum Station on the Great Northern Railway, and on Wind River, a tributary of the Columbia, about 1 mile from the junction.

In 1900 Washington State hatcheries were established in the Columbia River Basin as follows: White River hatchery, which was built on Coos Creek, which empties into a tributary of the White River, the location being about 2½ miles from where the Green River joins the White River; Methow River hatchery, built on the Methow River at the point where it is joined by the Twisp, about 22 miles from the Columbia River; Colville River hatchery, built on the north bank of Colville River, about 1½ miles from its mouth, and about 1 mile from Kettle Falls; Klickitat River hatchery, located on the east bank of the Klickitat River, about 6 miles from its mouth; and one on the Little Spokane River, about 10 miles from its mouth and about 9 miles north of the city of Spokane. The Klickitat River hatchery never was operated, while most of the others were operated intermittently.

In 1906 a hatchery was established by the State of Washington on the Lewis River, some distance above the town of Woodland. In 1919 this hatchery was operated by the United States Bureau of Fisheries.

In 1909 the State of Washington established a hatchery near Pateros, on the Methow River, a tributary of the Columbia River, and on the Tilton.

In 1915 Clarke County, Wash., built a hatchery on the east side of Cold Creek, about 2 miles from the town of Vancouver.

A temporary station was established by the State of Washington on Wenatchee Lake, near Leavenworth, in 1915.

The following table shows the plants of salmon and steelhead trout in the Columbia River and its tributaries by the Bureau of Fisheries and the States of Oregon and Washington:

PLANTS OF SALMON IN THE COLUMBIA RIVER AND TRIBUTARIES SINCE 1877.

Year ending June 30—	Sockeye.		Chinook.		Silverside.	
	Fry.	Yearlings, fingerlings, and adults.	Fry.	Yearlings, fingerlings, and adults.	Fry.	Yearlings, fingerlings, and adults.
1877			300,000			
1878			79,620			
1879			3,076,500			
1880			1,834,290			
1881			2,554,290			
1888			1,300,000			
1889			4,500,000			
1890			3,756,475			
1891			5,694,000			
1892			1,332,400			
1893			4,100,000			
1894			213,000			
1895			[a]2,523,000			
1896			9,832,150	557,150		
1897			10,641,394			
1898			26,212,074			
1899			19,979,241			
1900			22,510,869		7,175,824	
1901			24,977,310	1,668	5,559,750	
1902			44,328,085		17,545,724	
1903			40,174,313		8,721,720	
1904			71,694,587		8,422,085	
1905			17,107,217		1,354,610	
1906			[b]36,324,805	47,980	828,472	300
1907			23,171,235		2,657,349	
1908			32,856,262	1,995,746	1,705,543	
1909			33,081,994	16,949	2,439,415	
1910			37,743,777	225	3,374,733	
1911	1,488,327		28,791,095	11,700	[c]1,308,900	
1912	1,957,825		49,335,065	1,405,860	1,243,660	
1913	1,937,134		70,211,177		4,591,500	
1914	1,978,140		[d]81,995,039	1,732,805	636,900	
1915			81,504,641	812,801	608,747	
1916	4,478,362	1,526,024	85,657,635	8,686,789	873,882	
1917	1,526,024		47,187,410	9,922,869	1,381,915	86,100
1918	2,731,823		64,929,898	10,383,400	3,763,832	18,800
1919	3,199,800	939,960	22,571,500	46,382,420	4,205,864	2,200
Total	19,297,435	2,465,984	1,014,082,348	81,958,362	78,400,425	107,400

[a] Includes 23,000 eggs
[b] Includes 48,200 eggs.
[c] Includes 100,000 eggs.
[d] Includes 1,000,000 eggs.

PLANTS OF SALMON IN THE COLUMBIA RIVER AND TRIBUTARIES SINCE 1877—Contd.

Year ending June 30—	Steelhead trout.		Chum.		Total.	
	Fry.	Yearlings, fingerlings, and adults.	Fry.	Yearlings, fingerlings, and adults.	Fry.	Yearlings, fingerlings, and adults.
1877	....	....	....	....	300,000	....
1878	....	....	....	....	79,620	....
1879	....	....	....	....	3,076,500	....
1880	....	....	....	....	1,834,290	....
1881	....	....	....	....	2,554,290	....
1888	....	....	....	....	1,300,000	....
1889	....	....	....	....	4,500,000	....
1890	....	....	....	....	3,756,475	....
1891	....	....	....	....	5,694,000	....
1892	....	....	....	....	1,332,499	....
1893	....	....	....	....	4,100,000	....
1894	....	....	....	....	213,000	....
1895	....	....	....	....	2,523,000	....
1896	....	....	....	....	9,832,150	557,150
1897	....	....	....	....	10,641,394	....
1898	....	....	....	....	26,212,074	....
1899	8,625	....	....	....	19,987,866	....
1900	299,000	....	....	....	29,985,693	....
1901	245,000	....	....	....	30,782,060	1,668
1902	256,327	....	....	....	62,130,136	....
1903	563,550	37,033	....	....	49,459,583	37,033
1904	158,981	....	....	....	80,275,653	....
1905	[a]768,235	....	....	....	19,230,062	....
1906	[b]1,745,111	21,383	....	....	38,898,388	72,663
1907	26,640	....	....	....	25,855,224	....
1908	15,000	....	....	....	34,576,805	1,995,746
1909	[a]1,058,657	....	....	....	36,580,066	16,949
1910	[c]2,063,688	....	....	....	43,182,198	225
1911	1,982,331	....	420,730	....	33,991,383	11,700
1912	1,387,500	116,300	106,020	....	54,030,070	1,522,160
1913	40,000	....	105,800	....	76,885,611	....
1914	[d]932,700	....	591,638	....	86,134,417	1,732,805
1915	4,128,833	....	8,299,572	....	94,541,793	812,801
1916	1,459,067	6,000	16,448,199	....	108,917,145	10,218,813
1917	4,074,330	338,850	5,332,125	248,050	59,501,804	10,595,869
1918	4,274,330	....	8,881,640	....	84,581,523	10,402,200
1919	4,663,820	135,500	210,600	460,800	34,851,584	47,920,880
Total	30,151,725	658,066	40,396,324	708,850	1,182,328,257	85,898,662

[a] Includes 50,000 eggs.
[b] Includes 58,000 eggs
[c] Includes 25,000 eggs.
[d] Includes 79,000 eggs.

WASHINGTON.

Willapa River.—In 1899 Washington established a hatchery on Trap Creek, a tributary of the Willapa River, situated about 200 yards from the creek's mouth.

In 1916 local residents along the North River, a tributary of Willapa Harbor, contributed the funds to build a salmon hatchery, and this was constructed and put into operation the same year.

In 1917 a salmon hatchery was built and put into operation at Raymond. It is designated as Willapa Hatchery No. 2.

In 1918 some fishermen and public-spirited citizens of this section contributed the money for the building of a State hatchery on the Nasel River, a tributary of Willapa Harbor.

Chehalis River.—The construction of a hatchery on the Chehalis River, about 4 miles above the city of Montesano, was begun by the State in October, 1897, but owing to bad weather and extreme high water was not completed until late in 1898. The hatchery was a failure until 1902 when a fair season was had, as was again true in 1903. It was not operated in 1904. Since the State began taking eggs from the Satsop River, a tributary of the Chehalis, it has been possible to fill the hatchery each season.

In 1909 the site where eggs had been gathered on the Satsop River was purchased, and a new hatchery was erected there. It has three concrete rearing ponds and is fully equipped for the taking of spawn and the hatching out and caring for 5,000,000 fry. This plant was first operated in the fall of 1909.

Work was begun in September, 1914, by the United States Bureau of Fisheries on a hatching station on Lake Quinault, Wash., and a take of eggs was made the same year.

In lieu of installing fishways in their dams in the Humptulips River and tributaries, in the Grays Harbor section, two timber firms agreed to furnish the money needed to build a hatchery on Stevens Creek, west of Humptulips, and the same was constructed and put into operation in October of 1914. The plant is now the property of the State.

In 1917 a hatchery was built by the State on Chehalis River near Dryad, with money contributed by two lumber companies in lieu of building fishway over a dam.

Puget Sound and tributaries.—In 1896 the State established a hatchery on Baker Lake, which is the head of Baker River, a tributary of the Skagit River, and this was the first establishment for the hatching of sockeye salmon. In July, 1899, it was sold to the United States Fish Commission. In 1901 steelhead trout eggs were collected on Phinney Creek, about 5 miles from the town of Birdsview, and some 30 miles from Baker Lake. In 1901 an auxiliary station was opened at Birdsview, on Skagit River, and steelhead trout eggs were collected on Phinney and Grandy Creeks and brought to Baker Lake to be hatched.

In 1898 a private hatchery (the necessary money being raised by subscription among the residents of Fairhaven, now Bellingham, and vicinity) was built near Lake Samish, a few miles from Fairhaven.

In 1899 a hatchery was built by the State on Kendall Creek, a tributary of the Nooksack River, about 300 yards from same, and about 2 miles from the railway station of Kendall. Except in 1903, this hatchery has since been operated continuously. An eyeing station was built in 1907 on the south fork of the Nooksack River, about 1 mile from Acme. This hatchery is now used as a reserve station.

In the same year the State built a hatchery on the Skokomish River, about 4 miles from its mouth. An eyeing station was also erected on the north fork of the same river. The main station was not operated in 1904 and only on a small scale in 1903 and 1905.

The State in 1889 built a hatchery on Friday Creek, a tributary of the Samish River, situated about 1 mile from the mouth of the creek.

The following State hatcheries were first operated in 1900: Snohomish hatchery, built on the west bank of Skykomish River, a few miles from its mouth; Nisqually River hatchery, built on Muck Creek, about one-half mile fron the Nisqually River, and about 4 miles from the town of Roy, in Pierce County; and the Stillaguamish hatchery, located on the Stillaguamish River, about 4 miles from the town of Arlington, in Snohomish County. The latter has since been moved to Jim Creek, a tributary of the south branch of the Stillaguamish River. It is merely used as an eyeing station now.

The Startup hatchery, located near Startup, on the Skykomish River, was formerly used as a collecting station for the Snohomish hatchery. It is still used for this purpose, but also retains and hatches a considerable quantity of spawn. The station is about 4 miles from the Snohomish hatchery. In 1918 it was rebuilt and now bears the name of Skykomish hatchery

In 1900 the State established a fisheries experimental station at Keyport Landing, on the east arm of Port Orchard Bay, with Pearson as the nearest post office. The work of the station was devoted to salmon and oysters until it was abandoned a few years later.

The State established a hatchery on the Dungeness River, about 7 miles from the town of Dungeness, in Clallam County, in 1901. In 1906 it constructed a hatchery on a small tributary of the Skagit River, between Hamilton and Lyman. This was destroyed in 1917 by floods. The station built on Sauk River, a tributary of the Skagit, has been operated only occasionally since the Skagit hatchery was built.

The White River hatchery was constructed on Suice Creek, a tributary of Green River, some years ago. During the summer of 1909 a new hatchery was built at this station, the old one being too small to accommodate the amount of spawn that could be taken. The new hatchery is located on the east side of Suice Creek near the county road. The building contains 140 hatching troughs. The plant has a pond system, where the fry are kept and fed until they are able to shift for themselves.

During the summer of 1911 the city of Tacoma constructed a large concrete dam in the Green River, about 4 miles west of Eagle Gorge. As this dam prevented the salmon from reaching the spawning beds, the State established an eyeing station the same year just below the dam. In 1913 the name was changed to Green River hatchery, to conform to the name of the main stream.

In 1912 the United States Bureau of Fisheries completed the Quilcene and Duckabush hatcheries. Both are on small tributaries entering the west side of Hoods Canal, an arm of Puget Sound.

In 1913 a new station was operated by the Bureau on the Dusewallips River, a tributary of Hoods Canal, Puget Sound, near Brinnon. Two new field stations—on Elwell River, a tributary of the Skykomish River, near Sultan, and on Sauk River, a tributary of the Skagit River, near Darrington—were also put into operation the same year. The Sauk River had been worked by the State at one time.

In 1913 the Middle Fork Nooksak eyeing station was transformed into a hatchery. In the same year the eyeing station on the south fork was moved farther up the river.

In 1914 stations were established by the United States Bureau of Fisheries on Day Creek and Illabot Creek, tributaries of the Skagit River, while a substation was opened on Hamahama River at Eldon, distant about 9 miles up Hood Canal from the mouth of the Duckabush River.

On May 23, 1914, the Baker Lake hatchery building was destroyed by fire. In addition to the building and equipment, 1,305,820 silver fry and 823,097 sockeye fry were destroyed. The station was rebuilt but was burned down again in 1919. It has since been rebuilt.

In 1915 the State built a hatchery on the Pilchuck River, a tributary of the Skykomish River, near Granite Falls.

In lieu of building a fishway in its dam on the Elwha River, near Port Angeles, the Olympic Power Co. furnished the funds needed to build a hatchery below the dam, and this was opened by the State in 1915.

In 1916 the city of Tacoma furnished funds to build a hatchery in lieu of a fish ladder over the Nisqually power plant dam, and the hatchery was constructed by the State at Chambers Prairie and opened in 1916. It is known as the Chambers Creek hatchery.

In 1917 a new hatchery was established by the State at Orting, on the Puyallup River, while in 1918 an eyeing station was established at Tahuya, on Hoods Canal, near the Skokomish hatchery.

In 1919 the Nisqually hatchery was destroyed by floods.

The following tables show the total output of the salmon hatcheries in the State of Washington owned by the United States Bureau of Fisheries and the hatcheries owned by the State itself:

OUTPUT OF THE SALMON HATCHERIES IN WASHINGTON OWNED BY THE U. S. BUREAU OF FISHERIES.

Year ending June 30—	Chinook.			Sockeye, or blueback.			Silver, or coho.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1897		1,848,760							
1898		7,391,886							
1899	4,926,000	1,791,056							
1900	2,686,000	6,626,947			10,683,000				
1901	6,581,000	5,427,680			3,834,453			174,041	
1902		15,637,687			3,371,000				
1903		16,774,030			3,731,789			81,812	
1904	7,506,000	17,386,183			3,855,000			3,984,645	
1905		4,236,276			7,819,281	10,000	107,000	8,071,081	
1906	7,714,000	14,846,905		880,000	3,285,130	9,500	239,180	6,445,574	
1907	3,550,000	6,512,738			4,224,255		760,000	3,636,952	
1908	1,485,000	12,372,503	1,537,941	75,000	8,514,305		296,000	13,262,714	
1909	3,650,000	11,565,553	14,186	100,000	5,430,626		272,000	7,661,110	
1910	3,813,250	9,175,610			4,554,825		275,000	10,888,025	
1911	3,350,000	7,307,455	11,700		5,496,000		102,000	4,550,615	
1912	8,020,000	10,959,728	655,095		4,692,573		52,000	10,599,939	
1913	19,713,000	19,933,300			5,751,700		102,000	10,754,617	
1914	4,584,000	31,140,440	1,130,505	50,000	2,583,469	120,000		13,591,354	
1915	4,998,000	38,162,139	987,495	155,000	10,820,441	46,575	35,000	20,673,056	41,500
1916		38,012,864	7,488,270		15,737,420	2,666,308	2,500	5,466,334	1,460,354
1917		14,969,904	5,865,226		11,861,825	2,145,953		3,960,000	4,559,860
1918	3,150,000	2,185,218	41,202,694		3,625,000	12,705,285		972,300	10,118,815
1919	960,000	389,002	18,474,900		1,000,000	15,799,960		7,544,020	697,380
Total	86,686,250	294,653,864	77,368,012	1,260,000	120,872,092	33,503,581	2,242,680	132,318,189	16,877,909

OUTPUT OF THE SALMON HATCHERIES IN WASHINGTON OWNED BY THE U. S. BUREAU OF FISHERIES—Continued.

Year ending June 30—	Humpback.			Steelhead trout.		
	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1900					26,000	
1902					110,000	
1903				80,000	440,000	223,815
1904		176,597		255,000	70,000	
1905				411,400	3,205	
1906	2,000	969,990		348,000	540,000	
1907				200,000	941,505	
1908	502,000	6,764,762		221,000	136,916	
1909				220,000	717,691	
1910		1,368,000		300,000	1,437,038	
1911		96,000		660,000	911,650	
1912		2,566,325		905,000	2,284,315	
1913		1,880		1,330,000	1,477,150	
1914	13,260,000	21,114,023	4,355	729,000	1,792,430	
1915		6,929,500		125,000	2,008,698	137,665
1916	7,000,000	6,106,400	2,915,000	1,040,000	341,600	891,000
1917		165,000	7,449,030	550,000	1,979,010	1,424,000
1918		2,132,831	3,736,000	320,000	103,000	3,482,620
1919		2,354,500	369,958	250,000		305,000
Total	20,764,000	50,745,808	14,474,343	7,950,100	15,320,208	6,464,100

Year ending June 30—	Chum.		Total.		
	Fry.	Fingerlings, yearlings, and adults.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
1897				1,848,760	
1898				7,391,886	
1899			4,926,000	1,791,056	
1900			2,686,000	17,335,947	
1901			6,581,000	9,435,171	
1902				19,118,687	
1903			80,000	21,027,631	223,815
1904			7,761,000	25,472,425	
1905			521,400	20,129,843	10,000
1906			9,183,180	26,087,599	9,500
1907			1,510,000	15,315,450	
1908			2,582,000	41,051,200	1,537,941
1909			1,242,000	25,374,980	14,186
1910			4,388,250	27,423,198	
1911	69,000		4,112,000	18,430,720	11,700
1912	2,495,000		8,977,000	33,597,880	655,095
1913	19,479,000		21,145,000	57,397,647	
1914	8,672,735		18,623,000	78,894,451	1,254,860
1915	35,504,707		5,313,000	111,098,541	1,213,235
1916	21,500,944	1,000,000	8,042,500	87,165,562	16,420,932
1917	14,403,300	7,014,580	550,000	47,339,039	28,458,649
1918	9,892,145		3,470,000	18,910,494	71,245,414
1919	4,544,000	4,524,560	1,210,000	15,831,522	40,171,758
Total	116,560,831	12,539,140	118,903,330	730,470,992	161,227,085

OUTPUT OF THE SALMON HATCHERIES OWNED BY THE STATE OF WASHINGTON.[a]

Year ending June 30—	Chinook fry.	Chum fry.	Humpback fry.	Silver, or coho, fry.	Sockeye, or blueback, fry.	Steelhead-trout fry.	Total.
1896	4,500,000						4,500,000
1897	4,050,000				5,500,000		9,550,000
1898	4,275,000				5,400,000		9,675,000
1899	8,595,000			189,000			8,784,000
1900	12,251,600	10,301,760		13,778,280		1,736,560	38,068,200
1901	12,275,400	16,478,280		19,747,894		1,398,476	49,900,050
1902	14,766,822	9,937,390		32,964,593		2,481,371	60,150,176
1903	14,283,499	9,937,390		28,659,079		3,134,076	56,014,044
1904	13,261,184		295,200	15,725,196		3,868,866	33,150,446
1905	7,101,180			12,226,294		2,433,635	21,761,109
1906	10,943,550	3,268,800		28,906,380		2,769,784	45,888,514
1907	8,897,670	6,120,000		28,668,600		3,575,943	47,262,213
1908	18,647,600	4,342,350	2,655,900	29,273,202		4,578,075	59,497,127
1909	17,440,950	8,218,000		24,543,200		4,080,450	54,282,600
1910	21,168,350	8,607,500	519,600	30,894,100		4,855,000	66,044,550
1911	16,458,502	13,326,750		33,097,750		5,163,180	68,046,182
1912	23,380,516	4,684,950	370,785	37,164,125		4,832,067	70,432,443
1913	30,542,928	14,711,400		50,263,290		9,089,250	104,606,868
1914	35,529,709	7,842,266	1,532,737	33,494,380	49,792	3,601,514	82,050,398
1915 [b]	[c]39,784,092	27,458,665	578,504	60,169,474	62,631	3,457,130	131,510,496
1916 [d]	48,239,092	41,890,354	5,902,227	38,877,396	607,979	9,984,852	145,501,900
1917 [e]	34,228,979	15,086,648		5,842,775	808,455		55,966,857
1918 [f]	83,175,074	71,750,001	6,086,256	45,660,603	[g]6,571,770	10,250,532	223,494,236
1919 [f]	45,773,506	22,228,025		16,220,087	645,520	7,993,452	92,860,590
Total	529,570,203	296,190,529	17,941,209	586,365,698	19,646,147	89,284,213	1,538,997,999

[a] As the printed reports of the State before 1913 in many instances report as the output the number of eggs gathered, it has been necessary in such cases to make an arbitrary reduction from these figures, in order to allow for the loss in the egg stage. In addition to figures in table, in 1916, 13,424,362; in 1918, 6,745,823; and in 1919, 12,351,780 dwarf sockeyes were hatched and planted in waters of the State.
[b] A considerable proportion of the fry was fed in rearing ponds for some time before planting.
[c] 29,900 eggs were distributed in addition.
[d] Year ends Nov. 30, 1916.
[e] Period from Nov. 30, 1916, to Mar. 31, 1917.
[f] Year ending Mar. 31.
[g] In addition 6.000,000 eggs were furnished by the U. S. Bureau of Fisheries.

The following table shows the plantings made in waters of Washington other than the Columbia River by the United States Bureau of Fisheries and the State of Washington:

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER.

Year ending June 30—	Puget Sound and tributaries.					
	Chinook.		Sockeye.		Silver, or coho.	
	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.
1897			5,500,000			
1898			5,400,000			
1899	7,470,000				189,000	
1900			10,683,000		6,749,280	
1901	300,000		3,834,453		14,360,185	
1902	2,141,322		3,371,000		23,161,069	
1903	2,113,850		3,731,789		21,507,771	
1904	1,865,933		3,855,000		14,071,845	
1905	2,590,738				16,441,375	
1906	4,819,290		3,573,130	9,500	29,755,574	14,840
1907	3,907,598				26,960,552	
1908	8,356,709		8,514,305		37,613,466	
1909	9,647,288		5,430,626		28,622,310	
1910	11,681,060		4,554,825		36,837,125	
1911	4,984,482		5,496,000		29,941,865	
1912	4,646,254		4,692,573		39,788,614	
1913	7,561,328		5,751,700		56,128,207	
1914	7,392,826		[a]2,683,261	[b]120,000	42,213,911	
1915	15,222,734		7,371,056		74,505,147	
1916	22,022,439	802,795	1,897,420	520	42,696,932	1,455,190
1917	26,890,383	750,612	1,520,280	2,093,000	6,227,775	4,560,160
1918	35,318,366	411,060	7,696,750	9,319,275	29,249,710	6,845,115
1919	22,244,102	195,900	645,520	8,622,000	12,285,222	2,864,980
Total	201,176,702	2,160,367	96,202,688	20,164,295	589,306,935	15,740,885

[a] Includes 50,000 eggs.
[b] All fingerlings.

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER—Continued.

Year ending June 30—	Puget Sound and tributaries.					
	Humpback.		Chum.		Steelhead.	
	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.
1900			10,301,760		1,572,560	
1901			16,478,280		1,398,476	
1902			9,937,390		2,591,371	
1903			9,937,390		3,107,891	218,200
1904	471,797				3,518,476	
1905					[a] 1,329,940	
1906	969,990		1,800,000		3,162,174	15,000
1907	4,224,255		5,220,000		3,964,308	
1908	9,420,662		2,278,350		4,566,491	
1909			6,048,000		[b] 4,499,141	
1910	1,887,600		7,748,500		6,292,338	
1911	96,000		12,074,060		4,841,330	
1912	5,432,110		3,526,170		[c] 6,732,805	1,000
1913	1,888		31,408,960		9,731,400	
1914	22,647,060	[d] 4,355	15,535,046		4,444,271	
1915	7,508,004		51,852,050		4,925,555	
1916	12,005,627	2,918,000	41,541,949	1,000,000	5,102,566	891,000
1917	165,000	7,449,030	12,955,800	6,766,530	1,979,010	1,420,500
1918	8,219,086	4,736,000	52,674,752		4,851,092	3,520,420
1919	2,354,000	369,958	21,480,325	4,063,760	3,152,452	
Total	75,403,079	15,477,343	312,798,782	11,830,290	81,763,647	6,066,120

Year ending June 30—	Quinault Lake and River.						
	Chinook.		Sockeye.		Silverside.		Steelhead fry.
	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.	Fry.	Yearlings, fingerlings, or adults.	
1915	19,913		3,558,591		198,966		10,598
1916	29,600	4,810	13,840,000	2,665,788	96,650	4,864	
1917	160,000		11,150,000	52,953	1,910,000		
1918	220,000		2,500,000	3,386,010	200,000	3,303,700	
1919	100,000	109,400	1,000,000	4,738,000	600,000	419,400	
Total	529,513	114,210	32,048,591	10,842,751	3,005,616	3,727,964	10,598

Year ending June 30—	Chehalis River.				Willapa River.			
	Chinook.	Silver, or coho.	Chum.	Steelhead.	Chinook.	Silver, or coho.	Chum.	Steelhead.
1899	1,215,000							
1900	2,355,300				881,000			190,000
1901	1,909,800				653,400			
1903					2,163,019	1,800,000		500,000
1904	900,000				819,504	204,876		420,390
1905					630,000	1,800,000		288,000
1906		2,563,380	1,468,800		529,650	2,160,000		171,550
1907		2,250,000	900,000		393,660	2,250,000		526,500
1908	163,000	3,275,000	2,064,000		678,600	651,500		148,500
1909	148,000	1,800,000	1,757,000		322,200	504,000		399,000
1910	403,000	1,577,000	859,000		455,200	64,000		
1911	111,150	4,041,900	900,960	937,500	734,350	2,457,900		300,000
1912	118,750	3,575,700	1,052,760	93,752	748,600	3,111,750		303,825
1913	119,700	1,690,200	3,177,680	412,500	729,600	1,386,000		382,500
1914	139,000	2,977,260	497,300	701,118	3,247,345	1,785,580		248,555
1915	73,337	4,790,474	1,230,000	551,302	302,461	581,730	1,581,750	105,410
1916	854,170	6,811,315	4,218,930	638,733	2,570,105	108,550	1,181,720	
1917	495,350	120,000	2,590,000		2,178,185	595,000		
1918	2,978,288	12,275,990	17,725,949	967,975	5,411,725	1,809,901	2,359,805	771,600
1919	279,200	6,017,655	4,763,000	1,847,400	1,460,206	372,500	318,100	197,060
Total	12,263,045	53,765,874	43,205,379	6,150,280	24,908,810	21,646,287	5,441,375	4,952,920

[a] Includes 14,400 eggs.
[b] Includes 100,000 eggs.
[c] Includes 25,000 eggs.
[d] All fingerlings.

PLANTS OF SALMON IN THE WATERS OF WASHINGTON OTHER THAN THE COLUMBIA RIVER—Continued.

Year ending June 30—	Total by species.						Grand total.
	Chinook.	Sockeye.	Silver, or coho.	Hump-back.	Chum.	Steelhead.	
1878	[a] 3,000						3,000
1897		5,500,000					5,500,000
1898		5,400,000					5,400,000
1899	8,685,000		189,000				8,874,000
1900	3,236,300	10,683,000	6,749,280		10,301,760	1,762,560	32,732,900
1901	2,863,200	3,831,453	14,360,185		16,478,280	1,398,476	38,934,594
1902	2,141,322	3,371,000	23,161,069		9,937,390	2,591,371	41,202,152
1903	4,276,869	3,731,789	23,307,771		9,937,390	3,826,091	45,079,910
1904	3,585,437	3,855,000	14,276,721	471,797		3,938,866	26,127,821
1905	3,220,738		18,241,375			1,617,940	23,080,053
1906	5,348,940	3,582,630	34,493,794	969,990	3,268,800	3,348,724	51,012,878
1907	4,301,258		31,460,552	4,224,255	6,120,000	4,490,808	50,596,873
1908	9,198,309	8,514,305	41,542,966	9,420,662	4,342,350	4,714,991	77,733,583
1909	10,117,488	5,430,626	30,926,310		7,805,000	4,898,141	59,177,565
1910	12,539,260	4,554,825	38,478,125	1,887,600	8,607,500	6,292,338	72,359,648
1911	5,829,982	5,496,000	36,441,665	96,000	12,975,020	6,078,830	66,917,497
1912	5,513,601	4,692,573	46,476,064	5,432,110	4,578,930	7,131,382	73,824,663
1913	8,410,628	5,751,700	59,204,407	1,888	34,586,640	10,526,400	118,481,663
1914	10,779,171	2,803,261	46,976,751	22,651,415	16,032,346	5,393,944	104,636,888
1915	15,618,445	10,929,647	80,076,317	7,508,004	54,663,800	5,592,895	174,389,108
1916	26,283,919	18,403,728	51,173,801	14,923,627	47,942,599	6,632,299	165,359,973
1917	30,474,530	14,816,233	13,413,235	7,614,030	22,312,330	3,399,510	92,029,868
1918	44,339,439	22,902,035	53,684,416	12,955,086	72,760,506	10,111,087	216,752,569
1919	24,388,808	15,005,520	22,559,757	2,723,958	30,625,185	5,196,912	100,500,140
Total	241,155,647	159,258,325	687,193,561	90,880,422	373,275,826	98,943,565	1,650,707,346

[a] These were brought from the Clackamas (Oreg.) station and planted in some unnamed lake.

BRITISH COLUMBIA.

Fraser River.—The first hatchery established by the Dominion of Canada on the Pacific coast was erected in 1884 at what is now Bon Accord, a point on the lower river some 4 miles above New Westminster, and on the opposite shore. The next built was in 1901 on Granite Creek, Shuswap Lake, which discharges into the Fraser through the South Thompson River, the lake being about 280 miles from New Westminster. In 1904 another hatchery was established on Harrison Lake on the Lillooet River, first large tributary of the Fraser on the north side; also one about 4 miles east of the lower extremities of Pemberton Meadows, at the junction of Owl Creek and the Birkenhead River, 4 miles above its confluence with the eastern branch of the Lillooet River, which in turn discharges into Lillooet Lake. In 1907 a hatchery was built on Stuart Lake, near the headwaters of the Fraser.

In 1914 the Bon Accord hatchery had to be abandoned, due to the laying out of a town site around it, and the equipment was transferred to Queen's Park, New Westminster.

The Province of British Columbia owns Seton Lake hatchery, which was established in 1903 on Lake Creek, on the north side, about half a mile from the outlet of Seton Lake, and it has been operated continuously ever since. Seton Lake is a part of the Fraser River chain and is some 300 miles above the mouth of the river. Lake Creek, the outlet of Seton Lake, empties into the Cayoosh Creek, a tributary of the Fraser, 45 miles north of the latter's junction with the Thompson, and 1 mile south of the town of Lillooet.

In 1916 a subsidiary station was built by the Dominion on Cultus Lake to accommodate the surplus eggs which could not be handled in the Harrison and Pemberton hatcheries.

In 1913, the year of the quadriennially big run of sockeye salmon on the Fraser River, the contractors who were building the new Canadian Northern Railway, in blasting their way along the banks of the river, threw the rock and other débris into the stream until in the narrow part of the canyon south of North Bend at Whites Creek, Hells Gate, China Bar, and Scuzzy Rapids, all within a few miles of each other, the débris formed great sloping banks extending out into the stream at these points, and entirely changed the direction of the currents, and, of course, the velocity of the water. At best the salmon had a hard time getting through there, but the added obstructions rendered it practically impossible.

At a rather late hour the authorities woke up to the menace this work was to the run of salmon, and the dumping of débris into the river in such a manner as to obstruct their ascent was stopped.

How to clear the stream once more was now the problem, and this was seriously complicated by a slide of rock which took place in Hells Gate in February, 1914, which narrowed the channel of the stream considerably.

In March, 1914, the Dominion Marine and Fisheries Department contracted with a private concern to remove the obstructions, and this was done from Scuzzy Rapids, China Bar, and Whites Creek within a short period of time, but a couple of seasons' work were required to clear up Hells Gate so as to permit of passage for the fish. Some people claim that the fish still find it difficult to pass these obstructions.

Rivers Inlet.—A hatchery was established by the Dominion on McTavish Creek, one of the tributaries of Oweekayno Lake, about 20 miles up Rivers Inlet, in 1905, and has been operated ever since.

Skeena River.—In 1902 the Dominion established a hatchery on Lakelse Lake, in the Skeena River Basin, about 65 miles up the river from Port Essington. In 1919 a modern hatchery was commenced to replace the old one that was put out of commission by floods in 1917. In 1907 another was constructed on Babine Lake, the source of the Skeena River.

Vancouver Island.—In 1902 S. A. Spencer, of the Alert Bay cannery (now belonging to the British Columbia Packers' Association), in return for certain special fishery privileges granted by the Dominion, established a hatchery on the Nimpkish River, which is located on the northeast shore of Vancouver Island. The hatchery was burned down in 1903, but was immediately rebuilt. Since its establishment it has been operated by the Dominion.

In 1910 the Dominion put three new hatcheries into operation, all on Vancouver Island. They were located on Anderson Lake, Kennedy Lake, and Cowichan Lake, respectively. The two former are used for sockeyes and the latter for king and coho salmon and steelhead and other varieties of trout.

In 1915–16 the Draney Fisheries (Ltd.), operated a hatchery on a lake near by and hatched out 560,000 fry from eggs obtained from Rivers Inlet.

The following table shows the plantings made in the waters of British Columbia from the Dominion and provincial hatcheries:

PLANTS OF SALMON FRY MADE IN THE WATERS OF BRITISH COLUMBIA.

Year.	Fraser River.[a]						
	Chum.	Coho, or silver.	Spring, or king.	Humpback.	Sockeye.	Steelhead trout.	Total.
1885					1,800,000		1,800,000
1886					2,625,000		2,625,000
1887					4,414,000		4,414,000
1888					5,807,000		5,807,000
1889					4,419,000		4,419,000
1890					6,640,000		6,640,000
1891					3,603,800		3,603,800
1892					6,000,000		6,000,000
1893					5,674,000		5,674,000
1894					6,300,000		6,300,000
1895					6,390,000		6,390,000
1896					10,393,000		10,393,000
1897					5,928,000		5,928,000
1898					5,850,000		5,850,000
1899					4,742,000		4,742,000
1900					6,200,000		6,200,000
1902 [b]		90,000			15,808,000	75,000	15,973,000
1903	75,000	1,750,000	22,000		12,521,000		14,368,000
1904		210,000		50,000	13,729,200	12,000	14,001,200
1905		5,576,100	4,381,400		9,244,300		19,201,800
1906		4,774,000	1,791,500		100,479,000	4,000	107,048,500
1907		3,219,200	1,814,900		36,965,900		42,000,000
1908		5,890,000	2,815,000	22,500,000	51,855,200		83,060,200
1909		7,375,400	5,772,400		41,909,500		55,057,300
1910		450,000	6,300,000		105,312,500		112,062,500
1911		5,318,800	2,129,500		24,146,300		31,594,600
1912		3,899,500	5,962,500	28,773,350	34,183,850		72,819,200
1913	1,100,000	1,995,600	4,533,550		41,062,700		48,691,850
1914		1,522,000	50,000	500,000	92,308,000		94,380,000
1915	125,000	2,196,000	2,614,700		27,496,000		32,431,700
1916		1,652,000	2,540,000	[c] 3,834,000	[d] 67,201,000		75,227,000
1917 [e]	5,256,000	1,971,900	1,645,200	4,788,000	27,903,600		41,564,700
1918 [e]	378,000	1,729,800	2,763,000	13,940,100	37,153,350		55,964,250
1919	383,000	1,800,625	2,291,200	40,000	[f] 42,071,825	30,000	46,616,650
Total	7,317,000	51,420,925	47,426,850	74,425,450	868,137,025	121,000	1,048,848,250

Year.	Skeena River.			Rivers Inlet.			Nimpkish River.
	Humpback.	Sockeye.	Total.	Spring, or king.	Sockeye.	Total.	Sockeye.
1903		3,450,000	3,450,000				1,636,000
1904		4,000,000	4,000,000				2,496,000
1905		3,767,900	3,767,900				2,850,000
1906		3,784,450	3,784,450		8,000,000	8,000,000	4,873,400
1907		4,125,750	4,125,750		8,440,000	8,440,000	4,870,000
1908		8,946,950	8,946,950	4,706,000	8,594,000	13,300,000	4,800,000
1909		11,882,400	11,882,400		13,300,000	13,300,000	4,500,000
1910		[g] 11,521,700	11,521,700		12,750,000	12,750,000	5,055,000
1911		12,556,470	12,556,470		11,436,000	11,436,000	6,414,000
1912		12,367,500	12,367,500		11,791,000	11,791,000	5,114,500
1913		11,430,430	11,430,430		10,981,000	10,981,000	4,981,000
1914		11,843,200	11,843,200		12,397,000	12,397,000	5,053,000
1915	16,000	11,899,613	11,915,613		12,712,000	12,712,000	4,880,000
1916		11,202,257	11,202,257		12,594,100	12,594,100	4,980,000
1917		12.105,000	12,105,000		13,305,600	13,305,600	
1918		8,190,000	8,190,000		2,721,600	2,721,600	
1919		8,096,000	8,096,000		2,908,800	2,908,800	4,874,000
Total	16,000	151,169,620	151,185,620	4,706,000	141,931,100	146,637,100	67,376,900

[a] Some of the reports from the provincial hatchery at Seton Lake show merely the take of eggs; it has been necessary to make an arbitrary reduction in order to show the loss of eggs and fry before planting.
[b] No plants made in 1901.
[c] 3,549,000 were eggs.
[d] 3,242,000 were eggs.
[e] All were given as eggs, and an arbitrary reduction was made in order to show the loss in eggs and fry before planting.
[f] 500,000 were eggs; of the eggs from which the total plantings were made, 8,096,000 were obtained from the Skeena River.
[g] Includes 80,000 coho fry.

PLANTS OF SALMON FRY MADE IN THE WATERS OF BRITISH COLUMBIA—Continued.

Year.	Vancouver Island.					
	Chum.	Coho, or silver.	Spring, or king.	Sockeye.	Steelhead trout.	Total.
1911	40,000	4,550,000	425,000	7,862,000	145,200	13,022,200
1912	...	3,487,500	456,000	13,620,750	37,200	17,601,450
1913	...	3,180,000	712,500	15,031,750	173,900	19,098,150
1914	...	2,252,000	701,000	15,314,500	87,200	18,354,700
1915	...	2,229,220	250,600	15,911,000	55,000	18,445,820
1916	...	1,689,826	576,400	7,966,000	38,600	10,270,826
1917	...	1,426,860	1,209,600	2,862,000	...	5,498,460
1918	...	2,200,410	418,950	4,527,338	...	7,146,698
1919	...	2,152,194	[a] 431,760	[b] 4,589,250	[c] 33,798	7,207,002
Total	40,000	23,168,010	5,181,810	87,684,588	570,898	116,645,306

Year.	Total by species.						Grand total.
	Chum.	Coho, or silver.	Spring, or king.	Hump-back.	Sockeye.	Steelhead trout.	
1885	...	...	...	...	1,800,000	...	1,800,000
1886	...	...	...	...	2,625,000	...	2,625,000
1887	...	...	...	...	4,414,000	...	4,414,000
1888	...	...	...	...	5,807,000	...	5,807,000
1889	...	...	...	...	4,419,000	...	4,419,000
1890	...	...	...	...	6,640,000	...	6,640,000
1891	...	...	...	...	3,603,800	...	3,603,800
1892	...	...	...	...	6,000,000	...	6,000,000
1893	...	...	...	...	5,674,000	...	5,674,000
1894	...	...	...	...	6,300,000	...	6,300,000
1895	...	...	...	...	6,390,000	...	6,390,000
1896	...	...	...	...	10,393,000	...	10,393,000
1897	...	...	...	...	5,928,000	...	5,928,000
1898	...	...	...	...	5,850,000	...	5,850,000
1899	...	...	...	...	4,742,000	...	4,742,000
1900	...	...	...	...	6,200,000	...	6,200,000
1902	...	90,000	...	...	15,808,000	75,000	15,973,000
1903	75,000	1,750,000	22,000	...	17,607,000	...	19,454,000
1904	...	210,000	...	50,000	20,225,200	12,000	20,497,200
1905	...	5,576,100	4,381,400	...	15,862,200	...	25,819,700
1906	...	4,774,000	1,791,500	...	117,136,850	4,000	123,706,350
1907	...	3,219,200	1,814,900	...	54,401,650	...	59,435,750
1908	...	5,890,000	7,521,000	22,500,000	74,196,150	...	110,107,150
1909	...	7,375,400	5,772,400	...	71,591,900	...	84,739,700
1910	...	450,000	6,300,000	...	134,639,200	...	141,389,200
1911	40,000	9,868,800	2,551,500	...	62,414,770	145,200	75,023,270
1912	...	7,387,000	6,418,500	28,773,350	77,077,600	37,200	119,693,650
1913	1,100,000	5,175,600	5,246,050	...	83,486,880	173,900	95,182,430
1914	...	3,774,000	751,000	500,000	136,915,700	87,200	142,027,900
1915	125,000	4,425,220	2,865,300	16,000	72,898,613	55,000	80,385,133
1916	...	3,341,826	3,116,400	3,834,000	103,943,357	38,600	114,274,183
1917	5,256,000	3,398,760	2,854,800	4,788,000	56,176,200	...	72,473,760
1918	378,000	3,930,210	3,181,950	13,940,100	52,592,288	...	74,022,548
1919	383,000	3,952,819	2,722,960	40,000	62,539,875	63,798	69,702,452
Total	7,357,000	74,588,935	57,314,660	74,441,450	1,316,299,233	691,898	1,468,190,276

[a] Includes 24,361 fingerlings.
[b] Includes 205,700 advanced fry and 26,000 fingerlings.
[c] Includes 5,357 fingerlings.

ALASKA.

In 1891 several of the canneries operating at Karluk, on Kodiak Island, combined forces and built a hatchery on the lagoon at that place. As the cannery men were at swords' points in regard to their fishing rights on the spit, in 1892 the hatchery was closed. In May, 1896, the Alaska Packers Association broke ground for a hatchery at the eastern end of the lagoon, near the outlet of Karluk River, a short distance from where the hatchery was located in 1891, and operated it until 1916, when it was abandoned as a hatchery.

In 1892 Capt. John C. Callbreath, manager of the Point Ellis cannery on Kuiu Island, operated a small hatchery on the left bank of Kutlakoo stream. It was a very primitive place, and an exceptionally high tide destroyed the whole plant in September. It was never rebuilt.

Capt. Callbreath, however, after seeing to the operation of the hatchery, had returned to Wrangell during the summer, where his attention was again attracted to hatchery work, and in the fall of 1892 he built a small hatchery on Jadjeska stream, Etolin Island, about 200 yards from its mouth. The stream is about one-half mile in length and is the outlet of a small lake. Finding the location unsuitable, Capt. Callbreath removed the hatchery in 1893 to the northern side of the lake, about three-eighths of a mile from the head of the outlet, where it still stands. The owner's intention was to build up a stream which had a small natural run of red salmon until i had a large run, with the hope that the Government would then give him the exclusive right to take these fish from the stream for commercial purposes. The experiment was kept up until the end of the season of 1905, when Capt. Callbreath's failing eyesight compelled the cessation of the actual hatching. Until 1910 a man was stationed on the stream during the run of spawning fish for the purpose of lifting them over the dam, so that they could reach the spawning beds at the head of the lake, and the project was abandoned entirely shortly thereafter. The owner's expectation of a big run as a result of hatching operations was never realized.

In 1896 the Baranof Packing Co., which operated a cannery on Redfish Bay, on the western coast of Baranof Island, built a small hatchery on the lake at the head of Redfish stream. The following winter was so cold that not only the flume but the whole cataract froze solid, and as the hatchery was thus left without water the eggs were put into the lake and left to their fate and the hatchery closed down permanently.

In 1897 the North Pacific Trading & Packing Co., at Klawak, Prince of Wales Island, established a hatchery near the head of Klawak stream, close to Klawak Lake. In 1898 the plant was moved to the mouth of a small stream entering the lake about halfway up the western shore. This hatchery was operated continuously until the end of 1917, since when it has been shut down. In 1909 the North Alaska Salmon Co. acquired a half interest in it, which it relinquished to the original owners a few years later.

The Pacific Steam Whaling Co. in 1898 erected a small hatchery on Hetta Lake, on the west side of Prince of Wales Island, which was operated until the close of the hatching season of 1903–4, when the Pacific Packing & Navigation Co., successor to the original owner, went into the hands of a receiver. In 1907 it was reopened by the Northwestern Fisheries Co., which had acquired the interests of the old company, and has been operated each season since, with the exception of 1919.

Up to 1900 the work of hatching salmon was entirely voluntary on the part of the packers. On May 2 of that year the following regulation was promulgated at the Treasury Department, which at that time had control of the Alaska salmon-inspection service:

7. Each person, company, or corporation taking salmon in Alaskan waters shall establish and conduct, at or near the fisheries operated by him or them, a suitable

artificial propagating plant or hatchery, and shall produce yearly and place in the natural spawning waters of each fishery so operated red-salmon fry in such numbers as shall be equal to at least four times the number of mature fish taken from the said fisheries by or for him or them during the preceding fishing season. The management and operation of such hatcheries shall be subject to such rules and regulations as may hereafter be prescribed by the Secretary of the Treasury. They shall be open for inspection by the authorized official of this department; annual reports shall be made, giving full particulars of the number of male and female salmon stripped, the number of eggs treated, the number and percentage of fish hatched, and all other conditions of interest; and there shall be made a sworn yearly statement of the number of fry planted and the exact location where said planting was done.

On January 24, 1902, this regulation was amended so as to require the planting of "red-salmon fry in such numbers as shall be equal to at least ten times the number of salmon of all varieties taken from the said fisheries."

Although the regulation was mandatory, but few of the packers obeyed it, some because no suitable place was to be found within a reasonable distance of their plants, others because the establishment and operation of such a hatchery would cost more than their returns from the industry justified, and others because of lack of knowledge required in hatchery work. The greater number of them absolutely ignored it, and as a result those who conformed to the regulation were placed under a heavy financial handicap. The injustice of this arrangement was patent on its face, and in 1906, when a comprehensive revision of the law was made by Congress, provision was made for reimbursing in the future those cannery men who operated salmon hatcheries. The section covering this point reads as follows:

Sec. 2. That the catch and pack of salmon made in Alaska by the owners of private salmon hatcheries operated in Alaska shall be exempt from all license fees and taxation of every nature at the rate of ten cases of canned salmon to every one thousand red or king salmon fry liberated, upon the following conditions:

That the Secretary of Commerce and Labor may from time to time, and on the application of the hatchery owner shall, within a reasonable time thereafter, cause such private hatcheries to be inspected for the purpose of determining the character of their operations, efficiency, and productiveness, and if he approve the same shall cause notice of such approval to be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein any such hatchery is located, and shall also notify the owners of such hatchery of the action taken by him. The owner, agent, officer, or superintendent of any hatchery the effectiveness and productiveness of which has been approved as above provided shall, between the thirtieth day of June and the thirty-first day of December of each year, make proof of the number of salmon fry liberated during the twelve months immediately preceding the thirtieth day of June by a written statement under oath. Such proof shall be filed in the office of the clerk or deputy clerk of the United States district court of the division of the District of Alaska wherein such hatchery is located, and when so filed shall entitle the respective hatchery owners to the exemption as herein provided; and a false oath as to the number of salmon fry liberated shall be deemed perjury and subject the offender to all the pains and penalties thereof. Duplicates of such statements shall also be filed with the Secretary of Commerce and Labor.

It shall be the duty of such clerk or deputy clerk in whose office the approval and proof heretofore provided for are filed to forthwith issue to the hatchery owner, causing such proofs to be filed, certificates which shall not be transferable and of such denominations as said owner may request (no certificate to cover fewer than one thousand fry), covering in the aggregate the number of fry so proved to have been liberated; and such certificates may be used at any time by the person, company, corporation, or association to whom issued for the payment pro tanto of any license fees or taxes upon or against or on account of any catch or pack of salmon made by them in Alaska; and it shall be the duty of all public officials charged with the duty of collecting or receiving such license fees or taxes to accept such certificates in lieu of money in payment of all license fees or taxes upon or against the pack of canned salmon at the ratio of one thousand fry for each ten cases of salmon. No hatchery owner shall obtain the rebates from the output of any hatchery to which he might otherwise be entitled under this act unless the efficiency of said hatchery has first been approved by the Secretary of Commerce and Labor in the manner herein provided for.

Of recent years so much objection has been raised to the system of hatchery rebates that the matter of the Federal Government taking over all private hatcheries in Alaska, at a fair valuation, and operating same, is being favorably considered.

In 1901 the Pacific Steam Whaling Co. established two small hatcheries—one on Nagel Stream, which enters the northern side of Quadra Lake, on the mainland of southeast Alaska, and one on a stream entering Freshwater Lake Bay, Chatham Strait. Both were closed down in 1904 when the company failed. In 1908 the Northwestern Fisheries Co., which had acquired the Quadra plant, removed it to a small stream entering the head of the lake and has operated it ever since.

In 1901 the Alaska Packers Association erected a hatchery on Heckman Lake, the third of a series of lakes on Naha Stream, Revillagigedo Island, and about 8 miles from Loring, where the association has a cannery. This, known as Fortmann hatchery, is without question the largest and costliest salmon hatchery in the world, having a capacity of 110,000,000 eggs, and the association is entitled to great credit for the public spirit it has shown and the work it has done, entirely without remuneration until 1906, in building and operating not only this hatchery but also the one at Karluk.

The Union Packing Co., at Kell Bay, on Kuiu Island, and F. C. Barnes, at Lake Bay, on Prince of Wales Island, in 1902 built and operated small hatcheries, both of which were abandoned after one season's work.

Up to 1905 the work of hatching salmon in Alaska was confined to the salmon cannery men. In that year, however, the United States Bureau of Fisheries erected a hatchery on Yes Lake, which empties through a short stream into Yes Bay, on Cleveland Peninsula. In 1907 the Bureau constructed another hatchery, on Afognak Lake, near Litnik Bay, Afognak Island.

The eruption of Katmai volcano, on the Alaska Peninsula, June 6, 1912, covered the island of Afognak with volcanic ash and sand to an average depth of 9 inches. It is estimated that 20,000 salmon perished at the head of Litnik Lake, while thousands were driven back into the ocean. As a result of these conditions the work at the Afognak station was much hampered and curtailed. Even as late as 1915 work at this station was still being hampered by the volcanic ash and sand which fell in 1912.

In 1913 collecting stations were established at Eagle Harbor and Uganak Lake, on Kodiak Island. In 1915 another was established at Seal Bay, on Afognak Island.

In 1913 a collecting station was established on Ketchikan Creek, but, owing to the objections of the citizens of the town against the taking away of the eggs, the station was abandoned in 1915.

The following tables show the eggs and fry distributed by the Government and privately owned hatcheries in Alaska:

OUTPUT OF THE SALMON HATCHERIES IN ALASKA OWNED BY THE U. S. BUREAU OF FISHERIES, 1906 TO 1919.

Year ending June 30—	McDonald Lake or Yes Bay hatchery.							
	Red, or sockeye.		Coho, or silver fry.	Steelhead fry.	Humpback.		Total.	
	Eggs.	Fry.			Eggs.	Fry.	Eggs.	Fry.
1906		6,638,550						6,638,550
1907		54,610,800		143,500				54,754,300
1908		61,369,000						61,369,000
1909		48,653,000	9,900					48,662,900
1910		69,879,600						69,879,600
1911		68,239,900			100,000		100,000	68,239,900
1912		68,335,000						68,335,000
1913		60,422,100						60,422,100
1914	2,000,000	42,726,400				4,500,000	2,000,000	47,226,400
1915		[a]37,445,000			2,000,000		2,000,000	37,445,000
1916	18,100,000	[b]52,317,500					18,100,000	52,317,500
1917	2,000,000	[c]51,175,000					2,000,000	51,175,000
1918		32,539,200						32,539,200
1919	[d]47,300,000	[e]32,650,000			1,365,000	930,000	48,665,000	33,580,000
Total	69,400,000	687,001,050	9,900	143,500	3,465,000	5,430,000	72,865,000	692,581,450

Year ending June 30—	Afognak hatchery.						
	Red, or sockeye.		Coho, or silver fry.	Humpback.		Total.	
	Eggs.	Fry.		Eggs.	Fry.	Eggs.	Fry.
1909		39,325,870			10,000		39,335,870
1910		71,647,170			363,740		72,010,910
1911		26,755,000			364,150		27,119,150
1912		18,394,700		3,271,740		3,271,740	18,394,700
1913		12,551,100					12,551,100
1914	3,970,000	7,761,705	50,000		12,034,399	3,970,000	19,846,104
1915		[f]6,387,080		12,500,000	[g]343,480	12,500,000	6,730,560
1916		[h]22,933,640					22,933,640
1917		[i]21,116,000					21,116,000
1918	18,000,000	31,427,000				18,000,000	31,427,000
1919	[j]54,681,000	24,903,000		[k]8,697,000	2,142,000	63,378,000	27,045,000
Total	76,651,000	283,202,265	50,000	24,468,740	15,257,769	101,119,740	298,510,034

[a] Includes 2,925,000 fingerlings, yearlings, or adults.
[b] Includes 19,402,500 fingerlings.
[c] Includes 1,575,000 fingerlings.
[d] 1,059,900 sockeye eggs were shipped to the Little White Salmon hatchery, and 3,440,100 to the Oregon Fish Commission.
[e] Includes 6,000,000 fingerlings.
[f] Includes 5,444,830 fingerlings, yearlings, or adults.
[g] Includes 119,480 fingerlings, yearlings, or adults.
[h] Includes 11,100,440 fingerlings. Of the eggs from which these fry and fingerlings were hatched 15,000,000 came from Yes Bay hatchery.
[i] Includes 10,160,000 fingerlings.
[j] 5,100,000 of these eggs were shipped to the Bureau's Quinault (Wash.) hatchery, and 20,700,000 to the Province of British Columbia.
[k] 5,760,000 of these eggs were shipped to the Bureau's Puget Sound hatcheries.

Output of the Salmon Hatcheries in Alaska Owned by the U. S. Bureau of Fisheries, 1906 to 1919—Continued.

Year ending June 30—	Total, by species, both hatcheries.						Grand total.	
	Red, or sockeye.		Coho, or silver fry.	Steelhead fry.	Humpback.			
	Eggs.	Fry.			Eggs.	Fry.	Eggs.	Fry.
1906	....	6,638,550	....	....	....	....	....	6,638,550
1907	....	54,610,800	....	143,500	....	....	....	54,754,300
1908	....	61,369,000	....	....	....	....	....	61,369,000
1909	....	87,978,870	9,900	....	....	10,000	....	87,998,770
1910	....	141,526,770	....	....	....	363,740	....	141,890,510
1911	....	94,994,900	....	....	100,000	364,150	100,000	95,359,050
1912	....	86,729,700	....	....	3,271,740	....	3,271,740	86,729,700
1913	....	72,973,200	....	....	....	....	....	72,973,200
1914	5,970,000	50,488,105	50,000	....	....	16,534,399	5,970,000	67,072,504
1915	....	[a]43,832,080	....	....	14,500,000	[b]343,480	14,500,000	[c]44,175,560
1916	3,100,000	75,251,140	....	....	....	....	[d]3,100,000	75,251,140
1917	2,000,000	72,291,000	....	....	....	....	2,000,000	72,291,000
1918	18,000,000	63,966,200	....	....	....	....	18,000,000	63,966,200
1919	101,981,000	57,553,000	....	....	10.062,000	3,072,000	112,043,000	60,625,000
Total	131,051,000	970,203,315	59,900	143,500	27,933,740	20,687,769	158,984,740	991,094,484

[a] Includes 8,369,830 fingerlings, yearlings, or adults.
[b] Includes 119,480 fingerlings, yearlings, or adults.
[c] Includes 8,489,310 fingerlings, yearlings, or adults.
[d] 15,000,000 of the red salmon eggs shown under Yes Bay were transferred to Afognak, hatched out there and the fry counted under the "Fry" column of that hatchery.

Take of Eggs, and Output of Private Salmon Hatcheries of Alaska, 1893 to 1919.

[Unless otherwise stated in footnotes, all of the fry liberated were red salmon.]

Year ending June 30—	Callbreath's hatchery.		Karluk hatchery.		Klawak hatchery.	
	Eggs.	Fry.	Eggs.	Fry.	Eggs.	Fry.
1893	900,000	600,000	....	....	....	....
1894	3,000,000	2,204,000	....	....	....	....
1895	6,300,000	5,291,000	....	....	....	....
1896	6,200,000	5,475,000	....	....	....	....
1897	4,400,000	4,390,000	3,236,000	2,556,440	....	....
1898	3,400,000	2,526,000	8,454,000	6,340,000	2,023,000	800,000
1899	3,000,000	2,050,000	4,491,000	3,369,000	3,600,000	3,000,000
1900	3,400,000	2,335,000	10,496,900	7,872,000	3,600,000	[a] 1,000,000
1901	([b])	....	19,334,000	15,566,800	([c])	....
1902	6,000,000	5,500,000	32,800,000	28,700,000	3,500,000	2,800,000
1903	6,000,000	5,000,000	23,400,000	17,555,000	3,500,000	1,500,000
1904	6,000,000	5,000,000	28,113,000	22,000,000	3,000,000	1,700,000
1905	6,050,000	5,250,000	45,500,000	33,670,000	2,800,000	2,000,000
1906	7,700,000	6,500,000	36,933,000	28,236,412	2,800,000	2,300,000
1907	([d])	([d])	38,679,200	36,846,000	3,600,000	1,187,000
1908	([e])	([e])	47,808,200	43,655,000	3,500,000	2,776,000
1909	([e])	([e])	40,320,000	37,105,000	3,500,000	3,200,000
1910	([e])	([e])	45,228,000	40,620,000	5,800,000	5,300,000
1911	([e])	([e])	49,626,000	37,722,000	6,786,500	6,200,000
1912	([f])	([f])	41,026,800	37,495,100	5,600,000	3,530,000
1913	([f])	([f])	45,600,000	41,803,155	3,835,000	3,675,000
1914	([f])	([f])	34,629,160	31,546,080	3,645,000	3,465,000
1915	([f])	([f])	[g] 30,240,000	27,704,000	3,816,000	3,653,000
1916	([f])	([f])	41,135,000	23,948,000	4,180,000	4,020,000
1917	([f])	([f])	[h] 1,016,000	([f])	8,160,000	7,822,000
1918	([f])	([f])	([f])	([f])	([f])	([f])
1919	([f])	([f])	([f])	([f])	([f])	([f])
Total	[i] 62,350,000	52,121,000	628,066,260	524,309,987	77,245,500	59,928,000

[a] Many eggs frozen.
[b] No run of fish.
[c] Hatchery was not used, the eggs being hatched out in the lake.
[d] No report.
[e] Fish coming in to spawn were lifted over the dam.
[f] Not operated.
[g] A collection of 7,400,000 humpback eggs was made for Afognak, and these appear in the report of that hatchery.
[h] These eggs were turned over to the Afognak hatchery and the hatchery shut down.
[i] A considerable portion of these are coho eggs.

TAKE OF EGGS, AND OUTPUT OF PRIVATE SALMON HATCHERIES OF ALASKA, 1893 TO 1919—Continued.

Year ending June 30—	Hetta hatchery.		Quadra Bay hatchery.		Freshwater Bay hatchery.	
	Eggs.	Fry.	Eggs.	Fry.	Eggs.	Fry.
1899	2,800,000	2,600,000				
1900	2,000,000	1,500,000				
1901	1,800,000	[a] 500,000				
1902	2,500,000	1,700,000	4,500,000	3,500,000	1,500,000	1,000,000
1903	4,800,000	4,000,000	5,500,000	4,000,000	(b)	(b)
1904	5,127,500	3,750,000	600,000	[c] 400,000	(d)	(d)
1905	(e)	(e)	(e)	(e)	(e)	(e)
1906	(e)	(e)	(e)	(e)	(e)	(e)
1907	(e)	(e)	(e)	(e)	(e)	(e)
1908	8,000,000	6,125,000	(e)	(e)	(e)	(e)
1909	8,400,000	8,131,000	3,325,000	3,025,750	(e)	(e)
1910	10,313,000	9,000,000	10,863,000	9,850,000	(e)	(e)
1911	9,141,000	8,552,500	11,200,000	10,350,000	(e)	(e)
1912	2,585,000	2,342,000	11,000,000	10,166,000	(e)	(e)
1913	3,780,000	3,592,000	10,000,000	8,127,000	(e)	(e)
1914	4,082,000	3,590,500	18,400,000	17,054,000	(e)	(e)
1915	7,438,500	7,142,500	21,300,000	20,300,000	(e)	(e)
1916	7,408,000	7,092,000	8,114,000	7,598,000	(e)	(e)
1917	3,247,000	3,120,000	16,125,000	15,003,000	(e)	(e)
1918	4,826,000	4,587,000	13,600,000	12,990,000	(e)	(e)
1919	(e)	(e)	20,400,000	19,852,000	(e)	(e)
Total	88,248,000	77,327,500	154,927,000	142,215,750	1,500,000	1,000,000

Year ending June 30—	Fortmann hatchery.		Kell Bay hatchery.		Total.	
	Eggs.	Fry.	Eggs.	Fry.	Eggs.	Fry.
1893					900,000	600,000
1894					3,000,000	2,204,000
1895					6,300,000	5,291,000
1896					6,200,000	5,475,000
1897					7,636,000	6,946,440
1898					13,877,000	9,666,000
1899					13,891,000	11,019,000
1900					19,496,900	12,707,000
1901					21,134,000	16,066,800
1902	11,460,000	10,300,000			62,260,000	53,500,000
1903	40,050,000	29,005,000	2,500,000	2,000,000	85,750,000	63,060,000
1904	22,203,000	13,780,000	(e)	(e)	65,013,500	46,630,000
1905	65,010,000	63,181,000	(e)	(e)	119,360,000	104,101,000
1906	68,715,000	67,643,000	(e)	(e)	116,148,000	104,679,412
1907	105,450,000	80,973,000	(e)	(e)	147,729,200	119,006,000
1908	[f] 41,280,000	33,920,000	(e)	(e)	100,588,200	86,476,000
1909	24,465,000	22,785,000	(e)	(e)	80,010,000	74,249,750
1910	53,340,000	50,725,000	(e)	(e)	125,544,000	115,495,000
1911	34,920,000	30,245,009	(e)	(e)	111,673,500	93,069,500
1912	107,520,000	100,335,000	(e)	(e)	167,731,800	153,868,100
1913	23,160,000	20,800,000	(e)	(e)	86,375,000	77,997,155
1914	9,480,000	8,709,000	(e)	(e)	70,236,160	64,355,580
1915	22,500,000	20,820,000	(e)	(e)	85,294,500	79,619,500
1916	26,520,000	[g] 25,615,000	(e)	(e)	87,357,000	68,273,000
1917	62,580,000	57,405,000	(e)	(e)	91,128,000	83,350,000
1918	[h] 4,240,000	[i] 7,980,000	(e)	(e)	22,666,000	25,557,000
1919	[j] 23,280,000	15,205,000	(e)	(e)	43,680,000	35,057,000
Total	746,173,000	659,417,000	2,500,000	2,000,000	1,761,009,760	1,518,319,237

[a] Many eggs frozen
[b] No run of fish.
[c] Hatchery was not used, the eggs being hatched in the lake.
[d] No report.
[e] Not operated.
[f] Includes 30,000 coho eggs taken and 27,000 fry liberated.
[g] Includes 600,000 humpback eggs taken and 560,000 fry liberated.
[h] Includes 2,400,000 humpback eggs taken.
[i] Includes 1,845,000 humpback fry planted.
[j] Includes 3,660,000 humpback eggs.

THE SALMON FISHERIES OF SIBERIA.

As on the Alaska coast, the aborigines of Siberia must have learned early of the excellent food qualities of the salmon which each year frequented the rivers of that country for spawning purposes, and not only ate them fresh but also dried large quantities for winter use for themselves and their dogs.

Owing to the inaccessibility of the Siberian coast, due mainly to the lack of transportation facilities for many years and the decided objection of the Russian Government to travelers roaming over the country, partly because of the presence of political and criminal convicts and partly because of a fear that they might learn too much of its resources, there has been but little written, especially with regard to its fishery resources, about this remote section of the Russian Empire, and what little has been published is usually filled with inaccuracies, due, doubtless, in many instances to the fact that the writer generally had to get most of his information at second and third hand and was also unfamiliar with fishery subjects.

Most of the data given below were obtained directly from persons living in Siberia or Japan, most of whom are engaged in the fishing industry of Siberia, or from Americans who have on various occasions visited the country in order to view its fishing possibilities at first hand.

SPECIES OF SALMON.

All five species of salmon are to be found along the Siberian coast, and the schools appear to run about the same as they do on the American side. Although we have very little authentic data relating to their movements, these are doubtless similar to the runs on the Alaska coast, where climatic and other conditions are very similar. Nearly all streams from the Arctic Ocean to north China seem to have runs of one or more species. The steelhead does not appear to be an inhabitant of the Asian coast.

The fishing carried on by the Russians has usually been along the rivers of the mainland, principally in the Amur and on Sakhalin Island.

From very early times Japanese fishermen have frequented the Siberian coast and Sakhalin Island (the southern portion of which they at one time owned, exchanging it to Russia for the Kurile Islands in 1875 and again acquiring it in 1905, as a result of the Russian-Japanese war), being drawn here mainly by the rich stores of salmon which could be secured easily and quickly, and were so necessary to eke out the vast quantity needed to supply such a fish-eating nation as Japan.

FISHING DISTRICTS.

The Priamur fishing district is subdivided into several districts as follows:

Nikolaevsk district.—This district comprises the whole lower part of the Amur River from the village Zimmermanovka down to the mouth of the river, about 300 miles; the River Amgun, 200 miles; the Amur estuary, about 150 miles on the mainland and about 130 miles on the coast of Sakhalin Island, and about 865 miles of the coast line on the southwestern shore of the Okhotsk Sea. In 1913 there were 139 fishing stations operated in this district, and this number has been materially increased since. Humpbacks and chums were the principal species of salmon taken.

Sakhalin district.—The Sakhalin district includes the entire coast line of Sakhalin island with the exception of that facing the Amur estuary, which belongs to the Nikolaevsk district. It is the smallest district, and at present is of little importance. In 1913 there were 14 stations on the island and they produced chum and humpback salmon.

Okhotsk-Kamchatka district.—The Okhotsk section covers the coast line of the northern part of the Okhotsk Sea from Port Ayan to Penjin Promontory, about 1,620 miles. Chum, humpback, coho, and red salmon, and Dolly Varden trout are found here. The West Kamchatka section includes the coast line from the Sopotshnaya River down to the southern Ozernof shore fishing stations, a distance of about 335 miles. The Ozernaya River is, so far as known, the only river in this section that the red salmon visit in any quantities. In 1913 there were 152 fishing stations in this section, most of which were leased to Japanese. The number has since been increased. All five species of salmon and the Dolly Varden trout are found here. The East Kamchatka section covers the coast line of eastern Kamchatka and Anadir Peninsulas, about 1,843 miles. The majority of the fishing stations are concentrated around Karaginsky (Count Litka) Bay, in the straits from the Malo-Voyam River to Kitchigin River, about 135 miles long, and in the region of Kamchatka River. All five species of salmon and Dolly Varden trout are taken here and most of the canneries are located here and in the West Kamchatka section.

Southwestern district.—This district covers the waters from the southern boundary of the Amur River estuary (the line between Capes Lazarev and Pogibi) down to the Chosen frontier, including Vanina Bay, Imperial Harbor, Peter the Great Bay, and other bays. The total length of the shore line is about 1,350 miles. The northern part, from Lazarev-Pogibi line to Cape Povorotni, with the exception of various bays, includes the conventional waters, while the southern part, composed of Peter the Great Bay and Posiet Bay, are excluded from the conventional waters. In the first-named section chum and humpback salmon are caught to some extent. In the southern section chum and humpback salmon are taken and marketed fresh.

Amur River.—The Amur River is subdivided into two districts—the Marinsk, or the Lower Amur, district and the Khabarovsk district. The first named includes the area from the village Troitskoe to the village Sophiskoe, or a tract about 278 miles long. The Khabarovsk district includes the river line from the northern boundary of the Maryinsk district up the river to Khabarovsk, about 127 miles. Chum salmon form the bulk of the catch in this district.

FISHERY RIGHTS AND REGULATIONS.

Along the entire seacoast of Siberia, by virtue of the Russo-Japanese convention of 1907, concluded for 12 years, and, it is reported, with what truth we have no means of telling at present, renewed in 1919, the Japanese are permitted to engage in fishing on equal terms with Russians. In such sections there is no restriction with regard to the nationality of the laborers employed or the method of preparing the fish, except that the manufacture of fish manure from fish of the salmon variety is prohibited. On the face of it this convention looks like an equitable agreement, but in putting the Japanese on the same footing as the Russians it subjected them to a lot of unstated and arbitrary laws, by-laws, and local regulations, besides making the tenure exceedingly short, virtually only one year, as a result of which Japanese capital refuses to erect more than the crudest of plants.

The Department of Domains fixes the limits of the stations, and these are sold at public tender, usually during February and March.

The exhaustion of the fishery resources of many of the European waters belonging to Russia has forced some of her more enterprising fishermen to seek for new supplies in her Siberian waters, and as these resources become better known, and means of transportation are increased and improved, there will doubtless be a tremendous impetus given to their development.

The World War which devastated Europe between 1914 and 1918 had a particularly disastrous effect on Russia, where the terribly devastating internecine warfare resulting from the revolution within her borders sapped her resources to such an extent that her Siberian fishery operators have been unable to do anything other than make a bare living out of the business and not even that in many cases owing to the uncertainty of business conditions. As a result of these distressing handicaps upon the operations of the Russians, the Japanese have had virtually a free hand in their exploitation of the coastal fishery resources of Siberia. As Siberia in the near future will be the greatest producer of salmon, it behooves us to bestir ourselves if we are to retain our command of the salmon market by taking an active part in the development of Siberia's fishery resources, for which development Russia has not heretofore welcomed foreign capital. When peace finally comes to that devastated land, however, her capital will be so depleted that she will doubtless welcome relief from whatever source it comes, and as she knows the United States has no territorial aspirations in her direction we will doubtless be far more welcome than the Japanese, of whose disinterestedness the Russians are extremely suspicious.

Fishing rights in the gulfs and bays not included in the Russo-Japanese convention, such as Peter the Great Bay, Imperial Harbor, Vanina Bay, Avatchinsk Bay, and others, as well as the rivers of Okhotsk and Kamchatka, are granted by the Governor General, without public tenders, to persons of good repute, but for one year only, and if they show their ability to establish a successful fishing station a lease for 12 years can be secured on the basis of paying a royalty of $2\frac{1}{2}$ cents per pood (36.112 pounds) of prepared fish. Under the terms of the lease only Russian subjects can be employed at the stations, while all sailing vessels serving the stations must be under the Russian flag.

The regulations governing the river districts vary from those relating to coast concessions, and also vary from each other, as the local authorities in the river districts are authorized to issue temporary rules and regulations to cover local conditions.

On the Amur River, within the boundaries of the Nikolaevsk, Maryinsk, and Khabarovsk districts, the fishing stations are leased by public auction to the highest bidder, some on a long-term basis and others for only one year. At stations above the city of Nikolaevsk, within 30 miles of the Amur estuary and farther, no foreign labor is allowed. Below the city of Nikolaevsk foreign labor can be employed to handle the fish on shore, but the actual fishing can be done only by Russian subjects.

At the present time the chief aim of the Russian authorities is to break the monopoly the Japanese have of the fisheries along the greater part of the coast. This will be an exceedingly difficult thing to do, owing to the proximity of the Japanese to the Siberian coast, the ease with which they can transport by water the necessary supplies, etc., for carrying on the fisheries, the vastly greater skill in carrying on this work displayed by them over their Russian competitors, and their unlimited supply of cheap labor, while the Russian fisheries are badly hampered as a result of the few Russian subjects available for such work and the consequent high wage cost of same. Japan also has another big advantage in that she is at present almost the sole market for the greater part of the salmon and other fishes taken in Siberia. The very fact of this fish being necessary for feeding her people will cause Japan to battle hard to hold her present advantage.

In order to encourage opposition to the Japanese, the Russian authorities in 1913 gave to Denbigh & Biritch, on a long lease, a fishing station on the Kamchatka River (eastern shore of Kamchatka peninsula), and to S. Grooshetsky & Co. one on the Bolsha River (western shore of Kamchatka). In order to safeguard the fishery in the lease each was to build a fish hatchery with a capacity of 3,000,000 salmon per annum in the vicinity of the station. Each was to release 500,000 in 1914, 1,000,000 in 1915, and 3,000,000 yearly from 1916 to the end of the lease. Owing to technical difficulties only the latter firm built a hatchery, and this not until 1915 or 1916. It has since been shut down.

The development of the salmon and other fisheries of Siberia has been much hampered by the disinclination of the Russian Government to permit foreigners to acquire fishing concessions except on very short tenure. As the Russians themselves are generally unskilled in fishing operations, and are compelled to do the work with Russian labor, which is quite scarce, they do but little with their concessions. American capital would doubtless be available for developing Siberia's fisheries were it assured of a sufficiently long tenure of lease with some other minor concessions.

APPARATUS EMPLOYED.

In the river districts somewhat primitive fishing apparatus is employed. Spears, dip nets, and the other simple forms which seem to be common to all savage tribes depending upon the water for the greater part of their subsistence, are all in use by the natives living along the upper reaches.

Weirs of a primitive type known as "zaezdka," are also used. These have a lead consisting of willow poles and branches built from the river bank or a sand bank out into the stream. At the outer end is attached a net compartment with a lead, into which the fish, which have been following the lead in the search for an opening, pass. Two men in a boat are anchored close by, and as soon as 30 or 40 salmon have passed into the compartment, it is hauled up and the fish emptied into the boat, after which the net is reset.

Haul seines of varying lengths and depths are used in connection with the more important river fishing stations.

Along the coast the Japanese use a floating trap net somewhat similar to the type used in Alaska, also haul seines and a few gill nets.

ABUNDANCE OF SALMON.

It is exceedingly difficult to secure even approximate statistics of the Siberian catch of salmon, owing to the wide extent of coast, the totally inadequate means of transportation preventing close supervision, the presence of so many foreigners who go directly home with their catches at the end of the season, and the crude system of control in operation by the authorities.

The following table shows the catch of salmon in the four districts for the year 1898:

District.	Spring.	Summer.	Autumn.
Nikolaevsk		7,464,896	4,685,480
Okhotsk	60,000	873,000	2,662,000
Kamchatka	1,067,000	316,950	665,500
Sakhalin	666,000	635,000	748,000
Total	1,793,000	9,289,846	8,760,980

In the Anadir district the catch in 1909 was as follows: Cape St. Michael, 91,616; above Cape Neuman, 8,234; Anadir River, 150,746; Anadir River estuary, 9,864; Hanchelar River, 6,121; Cape Observation, 270,000; total, 536,581. The catch by natives and small Russian fishermen is estimated at about 3,000,000 and 500,000 fish, respectively. In addition to this, 130 barrels of caviar, weighing 14 tons, were prepared, and there were 20 tons from Cape Observation.

According to the statistics of the Fisheries Control, the catch of salmon in the Amur River in 1910 was as follows: Spring salmon, 7,701,344; summer salmon, 21,384,549; autumn salmon, 9,546,254; in all, 38,632,147. Of this number 34,649,025 fish were marketed and the balance consumed locally. Japan bought 23,228,481 fish, valued at $473,800; the balance was valued at $681,345. In addition there were 4,766,784 pounds of salmon caviar, valued at an average price of $0.114 per pound, totaling $543,413, which brings the total value of the salmon catch and by-products up to $1,698,558. During the same year, in Peter the Great Bay, 8,263 salmon were caught.

The number of salmon caught in eastern and western Kamchatka and in the bays and rivers in this region not included in the Fishing Convention, and at the Russian river stations, in 1911, was as follows:

Species.	Western Kamchatka.	Eastern Kamchatka.	River stations.	Bays and river outlets.	Total.
Chavitch (king)	5,421	7,818	207	590	14,036
Keta (chum)	3,082,300	2,675,000	297,300	890,790	6,945,390
Krasnaia (red)	2,136,800	747,000	689,000	236,240	3,809,040
Garbusha (humpback)	39,448,500	1,411,000	1,320,200	175,980	42,355,680
Kishutch (coho)	327,200	179,000	114,200	7,770	628,170
Total	45,000,221	5,019,818	2,420,907	1,311,370	53,752,316

In the Okhotsk district the catch amounted to 827,274 keta and 37,790 krasnaia. Of salmon caviar 489 tons were prepared by the Japanese and 60 tons by the Russians.

In 1915 about 50,000 barrels of pickled salmon were prepared on the Amur River. In the sections covered by the Fishing Convention 6,000,000 salmon, mostly keta with a few krasnaia, were dry-salted, while 80,000,000 humpback salmon, called "salmon trout" in Japan, were so prepared. No fish were frozen for the European market, due to the war. A considerable quantity of caviar was prepared, but the quantity is unknown. The pack of canned salmon is shown elsewhere.

In the "Pacific Fisherman" (February, 1917), Seattle, Wash., its Hakodate (Japan) correspondent reports the following particulars of the 1916 salmon season:

During the year 1916 the salmon catches in the States of Kamchatka and Okhotsk, Siberia, varied greatly according to districts. On the west coast of Kamchatka and Okhotsk there was a big run all season, but the run on the east coast of Kamchatka was extremely poor, except in the Kamchatka River. The distribution of salmon varieties is always limited to about the following districts:

Chums are present in large quantities on the east coast of Kamchatka and Okhotsk, but on the west coast of Kamchatka they are never plentiful.

Red salmon are almost entirely limited to two districts, the Kamchatka and Ozernaya rivers, being very scarce in other districts.

Humpbacks are found all along the coast, but most especially in the district of Boliskreska [Bolsheryetzk], where there is always a large run.

Silver salmon are found in small quantities on the west and east coasts of Kamchatka at certain seasons of every year.

King salmon are present in very limited quantities, early in the season on the west and east coasts of Kamchatka.

There were 17 canneries operated in 1916, and they packed about 470,000 cases. There were 218 fishing places on the shores, and the number of salmon caught during the season was 94,582,228.

All the salmon packers and fishermen in Siberia have used steamers for the transportation of their goods for several years past, but owing to the high rates now prevailing on steamer tonnage they were obliged again to make use of sailing vessels. Prices of all equipment and outfits for the canneries and salting stations were from 30 per cent to 50 per cent higher than for the previous year, but as a result of the strong demand for salmon products due to the European war, all the markets are in good condition. Accordingly, preparations for the coming season are expected to be on a more extensive scale, both as to number and size of canneries and development of the fisheries.

The above statement is accompanied by the following estimate of the number of salmon caught in 1916 in the States of Kamchatka and Okhotsk, except in the rivers:

Species.	Okhotsk.	East Kamchatka.	West Kamchatka.	Total.
	Number.	*Number.*	*Number.*	*Number.*
Chum	1,482,312	2,318,964	1,669,056	5,170,332
Humpback	3,710,320	1,776,112	79,926,512	85,412,944
King		3,276		3,276
Red		308,502	3,311,304	3,619,806
Silver			75,870	75,870
Total	5,192,632	4,406,854	84,982,742	94,582,228

FREEZING SALMON.

As when the Russians owned Alaska, the exploitation of Siberia was carried on for many years by trading companies with large powers granted by the Government. In 1892 a very enterprising company was in charge, judging from the following extract from a letter written on February 2, 1893, by the late Eugene G. Blackford, the well-known fish dealer of New York, to the late Col. Marshall McDonald, then United States Commissioner of Fish and Fisheries:

> I have just learned of the arrival in Chicago of 60,000 pounds of frozen salmon. They were caught in Petropavlovsk, Kamchatka. These fish are a new venture undertaken by a commercial trading company who control that country, and these salmon have been taken from a river where none have been caught before, and my information is that they catch fish weighing as much as 150 pounds each. The above lot of fish was brought frozen to Tacoma and then shipped by refrigerator car to Chicago, where they were sold to Mr. Booth, of the Booth Packing Co., Chicago. Mr. Booth has declined to pay for them because of their not being in satisfactory condition.

Nothing further appears to have been done in this line until in 1903, when a Berlin fish merchant outfitted and sent to the Siberian coast a refrigerator steamer with a capacity of 2,500 tons. The fish were caught mainly in the Amur River and were frozen immediately after being brought aboard. In all, 160,000 salmon were obtained, and these were in excellent condition when landed at Hamburg, Germany.

In 1907 the Salmon Steam Fishing Co., a combined British and Japanese company, chartered the steamers *Zenobia* and *Zephyrus*. These vessels were fitted with refrigerating apparatus and cold-storage chambers and sent to the Kamchatkan Peninsula to get a cargo. Both secured good cargoes.

In 1909 two refrigerating steamers visited the coast and froze salmon for the European market. One vessel was outfitted by a British company and the other by a German company, J. Lindenberger (Inc.). The latter reported that the dog salmon, the principal species frozen, were large and very bright. The British steamer left England in April and arrived home again late in December.

CANNING SALMON.

In 1900 the Kamchatka Commercial & Industrial Co. (Ltd.), was organized at St. Petersburg, Russia, by A. T. Prozoraf, president of the St. Petersburg Chamber of Commerce; P. M. Grunwalt; H. T. M. Court, and A. A. Prozoraf, secretary. A complete canning outfit was purchased in the United States, and the first cannery in Siberia established at Petropavlovsk, Avacha Bay, Kamchatka.

The San Francisco Trade Journal, under date of December 19, 1902, printed the following item relating to the operations of this cannery:

> On December 8 the Russian barkentine *Bitte* arrived from Petropavlovsk, Siberia, with 10,436 cases canned salmon. This is the first consignment of salmon received from them.

The greater part of the pack comprised dog salmon, although they were labeled "pink" salmon, the rest being reds and kings.

In 1903 the company did not operate, the fishing season being devoted to moving the plant to Ust-Kamchatka, at the mouth of the Kamchatka River, where, after being in use altogether for two or three years, it was abandoned and left all standing.

In 1907 two canneries were established in the estuary of the Amur River, near Nikolaevsk, but beyond getting out samples they were never operated.

In 1910 A. G. Denbigh, an Englishman, built a modern cannery near the second site of the Kamchatkan Commercial & Industrial Co. That year the cannery produced only about 10,000 cases, but each year since the equipment of the plant has been enlarged and improved until in 1913 the pack amounted to 60,000 cases. Early in 1914 a complete two-line plant of American can-packing machinery was installed.

In 1912 Mr. Denbigh built another cannery 1½ miles away from the above plant. This plant was first operated with German and Norwegian sanitary machinery, but in 1914 a two-line American sanitary can-packing plant was installed, the can-making plant at the first plant making all the cans needed at the two canneries.

In 1915 a number of additions were made to both plants in the line of flat fillers, etc., while still more were in contemplation for 1916.

Mr. Denbigh also operates a hand cannery at Kompakova, on the west side of the Kamchatka Peninsula.

Up to 1912 very few canneries, and these very primitive affairs, had been built by the Japanese, owing to the uncertainty of tenure referred to previously. The "canneries" were mere sheds or shelters where the cans—which were brought from Japan, made or half made—were filled, closed, and cooked, furnace-heated, vertical retorts being used for the latter purpose. If the owner lost his concession at the end of the fishing season he simply took his retorts away with him and the buildings were left to his successor.

In 1912 a Tokyo company (Ichigumi & Co.) put up two canneries near the Ozernaya River in Kamchatka, while a Japanese from Niigata, Japan, also put up a small plant in the same vicinity. Both plants were cheaply built and operated with hand-power machinery and small vertical retorts. That year the two companies together packed about 13,500 cases of salmon.

The same season Ichigumi & Co. put up another hand-power cannery, and Tsutsumi & Co., of Hakodate, Japan, built two others of the same type near the Kamchatka River, on the east coast.

In 1913 Tsutsumi & Co. built a modern cannery at Ozernaya and installed a complete line of American sanitary can-making and can-packing machinery.

The same year Ichigumi & Co. put up two hand-power canneries near the Kamchatka River, having succeeded to the concessions formerly held here by Tsutsumi & Co. In 1914 they built a modern plant and installed a complete line of American sanitary can-making and can-packing machinery.

The St. Petersburg firm of S. Grooshetsky & Co., which has been engaged for a number of years in the freezing of salmon and in the preparation of salmon caviar, under the name of the Pacific Ocean Sea Industry Association, erected a cannery near Ozernaya in 1914, and installed in it a full line of American sanitary can-making and can-packing machinery. This plant will compare favorably with most of our Alaska canneries. The buildings are of iron.

In 1915 a number of extensive improvements in the way of new buildings, machinery, etc., were made to the various plants, and during the winter of 1915–16 several of the canning firms had representatives in this country selecting much additional machinery for use during the 1916 season. During the latter season Tsutsumi & Co. erected a large new plant at Kiseka and a one-line plant above Kiseka. This company also operates a can-making plant at Hakodate, equipped with American Can Co. machinery and with a capacity of 800,000 cans per day. Owing to the heavy demand, caused by the war, a number of small hand-pack canneries also operated.

In 1917 A. G. Denbigh built a cannery at Javino, on the west coast of Kamchatka Peninsula. All the machinery in this plant is electric driven.

In 1918 the ravages occasioned by the war so far as personnel, transportation, tinplate shortage, and market conditions were concerned had come to a head, and as a result the Grooshetsky & Co. and some of the smaller canneries did not operate, while Tsutsumi & Co. operated only those of its canneries which packed red salmon.

In 1919 conditions were much more favorable in Siberia, and as a result the three Russian plants which were shut down in 1918 reopened. Tsutsumi & Co. erected and operated a new cannery in Ust-Kamchatka. The Nichiro Gyogyo Kabushi Kaisha, or Russo-Japanese Fisheries Co. (Ltd.), built and operated two additional one-line canneries at Kompakova and Kiseka.

The following table shows the detailed pack of canned salmon made by the various companies operating in Siberia in 1915:

SIBERIA CANNED SALMON PACK IN 1915.[a]

Name and cannery location.[b]	Canneries.	One-pound flats.					Total.
		Reds.	Springs.	Silvers.	Chums.[c]	Humpbacks.	
		Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
A. G. Denbigh, Kamchatka River (2) and Kompakova	3	58,000		26,000	38,000		122,000
Food Products Exp. Co	4	[d] 35,000					35,000
S. Grooshetsky & Co., Bolsheryetzk	1	6,000			23,000		29,000
Minard & Co	1				7,000		7,000
Nichiro Fishing Co. (Ltd.), Kamchatka River	1	14,703	3,334	2,191	11,981		32,209
Sugamiya	1	2,200					2,200
Tsutsumi & Co., Ozernaya	1	[e] 37,800			8,800		46,600
Hand-pack canneries, East and West Kamchatka	2	1,000			4,000	10,000	15,000
Total	10	154,703	3,334	28,191	92,781	10,000	289,009

[a] From Pacific Fisherman Yearbook for 1916, p. 44.
[b] There were also a couple of small canneries operated on the Amur River which are not shown here.
[c] Called "Pinks" in Siberia.
[d] Includes 10,000 cases one-half pound flats of 8 dozen each.
[e] Includes 10,800 cases one-half pound flats of 8 dozen each.

In order to show the changes which have occurred since 1915 the detailed pack made by the various companies for 1919 is given.

SIBERIA CANNED SALMON PACK IN 1919.[a]

Name.	Cannery location.	Number of canneries operated.	Spring.	Red.		
			1-lb. flats.	1-lb. talls.	1-lb. flats.	½-lb. flats.
Grooshetsky, S., & Co	Ozernaya, Bolsheryetzk	2			8,363	
Hakama, S., & Co	Opala	1			7,550	
Hokuyo-Gyogyo Kabushiki Kaisha (Ltd.).	Ust-Kamchatka[b]	2			73,058	
Nichiro Gyogyo Kabushiki Kaisha (Ltd.).	Bolsheryetzk, Opala, and Ust-Kamchatka.	3	1,533		56,877	
Shindo, S., & Co	Narachefsky	1			888	
Suda, K., & Co	Palana R	1			900	
Tsutsumi & Co	Ust-Kamchatka, Ozernaya, Javino, Koshegochinsky, Bolsheryetzk (2), and Kuftoi.	7	3,575	557	112,396	18,266
Yushutsu-Shokuhin Kabushiki Kaisha (Ltd.).	Opala Goluiginsky, Koshegochinsky, Javino [c]	4			80,832	17,604
Total		21	5,108	557	340,863	35,870

[a] From Pacific Fisherman Yearbook for 1920, p. 86.
[b] Formerly Denbigh canneries at Nerpichr and Seaside.
[c] Javino cannery bought from A. G. Denbigh & Co.

SIBERIA CANNED SALMON PACK IN 1919—Continued.

Name.	Cannery location.	Silver.		Chum.	Humpback.		Total.
		1-lb. talls.	1-lb. flats.	1-lb. flats.	1-lb. talls.	1-lb. flats.	Full cases.
Grooshetsky, S., & Co.	Ozernaya, Bolsheryetzk	....	5,337	....	....	20,248	33,948
Hakama, S., & Co.	Opala	....	....	....	....	....	7,550
Hokuyo-Gyogyo Kabushiki Kaisha (Ltd.).	Ust-Kamchatka[a]	....	31,484	78,589	....	....	183,131
Nichiro Gyogyo Kabushiki Kaisha (Ltd.).	Bolsheryetzk, Opala, and Ust-Kamchatka.	....	20,941	11,018	....	12,200	102,569
Shindo, S., & Co.	Narachefsky	....	177	....	....	....	1,065
Suda, K., & Co.	Palana R.	....	....	....	....	....	900
Tsutsumi & Co.	Ust - Kamchatka, Ozernaya, Javino, Koshegochinsky, Bolsheryetzk (2), and Kuftoi.	17,909	30,516	12,376	50,027	60,807	306,429
Yushutsu-Shokuhin Kabushiki Kaisha (Ltd.).	Opala, Goluiginsky, Koshegochinsky, Javino.[b]	....	....	....	....	14,484	112,920
Total	....	17,909	88,455	101,983	50,027	107,739	748,512

[a] Formerly Denbigh canneries at Nerpichr and Seaside.
[b] Javino cannery bought from A. G. Denbigh & Co.

The following table shows the pack of canned salmon in Siberia from 1910, the virtual inception of the industry, to 1919, inclusive:

Year.	Canneries operated.	Reds.	Silvers.	Pinks, or dogs.[a]	Springs.	Humpbacks.	Total.
		Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Full cases.*
1910	1	5,500	2,500	2,000	....	....	10,000
1911	1	15,000	6,000	4,000	....	....	25,000
1912	....	43,500	18,000	16,000	....	....	77,500
1913	....	102,900	7,000	21,000	....	2,500	133,400
1914	....	85,000	22,500	27,000	....	2,000	136,500
1915	10	119,703	28,191	92,781	3,334	10,000	254,009
1916	18	229,406	54,652	129,598	2,047	56,064	471,767
1917	18	275,212	29,980	66,056	2,556	137,197	511,001
1918	15	296,960	43,588	23,585	2,027	15,177	381,337
1919	21	377,290	106,364	101,983	5,108	157,766	748,512
Total	....	1,550,471	318,775	484,003	15,072	380,704	2,749,026

[a] Dog salmon are marketed under a "pink" label.

SALTING SALMON.

By far the greater part of the salmon catch of Siberia is either pickled or dry salted. This was the earliest commercial method initiated on the coast and has been followed for a number of years, mainly by the Japanese. The coast is dotted with concessions worked by Japanese, while there are large numbers in operation along the rivers, these being restricted to Russians. An idea of the extent of this branch of the industry may be gathered when it is stated that in 1915 there were 50,000 barrels of pickled salmon prepared in the Amur region, while the Japanese dry salted about 6,000,000 dog salmon, including also a few reds, and 80,000,000 humpbacks, or "salmon trout," as they are called in Japan.

In pickling salmon the fish are split down the back, the sides being held together by the belly. The roc, gills, and viscera are removed and the fish are then washed, and after salting are placed in large tanks for seven or more days, or until they are thoroughly struck, after which they are packed in barrels, flesh side up, except the two top layers, which have the skin side up. To about 700 pounds of fish 180 pounds of salt are used.

The dry salting, next to drying, is the most primitive method employed in preserving salmon. The process consists simply in splitting the fish up the belly, removing the gills and entrails, and then filling the belly with salt. The fish are then placed in rows on matting and covered with salt, and other rows are placed on top of them until the pile is from 8 to 10 feet high, when the entire lot is covered with matting and left for about seven days, after which they are relaid and again covered with salt. For shipping, the fish are packed in mats.

A very odd feature in connection with the operation of most of the Japanese plants is that the salt to be used in curing the fish is usually dumped loose onto some level spot, with absolutely no covering over it, and exposed to the elements.

The Japanese consume enormous quantities of these dry-salted salmon. During the Russian-Japanese war the latter country's fishermen were cut off from access to their usual fishing grounds, with the result that they were forced to look elsewhere for fish. During 1905 and 1906 large quantities were prepared in Alaska, British Columbia, and Washington for this trade, but as soon as the war ended and the Japanese got access once more to their old fishing grounds, the Japanese duty on salt fish, which had been suspended during and for a short period after the war, was reimposed. As a result our fishermen soon quit the business, and since then operations on this coast have been almost wholly restricted to Japanese operating in British Columbia waters.

At the height of the production on this coast Mr. King, the American consular agent at Hakodate, Japan, made the following suggestions to preparers and shippers of dry-salted salmon for the Japanese trade:

> The salmon should arrive in Japan by December 1. Most of these fish are used among the Japanese for New Year's presents. After the new year the price invariably declines 20 to 30 per cent, and for a month or two the fish are difficult to dispose of, as the consumers always stock up before the new year.
>
> The salmon should weigh not less than 5 pounds when thoroughly cured. They should be free from spots, which are usually found on the salmon if caught in fresh or brackish water. No Japanese would think of giving a salmon with red and black spots to a friend for a New Year's present, and spotted fish never realize more than half the price obtainable for clean white fish. The salmon should be split up the belly and should be salted with fine salt. Coarse salt always tears the flesh of the fish when being rubbed in. Care should be taken that the salmon are not oversalted.

Semga salting is a more improved and sanitary method than that of straight pickling and is used when the fish are being prepared for the European market. Selected fish are cut open along the belly and the viscera and gills are carefully removed. In order that the salt may penetrate the flesh more thoroughly, the flesh on the inside is scored several times. The fish are then carefully washed and rubbed with brushes, after which they are kept on ice for 24 hours. The brine is carefully prepared and very strong. When properly struck the fish are repacked into barrels.

"Kolodka" is a very crude and cheap method of salting. The fish are half salted and half dried without being cut open, and are sold at the place where prepared.

The natives prepare a great many salmon for the winter use of themselves and their dogs, the same as do the Alaskan natives. The fish are dried without the use of salt. The product is known as "youkala."

Some salmon bellies are also cut out and salted, although this has never attained to prominence.

Some fresh salmon, as well as salted, are smoked for local consumption.

Barrels, or tierces, for packing salmon are made from cedar, larch, or fir, with a net capacity of 900 to 1,000 pounds of fish, and are bound with wooden and iron hoops.

THE SALMON FISHERIES OF JAPAN.

Outside of Karafuto (that portion of Sakhalin Island, south of 50° north latitude, which belongs to Japan) and the Kuril Islands, the salmon fisheries of Japan are comparatively small, the principal portion of the immense catches made by Japanese fishermen being along the coasts of Siberia and Karafuto.

All of the five species of salmon found on the American side are to be found in the waters of Sakhalin during the usual spawning periods.

The dog salmon (*O. keta*), which is known in Japan as "sake," and when canned as "pink" salmon, is to be found on Hokushu Island, running up the various streams for spawning purposes from September to December.

On the same island is to be found also the masu (*O. masou*), a salmon, according to Dr. Jordan,[a] very similar to the humpback, the scales being a little larger, the caudal fin without black spots, and the back usually immaculate. It is fairly abundant in the streams of Kokushu, the island formerly known as Yezo, and is found nowhere else in the world. The author had an opportunity to examine a dry-salted masu (it might be well to state here that in Japanese masu means "trout") at the fish house of the Royal Fish Co., in Vancouver, British Columbia, in January, 1916. The manager, Mr. Emy, had imported the fish from his own country. Both in size and general appearance it closely resembled a humpback salmon, and when cut open the flesh had the same coloring observable in our humpback. This species, and the true humpback found in more northern waters, especially in Siberia, are dry salted in immense numbers and are generally marketed under the name of "white trout" or "salmon trout."

In Japan the "red trout" seem to be our rainbow and brook trouts, which were introduced into Japanese waters some years ago. The red salmon (*O. nerka*) is to be found landlocked in Lake Akan in the northern part of the island. It is smaller in size than the sea species. This species has been introduced into the waters of Honshu.

The section of this report devoted to the salmon fisheries of Siberia treats quite fully of the activities of the Japanese in that quarter.

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[a] Fishes, p. 296. By David Starr Jordan. N. Y., 1907.

In Sakhalin, or Karafuto, as it is called in Japan, the Japanese have had a rather checkered career. At one time this island belonged to the Chinese Empire. Early in the nineteenth century the southern portion was occupied by the Japanese. In 1875 she bartered it to Russia in exchange for some small islands in the Kuril group. As a result of the Russo-Japanese war the southern half, or all that portion south of 50° north latitude, was in 1905 ceded to Japan.

The salmon fisheries of this island are of much importance. For many years the Japanese had a virtual monopoly of them, but very early in the present century the Russians attempted to restrict considerably the activities of the Japanese fishermen, and encouraged her own subjects to compete with them. Many hundreds of Russians and Koreans were encouraged to migrate to the island and engage in its fisheries. Despite these handicaps, the operations of the Japanese fishermen, according to the statistics shown below, do not seem to have suffered.

Year.	Salmon.[a]	Spring salmon.	Total.
	Koku.[b]	*Koku.*[b]	*Koku.*[b]
1897	8,589	34,246	42,835
1898	6,335	11,228	17,563
1899	8,379	22,959	31,338
1900	7,719	8,797	16,516
1901	3,089	12,735	15,824
1902			24,726

[a] Species not specified. [b] Koku equals about 5½ bushels.

Considerable fishing is carried on around the island of Yetorofu, one of the Kuril group. Here are found red (*O. nerka*), silver (*O. kisutch*), and dog salmon (*O. keta*), also either the humpback or Dr. Jordan's masu.

CANNING INDUSTRY.

The salmon canning industry in Japan proper was inaugurated by the Hokushu Colonization Department, a local branch of the Federal Government. For some time this department had operated a fishery school on Hokushu Island, at which experimental work in the canning of salmon and other fishery products was carried on. This establishment canned considerable salmon during the Russo-Japanese war.

This same department also established a fishery school on Yetorofu Island, one of the Kuril group, which was, in 1908, taken over by Suhara Kakubei, a fisherman and graduate of the school, and used as a salmon cannery.

Some years earlier, however, about 1892 or 1893, Fujino Shirobei started canneries in Shibetsu and Bekkai, Nemuro Province, Hokushu Island, and a short time later Idzumi Shozo also started a plant at Nemuro. For a number of years these three canneries were the only producers. The plants were quite primitive, the product small, and most of it was consumed by the Japanese navy. A demand for the product was gradually worked up, however, and as a result there are now a number of small canning plants on Hokushu Island proper, the Kuril Islands, and Japanese Sakhalin. Most of these plants devote the major part of their energies to the packing of crab meat, the canning of salmon being in most cases a side issue. A few of the plants have been equipped with machinery, but the large majority are hand-pack plants, employing but a few persons.

Most of these plants pack what is called "white trout," which is really the humpback or masu salmon. In 1912 there were in Hokushu and adjacent islands 21 canneries which packed 730 cases (48 one-pound flat cans each) of red (*O. nerka*) and 72,770 cases (48 one-pound cans each) of "white trout," a total of 73,500 cases.

On the Japanese portion of Sakhalin Island 4 canneries packed 10,120 cases (48 one-pound cans each) of "white trout" in 1912.

The pack of canned salmon in Japanese territory in recent years has been as follows:

Year.	Hokkaido and Kurils.	Karafuto (Japanese Sakhalin).	Total.
	Cases.	*Cases.*	*Cases.*
1912	73,500	10,120	83,620
1913	46,000	....	46,000
1914	50,450	15,000	65,450
1915	55,000	15,000	70,000
1916	37,800	1,800	39,600
1917	39,545	16,607	56,152
1918	21,490	5,000	26,490
1919	50,500	18,000	[a] 68,500

[a] Composed of 2,500 cases of 1-pound flat red salmon and 66,000 cases of 1-pound flat chum salmon.

The following table shows the quantities and value of salmon and trout taken by the Japanese fishermen in certain years:

Year.	Salmon.		Trout	
	Pounds.	Yen.	Pounds.	Yen.
1902	5,722,475	454,662	923,025	121,499
1907	9,286,267	892,879	4,500,008	332,316
1912	26,438,017	1,594,230	44,038,383	928,513

FISHERY METHODS.

In Japanese waters salmon are taken by means of trap nets, haul seines, and gill nets.

The haul seines used along the seashore have a length of about 500 fathoms. Each is carried by a boat of 9 feet beam with 30 men, and the right wing, called the "outing wing," is first paid out as the boat heads out from the beach. When the pocket, or bunt, is cast the boat turns its course toward the right and steers gradually landward, casting the left wing. When the school is encircled the seine is hauled ashore by the seine ropes.

The floating trap net used for salmon is known as "kaku-ami," or square trap net. This consists of a main net and lead. The main net, or heart, is 70 fathoms long, 10 fathoms wide, and 10 fathoms deep, and the lead is 120 fathoms long. The latter guides the fish toward the main net. When being fished the pot is hauled up by a boat crew and the fish transferred to the boat by means of a dip net.

FISH CULTURE.

The artificial culture of salmon is carried on in 56 hatcheries, which are distributed in Hokkaido and the prefectures of Aomori, Akita, Yamagata, Niigata, Toyama, Kyoto, Iwate, and Miyagi. Nine of these belong to the government of Hokkaido and other prefectures, while the rest are owned by fishing associations, individuals, or corporations. The number of young salmon distributed by these hatcheries amounts to over 80,000,000 a year.

The largest hatchery is the one at Chitose, under the supervision of the Hokkaido Fishery Experimental Station. It was established in 1887, and it is estimated that the fish distributed by it number from 20,000,000 to 30,000,000 yearly.

The salmon hatchery of Murakami, Niigata prefecture, dates as far back as 1881, when a regulation pertaining to the preservation of young salmon in the River Miomote was enacted by the prefecture of Niigata. This was first called the "Murakami Salmon Raising Plant," but in 1891 it was turned into a hatchery, and is now distributing 2,000,000 young salmon a year. The salmon hatchery of Nitta River, Fukushima prefecture, is very similar in its history and organization to the above.

The industry has during the last few years become very popular in Yamagata prefecture, where 22 hatcheries are in operation as private enterprises.

In the prefectures of Shiga, Miye, Shizuoka, Nagano, Yamanashi, Kanagawa, Akita, Niigata, Hyogo, Miyazaki, and Hokkaido, the masu (*O. masou*) and the landlocked hime-masu (*O. nerka*) are raised and distributed in the lakes and rivers. There are eight hatcheries working on these species. The hatchery of Lake Towada, Akita prefecture, first transplanted hime-masu from Hokkaido in 1902, and it is now hatching from 5,000,000 to 10,000,000 eggs a year for the purpose of distributing the fish among the different districts.

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IMPROVEMENTS IN PROCESS OF SALTING RIVER HERRING, ESPECIALLY ADAPTED TO WARM CLIMATES.[1]

By Harden F. Taylor, *Technologist, U. S. Bureau of Fisheries.*

Contribution from the Fishery Products Laboratory, Washington, D. C.

INTRODUCTION.

In the warmer parts of the United States it has generally proved to be difficult, if not impossible, to preserve certain kinds of fish by salting, though some kinds appear to be more difficult of preservation than others. The reason for failure was believed to be that at warm temperatures the fish spoils before the salt penetrates to the innermost parts; this belief was verified experimentally in an investigation[2] in which several improvements in the process of salting alewives or river herring were evolved. No doubt these improvements are applicable also to other kinds of fish. As will be seen below, none of them are really new, but well known procedures were studied chemically and variations which gave best results were followed in every case, so that the process is very much more successful under adverse conditions, and the final product is superior in quality.

While the procedure herein described has been quite successful in a small way, it will be understood by all cautious persons that no unusual methods should be applied on a large scale until their practicability has been thoroughly established by commercial application. In Florida some 80,000 river herring, or alewives, were salted under the supervision of this Bureau in the 1920 season. These were marketed at a good price, and no complaints were lodged with the producers, so far as known. It therefore seems proper to make available in practicable form the details of the process employed for those who care to try it.

As stated above, the difficulty in salting fish in warm climates seemed to be due to slow penetration of salt and rapid decomposition of the fish. Obviously, then, any procedure that hastens penetration of salt and retards decomposition of fish should improve the prospects of success. A number of simple and practicable ways of doing both of these things were found. For example, it was found that calcium, or lime, and magnesium, the common impurities in salts used commercially, retard penetration altogether out of proportion to the quantities present. A salt consisting of 4.7 parts of magnesium

[1] Appendix II to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 903.

[2] For original chemical and scientific data on which this paper is based, see "Some Considerations Concerning the Salting of Fish," by Donald K. Tressler, B. F. Doc. No. 884, Appendix V, Report, U. S. Commissioner of Fisheries for 1919.

chloride and 95.3 parts of pure salt required five days to penetrate fish to the extent that pure salt did in three days; and the same salt required nine days to penetrate as far as pure salt did in four and one-half days. It was found that salt applied dry to fish penetrated fish as deeply in five days as saturated brine did in eight days. It was found that blood spoiled at a lower temperature than fish flesh, and that fish containing blood, roe, and milt spoiled at about 65° F., while thoroughly cleaned fish could be salted successfully at 90° or even 100° F. It remained, therefore, only to take advantage of these principles and to apply certain facts already known from other sources to hasten penetration of salt and retard decomposition of fish until they are preserved.

PRINCIPLES OF IMPROVED PROCESS.

The principles will now be taken up and discussed in such a way that by following in detail the method outlined it is believed any person can carry them successfully into practice. The principles are:

1. Careful handling of fish before salting.
2. Thorough cleaning, especially removal of all blood.
3. Use of salt of a high degree of purity.
4. Application of salt in the dry condition.

To these should be added—if the fish are to be stored for any considerable length of time—storage of fish in brine. (There is considerable doubt of the feasibility of storing salt fish in very warm climates; until this subject is investigated it seems advisable to hold only in cool storage.)

These principles are known, at least in part, to many experienced salters of fish, yet the combination of them all is rarely or never followed. The great difference that is made in the quality of salt fish by following them will be readily observed upon comparing the product with that of ordinary processes.

1. Careful handling of fish before salting.—Two precautions are particularly important under this head, namely, to avoid bruises and to avoid warmth. Bruises promote decomposition of fish in the same way that they cause fruits to rot. Therefore, fish should not be forked, walked on, squeezed when taken from nets, nor packed deep in boats, boxes, or barrels, and care should be exercised to see that they are not crushed or bruised by large chunks of ice. Warmth, as every fisherman knows, hastens decomposition. It is best to put the fish in finely crushed ice immediately after capture, but if not so treated they should be kept as cool as possible and should be salted with the least possible delay. It is well to remember that fish are of about the same temperature as that of the water from which they come, and therefore fish taken from warm water should be handled more expeditiously than those from cold water. Fish should be shielded from direct sunlight and should not be allowed to dry, as the skin shrinks and loses its luster if dried.

2. Thorough cleaning, especially removal of all blood.—It has been found in the case of river herring that blood spoils at a much lower temperature than flesh. These fish can be salted at from 90° to 100° F. or higher if the blood is all removed, while those containing

blood will sour if salted at 65° F. In cool climates the blood may be left in the fish if desired, as it imparts a distinct flavor, for example, in the Scotch method of curing herring. But in warm climates, where conditions are unfavorable at best, there is no choice but to remove every trace of blood as well as all entrails and roe and the head. To do this it is necessary to behead the fish, take out entrails, scrape the kidney out (the bloody strip lying under the backbone), and wash the fish thoroughly. (A 20-penny wire nail, the head of which has been sharpened with a file, makes a convenient instrument for scraping out the kidney.) Large fish may be split through the back and laid open. The washing should preferably be done by rousing the fish in brine of about the strength of sea water, but it may be done in cold fresh water. In the case of alewives or river herring, the washing operation should also serve to remove scales by vigorous rousing. It may seem that if the blood spoils at 65° F. the meat of the fish would not necessarily be ruined. But the taint of spoiled blood is sufficient to make the entire fish unfit for food. It is also probable that the presence of blood may initiate a kind of decomposition of the flesh.

3. Use of salt of a high degree of purity.—This is the most important factor in salting fish in warm climates; yet some people are inclined to question the truth of this statement. Fishermen generally have no first-hand way of knowing whether or not any particular lot of salt is pure, as neither the looks of salt nor the claims of advertising matter are always reliable indications of purity. By purity is meant not cleanness but the scarcity of foreign substance in the salt. Salt may be highly impure yet perfectly white and very fine and clean, for the two most objectionable impurities, lime and magnesium salts, are white, like salt. On the other hand, salt may be dirty or colored, and yet if lime and magnesium salts are absent may penetrate and preserve the fish.

It is therefore necessary to have a salt of a very high degree of purity; that is, with less than 1 per cent total impurity. There are grades of salt on the market containing a total of less than one-tenth of 1 per cent impurity.[1] These salts are especially suitable for salting fish by this method. Chemical analysis is the only reliable guide to purity; most reliable dealers are able to give the correct analyses of their brands of salt, and these figures should be required before purchase. The figures for sodium chloride (pure salt) should be 99 per cent or over—the higher the better, 99.96 per cent sometimes appearing. The figures for calcium (lime) and magnesium salts should be as low as possible. It makes little difference whether they are sulphates or chlorides, any salt in which calcium and magnesium taken together are more than 1 per cent should be looked upon with suspicion for salting fish in warm climates.

The presence of moisture does not cause the salt to be unsuitable. If moisture is present, as it usually is, allowance should be made for it; pure salt (sodium chloride) and moisture added together should

[1] Names of manufacturers of satisfactory brands of salt will be supplied on application to this Bureau; also if analysis of a salt is furnished, the Bureau will, upon request, give opinion as to its suitability for curing fish.

exceed 99 per cent. The following example will illustrate the point. A chemical analysis of some lot of salt is, let us say:

	Per cent.
Sodium chloride	97.50
Moisture	2.00
Magnesium chloride	.25
Calcium sulphate	.25
Total	100.00

This analysis shows only 97.5 per cent pure salt—which might not appear suitable for fish. But allowance must be made for the harmless moisture present. Strictly calculated, after this allowance is made, there is found to be 99.49 per cent pure salt; practically the same result (though not absolutely correct), 99.50 per cent is the sum of pure salt and moisture. The sample is therefore very pure and suitable for salting fish.

Calcium and magnesium in salt, even in small quantities, greatly retard penetration, so much so that in warm weather the fish may spoil before the salt strikes through. But in cold weather in northern climates salt containing considerable quantities of these substances may be used successfully. It will be noted by those who use highly purified salt that the fish do not become white and firm as they do with ordinary Turks Island, Trapani, or other crude salt. The lime and magnesia have a hardening effect on fish, and they whiten the flesh by coagulating it, as heat whitens the white of egg. Nevertheless, the somewhat yellowish, soft fish, produced in pure salt is equally as well preserved as the hard fish in crude salt, is milder and richer in flavor, and soaks out more quickly. This may be somewhat difficult to introduce in a market that has been accustomed to a hard, white fish, but the consuming public should not be long in discerning the superiority once the purer fish is distributed.

It may be objected that pure salt is too expensive. The crude salt may be, let us say, $10 per ton and pure salt $25, a difference of $15 per ton more for the pure grade. Fifteen dollars per ton is three-fourths of a cent per pound; about 35 pounds of salt will suffice for 100 pounds of fish. The difference in cost for salt is therefore about 27 cents per 100 pounds of fish, or one-fourth of a cent per pound on the basis of the above assumption. The loss of a few barrels of fish (including the labor that was put upon them) will cover the cost of a large pile of pure salt. In very warm climates, in salting river herring, pure salt is necessary to safety.

4. Application of salt in the dry condition.—There is very extensive business in both dry salting and brine salting or pickling fish. In the case being considered, where the greatest speed of penetration is necessary, the dry salt must be used, for, applied in this way, it penetrates much faster than brine. Again, the fisherman fortunately located in a cool country may follow his discretion, but the fisherman who works under the handicap of a warm climate will find it necessary to use the salt dry.

About 35 pounds of salt to each 100 pounds of fish is sufficient, if well distributed. The fish should be rolled in the salt (which should be fine grained), the belly cavities filled, and the fish packed backs down in tubs so as to hold the salt until it dissolves. These tubs may be made by sawing barrels in two in the middle. A weight should be placed on the fish to keep them from floating, but not sufficient to press or crush the fish. If barrels are used they should not be filled at first, as the pressure will be too great on the fish at the bottom, but after the fish are struck through barrels may be packed full.

The reason for using dry salt is not difficult to see. It is the brine or salt immediately in contact with the fish that acts on the fish. If brine is used, the water coming from the fish dilutes it and it rapidly becomes less effective unless the fish are continuously stirred; but if dry salt is used, the water coming out of the fish immediately becomes saturated with salt, so that the brine in contact with the fish is saturated at all times.

If the brine is warm, the fish may be struck through in less than 24 hours, but ample time should be allowed. It appears that the warmer the brine, the faster it penetrates; and also the faster the fish spoils; there should be therefore some temperature which would give the most rapid penetration without excessive decomposition, but this temperature has not been determined. One soon learns to tell by the appearance of fish after it is broken through the backbone whether or not it is struck through.

Shipping or storage of fish in brine.—If for immediate market, the fish may be taken from the brine and shipped at once. This involves draining off the brine, applying some more dry salt, packing the fish in sugar barrels or other containers, and shipping. In this condition the herring are excellent, but will not keep long, as the fat will rust and become rancid. In case the fish are to be held for a period of weeks or months, it will be necessary to keep them under brine at all times for the purpose of excluding air which causes the fat to rust. They should be allowed to remain in their original brine, strong, tight barrels being used. The barrels should be quite full of fish, and there should be a slight excess of undissolved salt. The barrel should be tightly headed, turned on its side, and nearly filled with brine through the bunghole, leaving slight space for expansion, and then bunged up. It should be stenciled or otherwise marked to show the nature and net weight of the contents. In very warm climates there is need for investigation of storage conditions under which salt fish can be kept successfully; until the subject is investigated, it is recommended that if fish are to be kept for any considerable time, they be placed in cool storage.

Summary.—If the method is followed as herein described, river herring (and possibly other fishes) may be salted under surprisingly unfavorable conditions of temperature; the cured fish will be sweet and mild; they will soak out readily, and be free from the acrid salty taste characteristic of fish that have been cured in salt containing calcium and magnesium. They will be softer and less white or chalky in appearance than fish cured in crude salt, but these differences should be regarded as marks of superior quality.

Numerous recipes for cooking salt and smoked fish will be found in Economic Circular No. 29, "Why and How to Use Salt and Smoked Fish," published by the Bureau of Fisheries, and sent free on application.

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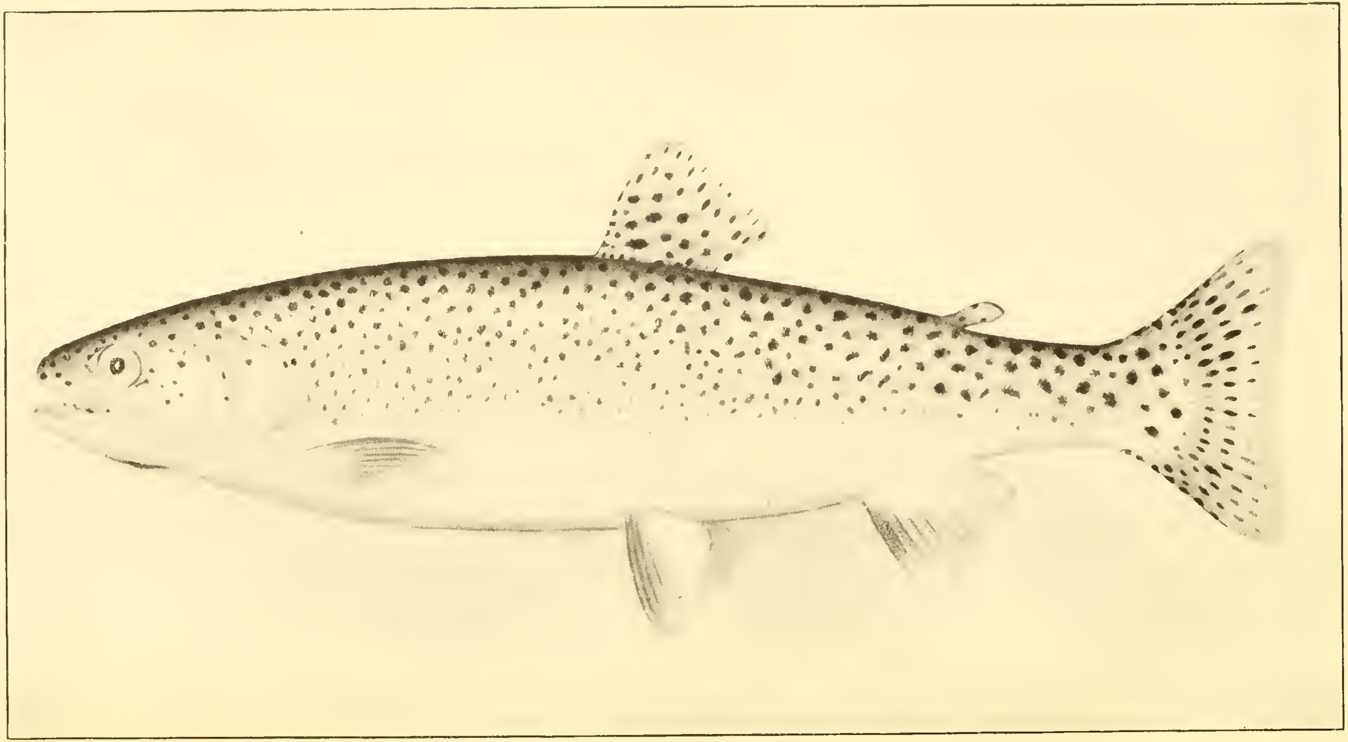

FIG. 3.—REDTHROAT TROUT; CUTTHROAT TROUT; BLACKSPOTTED TROUT.

FISHES OF THE YELLOWSTONE NATIONAL PARK.[1]

With Description of the Park Waters and Notes on Fishing.

By Hugh M. Smith and William C. Kendall.

CONTENTS.

INTRODUCTION.

The fishes of the Yellowstone National Park constitute one of the most interesting and noteworthy attractions of that wonderland. The special appeal which the fishes make to the park visitors comes partly from the beauty, gameness, and variety of the fishes, and partly from the inspiring environment in which fishing may be done. Among the wild, backboned animals in the park the fishes are the only ones whose killing is allowed and encouraged by the park authorities. The greatly increased number of visitors to the park in recent years has brought the fishes into unusual prominence and necessitates renewed efforts to maintain the supply by means of artificial propagation and protection.

It is hoped that this little document relating to fishes and fishing may serve a useful purpose beyond merely furnishing information for anglers. Increased knowledge of the park fishes should have the effect of increasing the public appreciation of the extraordinary opportunity for healthful recreation that the park affords, and at

[1] Appendix III to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 904.

the same time should discourage unnecessary destruction of fish life and develop a spirit of cooperation with the Government agencies that are striving to maintain the fish supply.

The present report is a revised and amplified edition of the one published by the Bureau of Fisheries in 1915.[2] The exhaustion of the supply of that document and the continued public demand for information on this subject, together with the availability of new data on the fishes, make this publication desirable.

INDIGENOUS FISHES.

The native fish life of the park was profoundly affected by the great lava flow which occurred over a large part of the park in Pliocene times. Whatever fishes were then present were necessarily killed, and, with the reestablishment of the watercourses after the cooling of the surface of the lava, fishes in outside waters were to a great extent prevented from reaching the lofty plateau, which comprises most of the area of the park, by the high and steep falls over which the streams leave the lava beds.

It thus follows that the native fish fauna of the park is very limited. Except in Yellowstone River and its tributaries practically no fishes occur naturally above the falls, and in the extensive basin of that river the few species that do exist gained access to the region above the falls because of the imperfect watershed separating the Yellowstone and the Snake River basins.

The original comparative barrenness of the park in fish life was due entirely to topographical conditions. The physical character of the waters is, in general, highly favorable for fishes, and an examination of the streams and lakes of the park by Prof. Forbes in 1890[3] disclosed the presence in certain barren waters of an abundant insect and crustacean food well suited for sustaining certain kinds of fishes. The theory that would account for the original absence of fishes in particular park waters as due to the high temperature and chemical constituents of the great volumes of water flowing from the geysers and hot springs is entirely untenable for several reasons: First, native trout abound and flourish in various streams and lakes in close proximity to the outpourings of geysers and hot springs, and, secondly, both native and exotic trouts have been successfully planted in barren waters receiving the discharge of geysers and hot springs.

The fishes of natural occurrence in the park represent 10 species, as follows: Longnose sucker, rosyside sucker, chub, silverside minnow, longnose dace, dusky dace, Rocky Mountain whitefish, redthroat trout, Montana grayling, and blob. Of these only the trout and the grayling have generally been recognized as game fishes, although the whitefish might properly be so considered. While these were very abundant in certain waters, the annually increasing numbers of angler-tourists in the park made it desirable to augment the natural supply of game fishes by the introduction into barren waters of selected species of other game fishes.

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[2] The fishes of the Yellowstone National Park. By William C. Kendall. Bureau of Fisheries Document No. 818. 1915.

[3] A preliminary report on the aquatic invertebrate fauna of the Yellowstone National Park, Wyo., and the Flathead region of Montana. By S. A. Forbes. Bulletin U. S. Fish Commission, vol. XI, for 1891, p. 207-258, pl. XXXVII-XLII. 1893.

INTRODUCED FISHES.

In immediate response to the outcome of investigations to determine the suitability of fishless park waters for game fishes, the Bureau of Fisheries in 1889 inaugurated the planting of selected species in predetermined waters, and this work has been continued to the present time. The one species of native trout was soon supplemented by the very successful introduction of five other trouts, and in a short time the park became an angler's paradise, affording better and more varied trout fishing than could be found anywhere else in the country, if not in the world.

The nonindigenous trouts that have been introduced into park waters are the rainbow, Loch Leven, brown, lake, and eastern brook trouts, all of which have become firmly established. The distribution of the native redthroat trout has been greatly extended into previously barren waters. The introduction of two other game fishes has been attempted, but apparently without positive results. One of these is the landlocked salmon (*Salmo sebago*), of which 7,000 fry were planted in Yellowstone Lake and 2,000 in Duck Lake in 1908, but not a vestige of these plants has ever been seen. The other species is the largemouth black bass (*Micropterus salmoides*), of which 500 fingerlings were planted in "lakes in Yellowstone National Park," according to the indefinite official record. These lakes are thought to have been Feather Lake and Goose Lake, in the Lower Geyser Basin. An earlier plant of 250 black bass was made in the Gibbon River, in 1893, but it is not known which of the two species of black bass composed this plant. There is no evidence of the survival of black bass anywhere in the park, and this may be regarded as a fortunate circumstance. In our opinion, there should be no further attempts to establish black bass in the park, as they do not harmonize with the trouts, and their predatory habits make them unsafe species to introduce among the soft-finned fishes which, with two minor exceptions, constitute the local fauna. The only other species of fish that has been introduced into park waters is the yellow perch, whose planting was unofficial and is apparently to be ascribed to the unauthorized act of a private individual. This fish now abounds in certain lakes in the Lower Geyser Basin.

FISH CULTURE IN THE PARK.

The hundreds of thousands of visitors who have already been in the park and the millions of others who are destined to visit it owe to fish culture and fish acclimatization a debt whose value can hardly be estimated. Within a few years after experienced fish-culturists began to give attention to needs of the park the hitherto fishless waters began to produce desirable game fish in abundance, and this has continued up to the present time. The early work, as well as the efforts of the fish-culturists of late, has been directed mostly to maintaining the supply of fishes already established.

For many years the Bureau of Fisheries has conducted fish-hatching operations in the park. The first hatchery was located at the Thumb of Yellowstone Lake; the principal hatchery now is on the lake shore near the Lake Hotel. In 1921 a permanent hatchery was erected on Soda Butte Creek, which had been the site of a field hatchery for a number of years. The hatcheries are maintained, primarily, for the purpose of keeping up the supply of redthroat trout.

The redthroat trout is the only local trout which spawns during the season when the park is easily accessible and when it is possible without unwarranted effort and expense to obtain a supply of running water for hatching purposes. The adult fish begin to ascend the streams that are put into flood by the melting snows and they continue to run until the latter part of July. Some fish, however, doubtless spawn also in Yellowstone Lake and other large lakes.

The principal supply of eggs for hatching purposes comes from creeks on the eastern side of Yellowstone Lake. Into these creeks the trout run at spawning time and across them the fish-culturists erect intercepting barricades or racks. These racks are provided with narrow passageways that lead into traps in which the fish congregate. The trout are transferred to live cars, where they are held pending the ripening of their eggs. At the proper time the eggs are stripped from the fish and held at improvised field hatcheries pending shipment to the central station. The adult fish are released alive.

The questions naturally arise, Why not let the trout run up the creeks and spawn naturally? Why not permit the eggs to hatch in the manner intended by nature and let the young remain for awhile in the water where they were born and then run back to the lake at the proper time? These questions, which will, no doubt, be asked by many thoughtful park visitors, afford an opportunity to indicate one way in which it is possible to improve on nature and to point out why in the Yellowstone National Park, as elsewhere, it is desirable or necessary for the fish-culturist to go to nature's assistance.

The streams in which the redthroat trout spawn are usually much swollen at the time of the run. Pushing upstream energetically, the fish often go far from the lake and deposit their spawn during high water in places which later, with the complete melting of the snow, may become exposed to the air. Heavy losses of eggs occur in this way. If conditions are favorable for the laying and hatching of the eggs in streams that may be raging torrents in spring and early summer, it frequently happens that by July and August such streams become almost dry, are cut off from the lake and reduced to disconnected pools, and the young fish necessarily perish sooner or later.

The adverse conditions occurring in nature make it probable that at best only 5 or 10 per cent of the eggs produce fry that reach the feeding stage at which the hatchery turns the fish loose. On the other hand, fully 90 per cent of the eggs taken by artificial methods are safely incubated and yield fry that are liberated in selected places—along the lake shore or near the mouths of open creeks where there is a good prospect of survival.

There are still a few fishless waters in the park, but each season additional lakes and streams are stocked and ultimately all waters suitable for fish will have received attention. In 1919 Mallard Lake, a beautiful mountain gem not far from Old Faithful Inn, was found to be fishless and was planted with eastern brook trout. This seems destined to become a favorite angler's resort. Other waters recently stocked with redthroat trout for the first time are various lakes in the southwest section of the park.

PRINCIPAL FISHING WATERS.

The fishing season in the park does not ordinarily begin before July, by which time, according to one of the angling writers hereafter cited, "the plethora of water has disappeared and the streams flow swift, clear, and cold. At this season of the year trout fishing is at its best."

Information regarding the fishing in various localities may be found in the annual reports of the superintendent of the park, particularly the report for 1897, and in the annual circulars of information issued by the National Park Service. The following publications pertaining wholly or partly to fishing in the park may be consulted for detailed or special data:

Fish in the National Park and tributaries of Snake River. By J. E. Curtis. Bulletin U. S. Fish Commission, vol. IV, for 1884, p. 335–336.

A reconnoissance of the streams and lakes of the Yellowstone National Park, Wyo., in the interest of the United States Fish Commission. By David Starr Jordan. Bulletin U. S. Fish Commission, vol. IX, for 1899, p. 41–63, with map and many plates.

A reconnoissance of the streams and lakes of western Montana and northwestern Wyoming. By Barton W. Evermann. Bulletin U. S. Fish Commission, vol. XI, for 1891, p. 3–60, with plates and maps.

A woman's trout fishing in Yellowstone Park. By Mary Trowbridge Townsend. Outing, vol. XXX, no. 2, May, 1897, p. 163–164.

A list of the fishes of Montana, with notes on the game fishes. By James A. Henshall. Bulletin of the University of Montana, No. 34, Biological series no. 11. 1906.

Wyoming summer fishing and the Yellowstone Park. By Ralph E. Clark. Outing, vol. LII, no. 4, July, 1908, p. 508–511.

Fly fishing in wonderland. By Klahowya (O. P. Barnes). 56 p. 1910.

The Yellowstone National Park. By Hiram Martin Chittenden. Fishes, p. 210–212. 1915.

The following annotated list of park fishing waters is based partly on information kindly furnished by Col. L. M. Brett, United States Army, formerly acting superintendent of the park; partly on notes taken from the works before cited; partly on observations by A. H. Dinsmore, of the Bureau of Fisheries, in 1919 and 1920; and partly on the senior author's observations in 1914 and 1919.

YELLOWSTONE LAKE.

Yellowstone Lake is one of the most beautiful lakes in the world. It and some of the tributary creeks abound with the native or redthroat trout. There appear to be no other game species in the lake. Landlocked salmon planted in 1908 and 1909 have not been seen since. The rainbow trout, planted at the same time in some of the affluents, have shown no evidence of establishment, excepting on the statement of Mr. Croley, a hotel fisherman for 12 years, to the effect that he had seen only one fish other than the blackspotted trout. This fish "looked different and had a broad side band" and was thought to be a rainbow.

In 1919 the senior author found the water of Flat Mountain Arm, though shallow, distinctly colder than in the lake, evidently owing to the inflow of springs and the creek at its head. Near the head of this arm he found the largest redthroat trout met with in the park, fine, clean, trim, vigorous fellows, not like those observed elsewhere.

All suitable tributary creeks contain redthroat trout. The most notable creeks on the east side of the lake, enumerated from north to south, are: Pelican, Cub, Clear, Columbine, and Beaverdam Creeks. All contain native trout. Sylvan Lake, which discharges through Clear Creek in times of high water, contains a few trout. It is a beautiful mountain lake, clear and moderately cold. Ralph E. Clark said of Pelican Creek:

> One mile east of Yellowstone River outlet is Pelican stream, which rises in the cold snows of the mountains and empties its waters into the lake. Here you catch quantities of uncontaminated trout, large, beautiful, fat, and gamy, as free from worms as the fresh cold waters they swim in are free from pollution.

On the west side of the lake, named in the same order, are Bridge Creek, entering Bridge Bay; Arnica Creek, an affluent of the northwest side of the Thumb; Solution Creek, a small, narrow stream, with lava bottom and grassy banks bordered with willows, the outlet of Riddle Lake, sometimes going dry. Riddle Lake, so called because of the former mystery of its outlet, is a clear pond of roundish outline, about 1½ miles in diameter, about whose outlet are numerous lily pads and other plants. Its shores are shallow, and its bottom is chiefly of lava gravel. The temperature is about 50° F. Trout are numerous.

Near West Thumb is another small, deep-set lake, named Duck Lake, which has no outlet. It formerly contained no trout, but redthroat trout and landlocked salmon were planted in it. Redthroat trout now appear to be abundant, but landlocked salmon have never been observed. However, the senior author found good-sized Loch Leven trout common in 1919.

Grouse and Chipmunk Creeks enter opposite sides of the southern end of the South Arm. Besides these there are numerous unnamed creeks, some of which go dry in summer. One, however, flowing into Flat Mountain Arm, was found by the senior author on July 17, 1919, to contain more water than many of the other creeks around the lake, probably never going dry. A creek that will flow as did this one during a period of drought, with the lake level one-third lower than ever before known, must be permanent. The creek, unnamed on the available maps, clear and cold, with beautiful green, grassy banks with trees here and there, meanders to an extraordinary degree through a broad, open valley, flowing over a gravelly bed, now with riffles, now with deep holes, making a charming trout brook. At its mouth is a flat much frequented by elk. This creek was found to contain numerous trout of season's hatch; some 3 to 5 inches long of the previous season; and older fish up to 12 inches in length.

YELLOWSTONE RIVER ABOVE THE LAKE.

Above the lake the Yellowstone River winds through marshy meadows, between wooded hills, behind which are the rugged peaks of high volcanic mountains. The current is sluggish, and, according to Mr. Dinsmore, the fall is so slight that it would be a comparatively easy matter in times of ordinary flow to travel by canoe the entire distance from the lake to the southern boundary of the park.

The principal tributaries of this portion of the river from the lake southward on the left are Cabin, Trappers, Mountain, Cliff, Escarpment, and Thoroughfare Creeks. On the other side in the same direction are Badger, Phlox, and Lynx Creeks. Good fishing is found in the river and in the creeks high up where they meander from the mountains.

YELLOWSTONE RIVER BELOW THE LAKE.

Below the lake to the upper falls there is no great descent, and the river flows for about 15 miles with a quiet current. Here its banks are bordered with low hills, some of them wooded, others forming open pastures. On the right side going northward the principal creeks are Cotton Grass and Sour Creeks, which unite to discharge their waters into the Yellowstone not far from Alum Creek on the opposite side of the river. On the west side of the river is Trout Creek, which is a clear stream, with grassy banks and gravelly bottom. It has a summer temperature of about 58° F. and is a good trout stream.

Alum Creek is a clear stream about 8 feet wide and 1 or 2 feet deep, rising in the Continental Divide opposite the head of Nez Perce Creek and flowing eastward through the grassy fields of Hayden Valley. Its bed contains much white alkali from the hot springs above, and there is a perceptible alkaline taste to the water, which has a temperature of about 60° F. in summer. In its upper course it has some hot tributaries. One of these is Violet Creek, with a number of hot springs and mudholes. Still another fork is charged with alum, but a third branch is said to be one of the best redthroat trout streams in the park.

YELLOWSTONE RIVER AND BRANCHES BELOW THE FALLS.

About 15 miles below the lake the river plunges into a deep canyon over two vertical falls 109 feet and 308 feet in height. This remarkable canyon is more than 20 miles long, with nearly perpendicular walls 800 to 1,100 feet in height. The current below the falls is swift until the river leaves the park.

The most important eastern tributary of the Yellowstone River is Lamar River. It is a large stream, sometimes referred to as the East Fork of the Yellowstone. It joins the Yellowstone not far below Butte Junction. There are many tributary creeks of various sizes, particularly on the north and northeast side. The principal of these are: Miller, Calfee, Cache, Soda Butte, joined by Amphitheater and Pebble Creeks; Slough Creek, the largest branch of which is Buffalo Creek. On the west side the creeks are smaller than most of those of the other side, the principal ones being Cold, Willow, and Timothy, near the upper course. Chalcedony Creek is farther down, and all but Cold Creek are in rather deep ravines near the river. Cascade Creek is a clear brook a few feet wide which enters the Yellowstone between the falls. The high, nearly vertical "Crystal Falls" (129 feet) is near the mouth of the stream and, of course, prevents the ascent of fishes. Redthroat trout were once planted above the falls.

Lamar River and most of its tributaries are inhabited by native trout. The junction of Yellowstone and Lamar Rivers is noted for fine fishing. Soda Butte is well stocked up to near its head, where a waterfall keeps the fish back. According to Mr. Dinsmore, Fish Lake, where the Bureau of Fisheries has for a number of years collected native trout eggs and where in 1921 a small hatchery was established, is a very remarkable water, with an area of only 75 acres. It contains a dense growth of vegetation, which in the late summer blossoms near the surface. After sundown the fish, which average about 2 pounds each, will come up out of the weeds and take gray-hackle flies almost as fast as they can be placed upon the water.

Slough Creek is said to be well stocked with trout up to the lakes at its head, only one of which, Lake Abundance, in Montana, contains trout.

Hellroaring Creek, which joins the Yellowstone from the north below the mouth of Lamar River, is abundantly supplied with native trout in its lower part.

The tributaries of the west side of the Yellowstone worthy of mention all enter this river below the Grand Canyon. The uppermost is Antelope Creek, which joins the river not far from the mouth of Tower Creek. It contains native trout. Tower Creek, for almost its whole length, is hidden in dense forests. Its current is swift, and it is perhaps the coldest stream in the park, the summer temperature being about 45° F. Carnelian Creek is one of its upper branches. About one-fourth mile from its mouth the creek forms a singularly picturesque, quite vertical fall of 132 feet, which is surrounded by lofty towers of volcanic conglomerate. Below the falls is a deep canyon, where the stream is about 10 feet wide and shallow. The waters above the falls were barren previous to the introduction of eastern brook, rainbow, and redthroat trouts.

The lower tributaries of the Yellowstone in the park are Geode Creek, Blacktail Deer Creek, and Gardiner River. Geode Creek is small. Rainbow trout planted in it in 1909 have not since been observed. Blacktail Deer Creek is a clear, rather cold (55° F.) stream running largely through open pastures, with willows along its course. It has no canyons or falls. Its bottom is of laval gravel and rocks, with some water weeds. In summer it is usually 5 or 6 feet wide by 1 or 2 feet deep and is well stocked with native redthroat trout and rainbow trout. Eastern brook trout were planted in 1912, 1913, and 1914.

GARDINER RIVER AND ITS BRANCHES.

In the park Gardiner River may be said to be formed by two branches, designated on the maps as Lava Creek and Gardiner River, but the latter is sometimes referred to as the "Middle Fork."

Lava Creek is a clear, mountain stream in its upper course, flowing through evergreen forests on the north side of the mountain range. The stream is normally about 10 feet wide and 1 or 2 feet deep. Toward its mouth it cuts its way into a broad, flat shelf of lava, forming two falls about one-tenth of a mile apart. The upper falls, called Undine Falls, are vertical for about 30 feet, with two additional leaps of about 20 and 10 feet. The lower falls are vertical and about 50 feet high. Below these falls the stream flows through a highly picturesque canyon, joining Gardiner River above Mammoth Hot Springs.

Lupine Creek is a small tributary of Lava Creek, entering it above the falls. Near its junction with Lava Creek this creek has a cascade about 100 feet high called Wraith Falls. Notwithstanding the barrier offered by the falls, Dr. Jordan said that it was reported on good authority that small trout had been taken in Lava Creek above the falls. His attention was called to a possible means of access from Blacktail Deer Creek to Lava Creek in times of high water. In Lava and Lupine Creeks the only trout is the native redthroat. Below the falls native redthroat and Loch Leven trouts occur in Lava Creek.

Gardiner River, or Middle Fork, rises on the east slope of the Gallatin Mountains in the northwestern part of the park. It flows eastward, southward, then abruptly northward, bending around Bunsen Peak and forming a deep canyon, toward the head of which are Osprey Falls. Gardiner Canyon is some 800 to 1,000 feet deep, with vertical walls of lava, basalt, etc., and in grandeur is surpassed only by the Grand Canyon of the Yellowstone. Osprey Falls are about 150 feet high and nearly vertical. The principal headwaters of the Gardiner are Fawn, Panther, and Indian Creeks, which, with their branches, unite near Seven-mile Bridge. Winter and Straight Creeks unite into one stream and join Obsidian Creek to form Willow Park Creek, which also joins the Middle Fork near Seven-mile Bridge. Obsidian Creek originates in or near Twin Lakes, according to Jordan, and some of its branches in other small lakes, notably Lake of the Woods, which flows into Beaver Lake. At first the creek is very small, and its course for 2 or 3 miles is full of hot springs, solfataras, boiling mudholes, and various similar heated areas. Lower down cold springs enter the stream, and at Beaver Lake the water is clear and cold. Beaver Lake is a shallow, grassy pond, about a mile long, formed in the stream by the beavers. Eastern brook trout are reported as plentiful, but the rainbow trout, also planted there, have never been heard of. Below this lake the creek receives the clear, cold waters of Winter Creek and Straight Creek.

Winter Creek is a large stream which heads in Christmas Tree Park at the foot of Mount Holmes. Straight Creek flows through dense woods, open grass-grown meadows, and narrow canyons. It is a very pretty stream, with many riffles and deep holes behind prostrate logs, and wide, shallow, gravelly reaches. In the course of Straight Creek is Grizzly Lake. It is a gem, with steep, wooded banks, clear, cold water, with shelving bottom and quite deep center. After their junction the waters of these creeks, under the name of Willow Park Creek, flow through Willow Park, a large mountain meadow, at the foot of which it meets the waters of Indian Creek and the others which have been mentioned, forming the Middle Fork of Gardiner River. Indian Creek is a clear, cold stream similar to the Gardiner.

All of the aforementioned creeks, previously barren, now teem with eastern brook trout, the only trout occurring in them. Jordan reported that Obsidian Creek with Winter Creek was one of the best eastern brook trout streams in the park. Its summer temperature is about 50° F. Its bottom is composed of laval gravel, lined with grass, algæ, and other water plants in which small crustaceans abound. The senior author observed that Straight Creek teemed with brook trout of all sizes up to 12 inches long. Hundreds, mostly about 6 or 7 inches long, were observed. The fish were the most beautifully colored seen in the park. Males only 3 or 4 inches long showed the brilliant coloration of the fully developed fish in breeding season. Females 6 inches in length and upward had well-developed eggs. Grizzly Lake contains very large brook trout.

Above Osprey Falls the Gardiner is a clear, cold stream, having a temperature of about 50° F. The bottom is composed of numerous stones and bowlders, and there are many deep holes. This previously barren stretch of water now contains the introduced eastern brook, Loch Leven, brown, and rainbow trouts. About halfway down from the falls to the junction with the East Fork Glen Creek joins the river on the left side. Glen Creek has been called the West Fork of the Gardiner. It rises in the Sepulcher Mountain region and flows southeast to Swan Lake outlet, thence northeast, joining the Gardiner at the foot of the canyon. It is a small stream, only 5 or 6 feet wide and 1 or 2 deep, which runs mostly through open meadows, with gravelly and grassy bottom. Its waters are very cold, about 48° F. in summer. Glen Creek has a waterfall some 70 feet high, known as Rustic Falls, at the Golden Gate near the base of Bunsen Peak. A small lake in the vicinity of Sepulcher Mountain was stocked with eastern brook trout in 1912, but the results are as yet uncertain. Below the falls the deep canyon is so choked with bowlders and talus that fish can not ascend it.

Swan Lake is a small, roundish pond about a half mile long, with a bottom of crumbled lava. While the water near shore is very shallow, the depth at the center seems considerable. The water is clear and cold and abounds with insects and crustaceans.

Eastern brook trout abound in the creek above the falls, but those planted in Swan Lake, it is said, seem to have left the lake for the small streams, as they have not been found in the lake. Near the junction of the Gardiner with the East Branch the stream is rough and bowlder-strewn, but of a good volume, much like the Gibbon in character. The lower course of the Gardiner below the falls is well stocked with native redthroat trout and introduced eastern, rainbow, and Loch Leven trouts. Indigenous whitefish, suckers, and minnows also occur.

Below Mammoth Hot Springs the scalding waters of those springs discharge through "Hot River" into the Gardiner. It is said that in winter native trout are especially abundant at the mouth of the stream.

GIBBON RIVER ABOVE FALLS, GREBE AND RAINBOW LAKES.

Gibbon River issues from Grebe Lake, which is located in a marshy area in the highlands. Grebe Lake is about a mile long and is one of the most attractive small lakes in the park. It was stocked with redthroat trout in 1912, but the results are not definitely known.

Approximately a mile or a mile and a half below Grebe Lake is another small lake visited by the senior author and Mr. Dinsmore in 1919. They proposed to name it Rainbow Lake. The lake drains a very extensive marshy area whose arms extend far into the hills, with greatly meandering, clear, cold streams. The lake has a gravelly bottom, gently sloping shores, and a deep center. At several points are extensive beds of yellow water lilies, and the mouth of the large main affluent is covered by the same plants. Large rainbows frequent the lake and the effluent, and smaller fish abound in all the minor streams.

Gibbon River emerges from the southeast corner of Rainbow Lake. About a mile below the lake are hot mineral springs which discharge into the river, and for a mile or more the water is warm, distinctly impregnated, and fishless. Then cold springs entering the river from the hillsides render the stream again inhabitable by trout, which occur all the way to the Upper Falls of the Gibbon. These falls are too high to permit of the passage of fish upward.

From Virginia Cascade to Norris Station the river, with Solfatara Creek, affords fine fishing for eastern brook trout. Mr. Dinsmore reports that on July 26, 1919, he had wonderful fishing for this species and no other species was observed in this section of the river, although rainbows occur above Virginia Cascade and in the Gibbon below Norris Station.

Below the falls Canyon Creek, entering the river from the eastward, contains redthroat trout. From the falls to the junction of the Gibbon with the Madison the fish are the same as those occuring in the Madison and below the cascades of the Firehole.

MADISON RIVER AND ITS BRANCHES, FIREHOLE RIVER, NEZ PERCE CREEK, LITTLE FIREHOLE RIVER, ETC.

Native redthroat trout, whitefish, and grayling are abundant, as are also the introduced Loch Leven and brown trouts in the upper Madison.

The Firehole River, about twice the size of the Gibbon River, joins it from the south. This stream heads just west of Shoshone Lake, separated from it and from the head of Bechler River by a relatively low divide, according to Gannett. It flows through Madison Lake, which is nearly dry in summer, but below it is reinforced by the fine, clear Spring Creek from the east. In its upper course the Firehole, like Spring Creek, is a clear and very cold stream, flowing through dense woods, with narrow marshy valleys alternating with small canyons. Keppler's Cascades, above the Upper Geyser Basin, is a series of very picturesque falls probably impassable to trout. Along the Firehole are the most noteworthy of the geyser basins, and a great volume of hot water is poured into it without, however, rendering its waters at any point really warm or unfit for trout. The principal tributaries are Iron Creek and Little Firehole River, in the Upper Geyser Basin. At the lower basin the Firehole receives the waters of Sentinel Creek, Fairy Creek, and the larger and more important Nez Perce Creek.

Nez Perce Creek comes in from the east, is nearly half as large as the Firehole, and is similar in character and temperature of the water. It is fed by numerous short streams, none of them hot and most of them confined to a narrow canyon.

Madison River.—The name Madison is used only for the river below the junction of its chief tributaries, the Firehole and Gibbon Rivers. The principal tributaries of the Madison as thus defined join the river beyond the park boundary. Named in order from the south to north they are Cougar, Gneiss, and Grayling Creeks. Within the park Cougar Creek receives the waters of Maple Creek, the principal tributary of which is Duck Creek. These upper waters are inhabitated by native redthroat trout. Campanula Creek joins Gneiss Creek beyond the park boundary. It also contains redthroat trout, as do the upper waters of all three of the main creeks mentioned, and in their lower courses they have whitefish and grayling besides native trout. The main Madison appears to contain a mixture of all the trouts that occur in the park, as well as whitefish and grayling.

SNAKE RIVER DRAINAGE.

Above its junction with Heart River the Snake pursues a northwest course, receiving numerous small tributaries, the most important of which is, perhaps, a branch which heads in Mariposa Lake. Two relatively large tributaries come in from the northeastward—Crooked and Sickle Creeks.

Mariposa Lake is a small body of water in the southeast corner of the park about a mile north of the park boundary. It is said to be alive with native redthroat trout and to afford wonderful fishing for large trout. About a mile beyond the boundary Bridger Lake is another remarkable native trout water.

Heart Lake, about 3½ miles long and not quite 2 miles in width, lies in a deep depression at the eastern foot of Mount Sheridan. Near the head of the lake and in the lake are numerous geysers and hot springs. Its bottom is of laval gravel, rather shallow near the shore but becoming deep in the middle. It receives some small tributaries, principal of which are Witch and Beaver Creeks. Heart River, its outlet, just below the lake receives a comparatively large tributary known as Surprise Creek.

Witch Creek has its rise 2 or 3 miles above the lake, in the singular collection of geysers, hot springs, and steam holes known as Factory Hill. Its water is at first scalding hot, but it gradually cools, receiving the waters of one cold tributary as large as itself. The lower course of Witch Creek winds through grassy meadows, with a bottom of fine laval gravel and sand. The creek at its mouth has a temperature of about 75° F. Native redthroat trout are numerous, occurring most commonly about the mouth of the creek. Besides the trout are suckers, chubs, and shiners, and the blob, or fresh-water sculpin, also occurs. There is plenty of fish food in the lake. The temperature varies according to the nearness to hot springs and geysers. Trout are said not to ascend Witch Creek, although the other species do, the chubs ascending until the water is fairly to be called hot.

Beyond the mouth of Heart River the Snake bends to the southward, thence later to the westward, receiving a number of tributaries, the largest being Basin Creek, Red Creek, and Forest Creek from the north. All the tributaries flowing directly into the Snake contain native redthroat trout.

Lewis River, which joins the Snake just within the park boundary, is the outlet for the waters of Shoshone and Lewis Lakes.

SHOSHONE LAKE AND TRIBUTARIES.

This lake has a length of about 6½ miles and a width of one-half to 4½ miles, being dumb-bell shaped or constricted in the middle. Its area is about 12 square miles. Its shores are mostly bold, rocky, and densely wooded, the eastern shore being especially abrupt, and the bottom is there made by large lava bowlders. On the other side somewhat different conditions obtain, there being a considerable growth of aquatic vegetation. The lake is clearer and colder than either Yellowstone Lake or Heart Lake. The principal tributaries are Shoshone Creek at the northwest corner and De Lacy Creek at the northeast corner. Moose Creek from the southward enters the southern side of the eastern expansion of the lake. Shoshone Lake is connected with Lewis Lake at the southward by a stream of still water known as the "Canal," about 3 miles long.

Lewis Lake occupies a rounded basin with rather low banks. It is pear-shaped, about 3 miles long by 2 miles broad, very clear and cold, and apparently in every way suited for trout. Its bold shores are heavily wooded and without any large tributary streams. A few hot springs enter it on the western side.

Below Lewis Lake Lewis River enters a deep and narrow canyon. At the head of this canyon is a cascade of about 80 feet, of which 20 feet at the top is perpendicular. Toward the end of the canyon and not far above the junction with the Snake is another cascade some 50 feet in height. Owing to the falls in Lewis River no fish were able to ascend to Lewis and Shoshone Lakes, which were therefore uninhabited by any trouts until they were introduced.

Loch Leven and lake trouts are numerous, and eastern brook trout abound in Shoshone Creek. Mr. Clark wrote that the Shoshone and Lewis Lake region was probably the best fishing in the park:

> These two lakes and their outlet, Lewis River, are full of native trout and have been stocked with Mackinaw and Loch Leven trout, which are increasing in number and size most successfully. These fish will not rise to the surface and take the fly as do the regular native trout, and it is necessary to go down into the water for them. In the lakes you can catch them by trolling if you can find the particular cove where they happen to be running. However, in spite of the uncertainty of the lake trolling, there is one place where you can troll with assurance of success, and that is the canal between Shoshone and Lewis Lakes. This is a natural body of water with little or no current and not very wide. In Lewis River just below Lewis Falls, in the deep pools where the eddies are covered with foam, you are sure to find good fishing.

Rainbow trout said to have been planted in De Lacy Creek in 1895 have never been observed, but eastern brook trout of small size are numerous.

FALLS RIVER AND BECHLER RIVER.

Falls River pursues a sinuous course near the boundary in the southwestern corner of the park. It rises by two branches, one originating in a marshy area, the other in Beula Lake, near which are Herring Lake and another smaller one, both mere ponds, and flows to the eastward. In the Birch Hills it passes through a short ravine, flowing over two falls, Terraced and Rainbow Falls, the latter being the most westerly. Before joining Bechler River it receives a considerable creek, Mountain Ash by name, which flows down from the south side of Pitchstone Plateau.

Bechler River rises on the northwest side of Pitchstone Plateau and winds to the southward to its junction with Falls River just north of the boundary. It passes through a deep gorge in which are several falls, notably Iris Falls, and a short distance below Colonnade Falls. Below these falls it receives several tributaries, the most important of which is Boundary Creek, which rises across the border and flows southeastward to its junction with Bechler River.

In 1920 A. H. Dinsmore visited this region and reported it as one of the most beautiful, if not the most beautiful, of the valleys in all the park—flat as a floor, abounding in wild and domesticated grasses, meandered by fine, clear streams in which native trout of good size may be taken in large numbers. At the head of the valley, within an area of not more than 3 miles, not less than eight streams fall from the timbered plateau over falls and cascades which rival any in the park excepting the Great Falls of the Yellowstone. So close to the valley are these waterfalls that many of them are in plain view as one rides through it.

Native trout are abundant in Falls River, probably up as far as Rainbow Falls, and in Mountain Ash Creek to Union Falls; also in all the waters below the falls.

FISHING REGULATIONS.

In order to prevent undue destruction of fish and depletion of the park waters, certain restrictions have become necessary, and it is believed that anglers generally will be in full sympathy with the protective measures that the park authorities find it desirable to adopt from time to time. The general policy is to curtail fishing as little as may be compatible with the maintenance of the supply and to depend largely on increased fish-cultural operations to prevent the depletion of park waters.

Following are the fishing regulations now in force:

1. Fishing with nets, seines, traps, or by the use of drugs or explosives, or in any other way than with hook and lines, or for merchandise or profit, is prohibited.
2. Fishing in particular waters may be suspended by the superintendent.
3. All fish hooked less than 8 inches long shall be carefully handled with moist hands and returned at once to the water, if not seriously injured. Fish retained should be killed.
4. Ten fish shall constitute the limit for a day's catch per person from all waters within 2 miles of the main belt-line road system. In the case of other waters the superintendent of the park may authorize a limit of not exceeding 20 fish for a day's catch per person.

LIST OF FISHES.

1. Montana Grayling (*Thymallus montanus*).

The Montana grayling, which originally existed only in tributaries of the Missouri River above Great Falls, in the park occurs naturally in the Madison and Gallatin Rivers and their branches, Grayling Creek and Fan Creek, and in the Firehole River below the falls. It is reported as sometimes abundant at the junction of the Gibbon and Firehole Rivers and is said to ascend in summer as far as Firehole Falls. It is the principal fish in the south fork of the Madison and occurs also in the backwater of the Madison at the dam. This is a most graceful and attractive fish, of shapely proportions and exquisite coloration. The adult averages about 1 pound, but may attain a weight of 4 pounds.

The grayling prefers swift, clear, pure streams, with gravelly or sandy bottom. It is quite gregarious, lying in schools in the deeper pools, in plain sight, and not, like the trout, concealed under bushes and overhanging banks. In search of food, which consists principally of insects and their larvæ, it occasionally extends its range to streams strewn with bowlders and broken rocks.

Unlike the native trout, the grayling will go long distances, if necessary, to find suitable spawning grounds. It spawns in April and May on gravelly shallows. In the north fork of the Madison River, where the water is comparatively warm, coming from the Firehole River in the park, the grayling spawns a month earlier than in any other waters in Montana.

In point of activity it even excels the native trout, when hooked breaking the water repeatedly in its effort to escape, which the trout seldom does. It takes the artificial fly eagerly, and if missed at the first cast will rise again and again from the depths of the pool, whereas

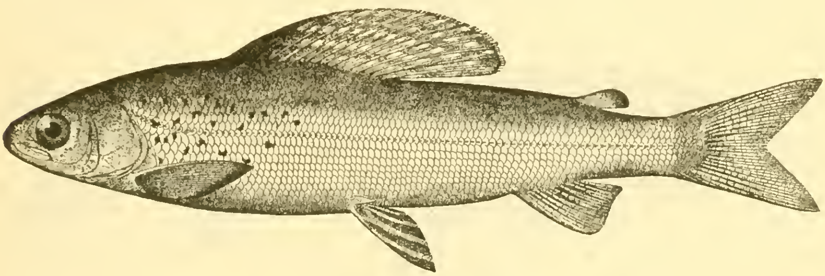

Fig. 1.—Montana grayling.

the trout will seldom rise a second time without a rest. It will also take various baits, such as caddis-fly larvæ, grasshoppers, and worms. Among the recommended flies are professor, Lord Baltimore, queen of the water, grizzly king, Henshall, coachman, and various gauze-winged flies, with No. 10 and 12 hooks. As a food fish it is even better than the trout, its flesh being firm and flaky, very white, and of delicate flavor. The grayling is artificially propagated in Montana by the United States Bureau of Fisheries and the State fish commission.

2. Rocky Mountain Whitefish (*Coregonus williamsoni*).

The Rocky Mountain whitefish occurs in all suitable waters on the west slope of the Rockies from Utah to British Columbia. A scarcely, if at all, distinguishable variety or subspecies bearing the name of *Coregonus williamsoni cismontanus* is found in certain waters of the upper Missouri Basin. In some localities this fish is miscalled grayling,[4] with which it should not be confused, as it is a very different species, and there seems to be a local Yellowstone River name, the phonetic spelling of which is "sterlet" or "steret."

[4] Referring to the fishing in the canyon of Sunlight Creek, Clark Fork, Ralph E. Clark probably made this mistake in writing the following: "You will probably first catch a scaly fish which looks like a long sucker. It is the Montana grayling, and there are many down there."

In the park it naturally occurs in the Yellowstone River below the falls as far up as Crevice Gulch, beyond which it is seldom found, in Madison and Gallatin Rivers below the falls, and has been reported also from the junction of Firehole and Gibbon Rivers. At the junction of Lewis and Snake Rivers "grayling," or "mountain herring," are reported as taken by anglers; these are doubtless whitefish.

Young whitefish 2 to 5 inches long from Montana were planted in park waters, as follows: In 1889, 2,000 were placed in Twin Lakes and 980 in Yellowstone River above the falls, and 10,000 more were planted in the latter place in 1890. It is considered doubtful if any of these have survived, owing to the number and size of voracious trout in the Yellowstone River and the mineral character and high temperature of Twin Lakes.

This fish prefers clear, cold lakes and streams, where the usual length of adults is about a foot, although it is known to have attained a weight of 4 pounds. The *cismontanus* form is essentially a river fish rather than an inhabitant of lakes and is most abundant in the

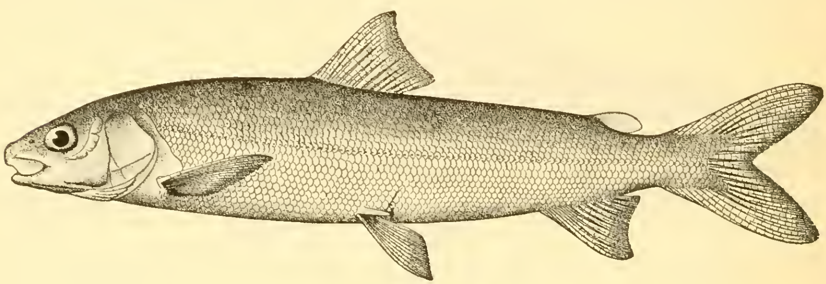

FIG. 2.—Rocky Mountain whitefish.

eddies or deeper places of swift streams. It spawns in late fall or early winter. This is a slender, graceful fish, readily taking the artificial fly like a grayling or trout, as well as natural baits, such as worms and insects and even fresh meat. However, owing to the smallness of its mouth, the hook should be no larger than No. 10 or 12, and when hooked the fish requires careful "playing" owing to the tenderness of the mouth parts. It is a game fighter. It ranks high as a panfish, for, when in condition, it is of surpassing sweetness and delicacy of flavor.

3. REDTHROAT TROUT; CUTTHROAT TROUT; BLACKSPOTTED TROUT (*Salmo lewisi*).

(See frontispiece.)

In its numerous varietal, subspecific, or specific forms the redthroat, cutthroat, or blackspotted trout is of extensive distribution on the Pacific slope. In the park a form designated as *Salmo lewisi* is found naturally in both upper Snake and upper Missouri waters, having doubtless gained access to the latter from the Snake River by the way of Two Ocean Pass, and it is not unlikely that an interchange of individuals still takes place.

Yellowstone Lake and Yellowstone River from its source to many miles beyond the park are inhabited by it. The abundance of trout above the falls is remarkable. At almost any time as one passes along fish are seen breaking water.

Trout are known to naturally occur in the following park waters:

Lower Yellowstone River.
- Sour Creek.
- Trout Creek.
- Alum Creek.
- Antelope Creek.
- Lamar River.
  - Cold Creek.
  - Willow Creek.
  - Timothy Creek.
  - Miller Creek.
  - Calfee Creek.
  - Cache Creek.
  - Soda Butte, Pebble, and Amphitheater Creeks.
  - Slough and Buffalo Creeks, Lake Abundance, etc.
- Hellroaring Creek.
- Blacktail Deer Creek.
- Gardiner River.
  - Lava and Lupine Creeks.

Yellowstone Lake.
- Beaverdam Creek.
- Rocky Creek.
- Trail Creek.
- Chipmunk Creek.
- Riddle Lake and Solution Creek.
- Arnica Creek and Beach Lake.
- Columbine Creek.
- Clear Creek.
- Bear Creek.
- Pelican Creek.

Upper Yellowstone River.
- Atlantic Creek.
- Jay Creek.

Upper Yellowstone River—Continued
- Bridger Lake and Creek.
- Falcon Creek.
- Thoroughfare Creek.
- Escarpment Creek.
- Cliff Creek.
- Lynx Creek.
- Phlox Creek.
- Mountain Creek.
- Badger Creek.
- Trappers Creek.

Madison River.
- Canyon Creek.
- Cougar Creek.
- Maple Creek.
- Gneiss Creek.

Snake River.
- Fox Creek.
- Crooked Creek.
- Sickle Creek.
- Pacific Creek.
- Heart Lake and Heart River.
  - Witch Creek.
  - Beaver Creek.
  - Surprise Creek.
- Basin Creek.
- Colter, Harebell, and Wolverine Creeks.
- Red Creek.
- Forest Creek.
- Falls River.
  - Mountain Ash Creek.
  - Bechler River and tributaries to the canyon.
  - Boundary Creek to the falls.

Gibbon River has no trout above the falls. In the Firehole River trout occur naturally below the falls. At times near the junction with the Madison there is very good fishing.

In the Gardiner River trout are abundant from the foot of the falls to its junction with the Yellowstone. Trout have not been seen above Osprey Falls.

In Soda Butte Creek trout are numerous until obstructed by falls in the upper part.

Hellroaring Creek is well stocked in the lower part.

In Canyon Creek trout abound below the falls.

It is stated on good authority that, notwithstanding the barrier offered by Undine Falls, trout occur above in Lupine and Lava Creeks. It appears that in 1889 trout obtained from Howard Creek, Idaho, were planted in Lava Creek. However, it was subsequently ascertained that trout had possible access to this locality from Blacktail Deer Creek, which has no falls and was abundantly supplied with trout.

Trout are numerous in Heart Lake and, according to A. H. Dinsmore, in Lewis River below the falls.

The size attained by trout in the park waters, as elsewhere, varies much with locality and conditions. Fish of over 4 pounds have been reported.

This trout in some waters is a highly esteemed game fish and can be taken in all sorts of ways—spoon, phantom, natural bait, artificial fly, etc. Mary Trowbridge Townsend (l. c.) writes of it in the Firehole River:

> The father of the Pacific trout, the blackspotted "cutthroat" with the scarlet splotch on his lower jaw, was most in evidence, with long symmetrical body, graduated black spots on his burnished sides. He is a brave, dashing fighter, often leaping salmon-like many times from the water before he can be brought to creel. We found him feeding on the open riffs or rising on the clear surface of some sunlit pool.

Ralph E. Clark wrote (l. c.) that "the dark, silvergray trout of the West seem to favor flies more in harmony with their own coloring," and mentioned the gray hackle, brown hackle, coachman, grizzly king, Seth Green, black gnat, and white moth:

> The junction of Yellowstone and Lamar Rivers is noted for fine fishing. If you find the waters high, swift, and roily, you will probably try your flies in vain. Put on a spinner or a little spoon and watch the fish rise to it, almost touch it, and then go away. They are after live bait and won't touch anything else. The grasshoppers are abundant. Catch a few, bait your hook carefully, and let it float down with the current. A large trout will rise to it, and if you are not very careful he will steal it from you.

This is an excellent food fish when fresh from cool waters, but the trout from some parts of the Yellowstone Lake, Upper Yellowstone River, and Heart Lake are generally reputed to be infested with a parasitic worm. In his book previously cited in the list of publications pertaining to the fish of the park, Gen. Chittenden says:

> The trout of Yellowstone Lake are to a slight degree infected with a parasitic disease that renders them unfit for eating. Many efforts have been made to discover the cause of this condition and a suitable remedy for it, but so far without success. An explanation sometimes advanced is that the excessive number of these fish and the absence of sufficient food reduce the vitality and they become an easy prey to parasites which a more vigorous constitution would throw off. Later investigations have shown that reports of the prevalence of this condition were much exaggerated.

The parasite referred to is a tapeworm, of which only the larval or intermediate form occurs in the trout, the host of the adult being an entirely different animal, as is the case with all tapeworms of this kind. Briefly, its life cycle has been found to be as follows: Starting with the egg in the water, it develops into a ciliated embryo. This passes into the fish, probably by way of the mouth, and becomes established and assumes the form usually observed. The fish is eaten by the pelican, and in the intestinal tract of that bird the parasite attains its adult and reproductive stage, and its round of life is there completed. The eggs pass into the water and a new generation is begun.

Gen. Chittenden's statement that the parasite renders the fish unfit for food involves a matter of prejudice rather than actual unfitness for food or danger to the consumer. Cooking destroys the vitality of the worm, and it may be said that this particular worm is not harmful to man. Probably no one would knowingly eat an infected fish, but if he should there would be absolutely no danger in doing so. Beyond doubt the presence of this parasite is greatly exaggerated, as Gen. Chittenden says, and lean, cadaverous, unsightly trout, the condition of which is commonly attributed to parasitism, are often fish which are run down from breeding, although they may carry some parasites. There is scarcely a fish that swims that is not more or less infected by some sort of parasitic worm, and in this respect the Yellowstone fish do not appear to be worse than fish of many other lakes in the country.

It has been said that there are two varieties of native trout in the park, the larger ones of the Yellowstone, with bright yellow bellies, and the smaller kind more silvery in appearance and exhibiting much greater activity and game qualities, of which Tower Creek fish are examples. Also trout of Yellowstone Lake seem to differ from those of Heart and Henry Lakes in having more distinct and rather less numerous black spots. However, in this respect very much individual variation is shown.

This is the principal fish artificially propagated by the United States Bureau of Fisheries at the hatcheries on Yellowstone Lake and Soda Butte Creek. From three to twenty million eggs are taken annually. After the local park waters are liberally stocked the remaining young are supplied to suitable waters in the adjoining States. The park, however, should and does have the first and major claim on the hatchery output.

4. Rainbow Trout (*Salmo shasta*).

The rainbow trout has its geographical range in the mountain streams of the Coast Range and the western slopes of the Sierra Nevada Mountains, but the natural abode of the rainbow trout of fish-cultural fame is the McCloud River, Calif. This form, now recognized as a species distinct from *Salmo irideus*, bears the name of *Salmo shasta*. It has been successfully introduced into many streams in different parts of the United States where it was not previously found.

The rainbow, first introduced into the park in the Gibbon River in 1880 and subsequently planted in various waters and on numerous occasions, has become one of the most abundant, most widely distributed, and most popular of the park fishes. The waters stocked, in addition to the Gibbon River above and below the falls, have included the Gardiner River, tributaries of Yellowstone Lake, and various small lakes.

The size attained by the rainbow trout varies greatly and is dependent upon volume of water, temperature, food supply, etc. Under certain conditions it reaches an extraordinary size, but in the ordinary environment 6-pound or 8-pound fish are to be regarded as large. In general, it may be said that the fish does not overrun 2 pounds. Its food is composed largely of insects.

This fish now abounds in the Gibbon River both above and below Virginia Cascades, and good fishing is found at times at the junction with the Madison. Regarding this stream the park superintendent's report for 1897 shows that the fish planted above the cascades seemed to have come down over the falls, as but few were found above, while below the stream was well stocked to its junction with the Firehole. In the Gibbon River above the falls it appears that the supply has been greatly depleted, in fact, nearly fished out, owing to the circumstance that the road follows the stream for many miles, and there must have been thousands of anglers fishing there in 1919, according to the senior author's notes of July, 1919. Grebe Lake, Blacktail Deer Creek, Madison, Firehole, and Little Firehole Rivers all contain rainbow trout. Referring to the last-named stream in 1897, the superintendent of the park wrote that several good specimens had been taken near its source, for which he could not account, as it seemed impossible for any fish to ascend the lower falls of the Little Firehole. A. H. Dinsmore reports the fish from Tower Creek above the falls.

Many persons who have had experience in angling for rainbow trout say it is one of the best, and some pronounce it the very best, of the trouts. It often dashes from the water to meet the descending fly and leaps repeatedly and madly when hooked. It has been said that it takes the fly so readily that there is no reason for resorting to other lures. However, its activity and habits, as in the case of most fishes, are modified more or less by its surrounding conditions. The same is true of its food qualities, which ordinarily are very good.

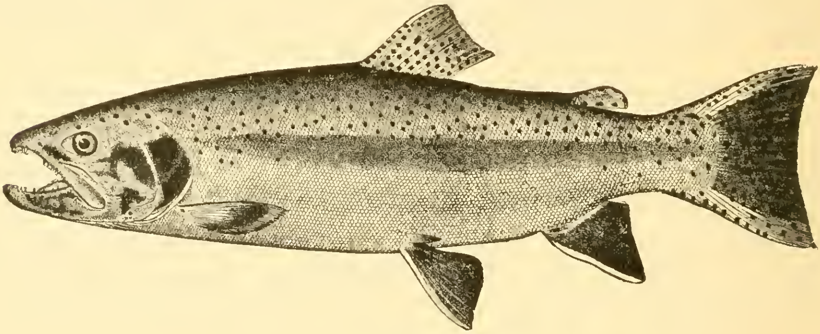

FIG. 4.—Rainbow trout.

Mary Trowbridge Townsend (l. c.) had the following to say relative to her experience with the rainbow trout in Firehole River:

> The California rainbow trout proved true to his reputation as absolutely eccentric and uncertain, sometimes greedily taking a fly and again refusing to be tempted by the most brilliant array of a carefully stocked book. During several days' fishing we landed some small ones, none weighing over 2 pounds, although they are said to have outstripped the other varieties in rapidity of growth, and tales were told of 4-pounders landed by more favored anglers.

5. SCOTCH LAKE TROUT; LOCH LEVEN TROUT (*Salmo levenensis*).

This trout originated in Loch Leven, the lake made famous by Scott's poem, "The Lady of the Lake." Typically it was peculiar to this loch, where it seldom if ever attained much over 1 pound in weight. The claim has been made that it is merely an ontogenetic development of the common brown trout, and that when transferred to other waters its progeny can not always be distinguished from the common brown trout. On the other hand, information derived from persons familiar with Loch Leven indicates that both this trout and the brown trout exist in the same lake, and that in that body of water they can always be distinguished.

It is not impossible that confusion has arisen by brown trout from that lake having been propagated under the supposition that they were Loch Leven trout. There are parallel instances of such mistaken identity in this country in respect to other species, and so-called Loch Leven trout have been propagated for a long time in this country. In the early years the progeny of Loch Leven eggs could easily be distinguished from brown trout hatched at the same time, especially when they had attained a few inches in length. Recently, however, there is reason to suspect that many of the so-called Loch Leven plants have been brown trout. Be that as it may, trout under each name have been introduced into Yellowstone Park waters, and there are records of both having been subsequently taken. The first plants of this trout in the park were made in the upper part of the Firehole River in 1889. The next year Lewis Lake and Shoshone Lake were stocked, and in 1903 further plants were made in tributaries of the Firehole.

The Loch Leven trout has been taken in the following park waters, in some of which it is abundant: Firehole River above and below the cascades, Madison, Gibbon, and Gardiner Rivers, Shoshone and Lewis

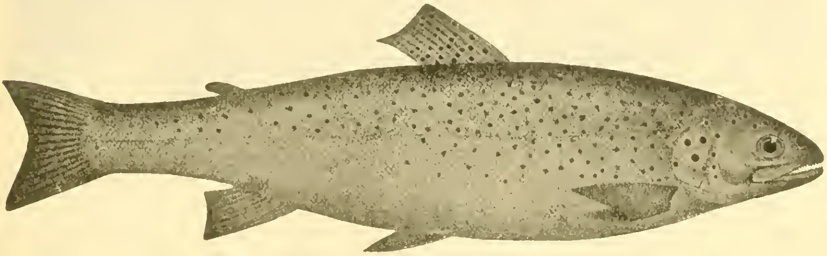

FIG. 5.—Scotch lake trout: Loch Leven trout.

Lakes and the "canal" connecting those lakes, upper Snake River waters, Heron Creek, and Duck Lake, near the Thumb of Yellowstone Lake.

Fish of large size and in great abundance were found in Duck Lake in 1919. Landlocked salmon had been planted in this lake in 1908 and were reported to have survived and flourished, but none have ever been authentically identified, and it seems likely that the Loch Leven trout, the history of whose introduction into this lake is quite obscure, have been mistaken for landlocked salmon. Hundreds of fish were observed jumping at times, and a number of specimens up to 4 pounds in weight were taken in the summer of 1919 after a game fight.

6. European Brown Trout; Von Behr Trout (*Salmo fario*).

The brown trout is widely distributed in continental Europe and the British Isles, inhabiting lakes as well as streams, but it is the "brook trout" of the continental European countries. Under favorable conditions it is known to grow to over 20 pounds, but as a true brook trout it seldom registers over 1 pound in weight.

The brown trout thrives in clear, cold, rapid streams and at the mouth of streams tributary to lakes, having much the same habits as our eastern brook trout. It is by some regarded highly as a game fish, taking either bait or artificial fly. The best fly fishing is usually toward night. As a game and food fish it is in its prime from May to September. Its flesh is very agreeable in flavor. Spawning begins in October.

The brown trout has a rather extensive distribution in the park, although only a single plant of 9,300 fish was made in Nez Perce Creek in 1890. The fish now inhabits the Madison, Gibbon, and Firehole Rivers. In the last named it is found from its junction with the Gibbon to Keppler Cascades and is particularly numerous in Nez Perce Creek, Little Firehole River below Mystic Falls, and Iron Creek. In the main streams fish have been taken weighing up to 8 pounds. In the park, as elsewhere, the brown trout has the reputa-

FIG. 6.—European brown trout; Von Behr trout.

tion of being antagonistic to other trouts and of increasing in size and abundance at the expense of the others.

Mary Trowbridge Townsend, in her interesting article on trout fishing in the park (l. c.), mentioned a brown trout from the Firehole River:

> A good 4-pounder, and unusual marking, large yellow spots encircled by black, with great brilliancy of iridescent color. * * * I took afterwards several of the same variety, known in the park as the Von Behr trout, and which I have since found to be the same *Salmo fario*, the veritable trout of Izaak Walton.

7. LAKE TROUT; MACKINAW TROUT (*Cristivomer namaycush*).

The lake trout, otherwise known as laker, lunge, togue, Mackinaw trout, etc., is of wide northern distribution. In British America it ranges from the Atlantic to the Pacific coasts and northward to the Arctic Ocean. In the United States it is found in many of the larger and deeper lakes in New England and New York, in the Great Lakes Basin, and in a few localities in the Western States, as Montana and Idaho. It occurs also in Alaska. It has also been spread by fish-cultural operations into waters where it did not previously exist.

The lake trout owes its presence in the park to two plants of 30,000 and 12,000 fingerlings in Shoshone Lake and Lewis Lake, respectively, in 1890. The fish is now common in those waters, especially around the shores, and was formerly taken in large quantities to supply the park hotels. It is found also in the "canal" connecting the two large lakes. In some waters it attains a very large size. Examples weighing over 100 pounds have been reported from the Great Lakes, and in former years the average weight of the fish in the commercial fisheries of those waters was stated at 20 to 30 pounds. At this time, however, 10 to 15 pounds can be considered large.

Park Ranger Dewing reports that in 1915 he saw a lake trout that weighed 32 pounds caught in Shoshone Lake by a soldier. Mounted specimens of two large lake trout from Shoshone Lake are in the lobby at Old Faithful Inn. One taken July 13, 1912, by Pete Bergendorf, hotel fisherman, weighed 12 pounds, the other, 39 inches long, weighed 21 pounds. In the summer of 1911 Howard Eaton with a party fished in Lewis Lake and in one day caught 200 pounds of lake trout. The largest fish was 39½ inches long and weighed 20 pounds; another was 34 inches long.

According to A. H. Dinsmore, as early as 1901 the lake trout had spread from Lewis Lake and become abundant in Lewis River below the upper falls. The fish has been reported also below Idaho Falls and has passed up through the tributary coming from Jenny Lake, in which water it occurs in numbers about equal to the native trout,

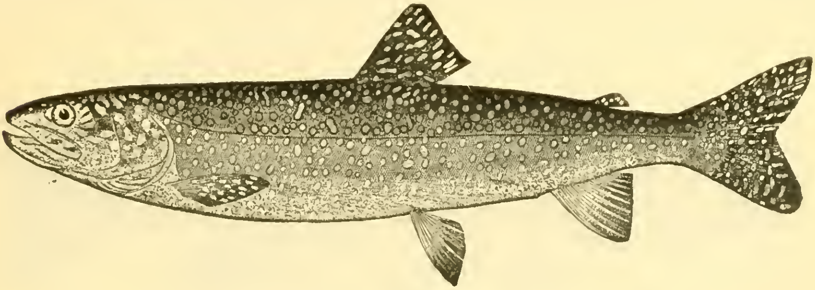

FIG. 7.—Lake trout; Mackinaw trout.

and specimens are recorded from the Buffalo Fork of the Snake River.

The large size of the lake trout affords its chief attraction as a game fish, for it is not ordinarily a very active fighter, although a powerful antagonist. It is usually caught by deep trolling, but is sometimes found at the surface and is occasionally taken on an artificial fly. The fish may be caught by trolling or casting with artificial or natural baits.

Opinions differ regarding its table qualities, and, as with most fishes, much depends upon how it is prepared and cooked. It is a very oily fish and often has an unpleasant, strong, oily flavor. This may be obviated, however, by removing the skin before the fish is cooked. The best method of cooking it is by boiling, serving with mayonnaise dressing or egg sauce.

Mr. Clark (l. c.) wrote in 1908 that the lake trout were plentiful in Shoshone Lake and Lewis Lake and River, and that they could be caught in the canal between Shoshone and Lewis Lakes as fast as one could throw in a trolling spoon, and he remarked that they were large and fat. On August 6, 1919, Mr. Dinsmore caught a 4-pound fish on a feathered spinner, in the canal off Point of Rocks.

8. Eastern Brook Trout; Speckled Trout (*Salvelinus fontinalis*).

The natural western limit of this brook trout in the United States is northeastern Minnesota. It inhabits lakes as well as streams and varies in size according to locality. It does not flourish in water temperature over 68° F., and about 50° F. is preferable. The largest trout of this species authentically recorded weighed somewhat over 12½ pounds. In some lakes trout of 5 or 6 pounds are not uncommon, but such large fish are seldom found in streams unless the streams are tributary to fairly large lakes. In streams of moderate size trout of 1 or 2 pounds' weight are to be considered large, and in most brooks a trout of one-half or three-fourths pound is an exception, at least in recent years. Its spawning season is in fall.

Plants of eastern brook trout have been made by the Bureau of Fisheries in various park waters, and the fish is now abundant and widely distributed. It is known to occur in Gardiner River and its tributaries with their branches, particularly those of the west side: Glen, Fawn, Panther, Indian, Willow, Winter, Straight, and Obsidian

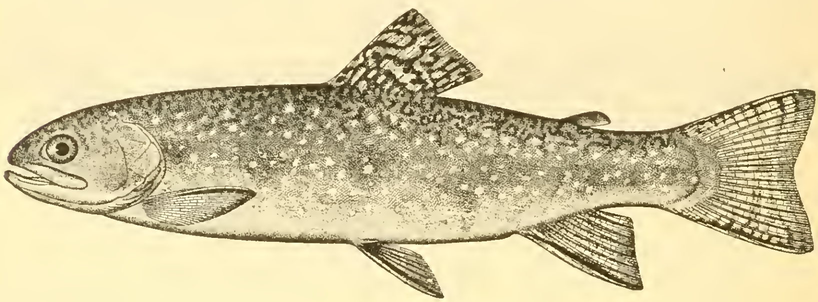

Fig. 8.—Eastern brook trout; speckled trout.

Creeks; Swan, Grizzly, and Beaver Lakes; Gibbon and Madison Rivers; Solfatara Creek; Virginia Meadows; Firehole River, above Kepler Cascades, where, according to the 1897 report of the superintendent of the park, this trout was very abundant, and between its junction with the Gibbon and the lower falls; Upper Little Firehole; Upper Nez Perce Creek, but, according to Park Ranger Dewing, not in lower Nez Perce. According to Mr. Dinsmore it is found in Juniper Creek, a tributary of the Upper Nez Perce, and it occurs in Lone Star Creek and Spring Creek. Tower and Carnelian Creeks above the falls contain it, according to Mr. Dinsmore. It is abundant in Shoshone Creek, and according to the park superintendent's 1897 report that creek was alive with brook trout up to 1½ pounds in weight. Small fish are found in lower De Lacy Creek.

The brook trout is one of the most noted and esteemed of American game fishes, but there must be something besides activity that makes it such a general favorite, as in that respect it is surpassed by several others. One appealing attribute is its beauty of coloration, and another its delicacy of flavor, which is hardly surpassed by any other fish.

The brook trout may be taken by almost any method known to anglers. In open streams fly fishing is the method par excellence.

In streams where overgrowth prevents fly casting, angleworms, grasshoppers, or almost any bait will be taken when the trout is feeding. Everything will be disregarded when it is not feeding. The best flies to use in any body of water must be learned by experience, but the brown hackle is seldom a failure anywhere. Professor, queen of the water, Montreal, coachman, and many others are usually quite successful. Gauze-winged flies will sometimes succeed when others fail. The best time to fish for this trout is in the morning and early evening. It lurks in eddies and pools and at the foot of rapids or under overhanging banks, old stumps, or rocks.

9. YELLOW PERCH (*Perca flavescens*).

The yellow perch has a wide eastern distribution. It is common in the Great Lakes and the tributaries of the upper Mississippi River

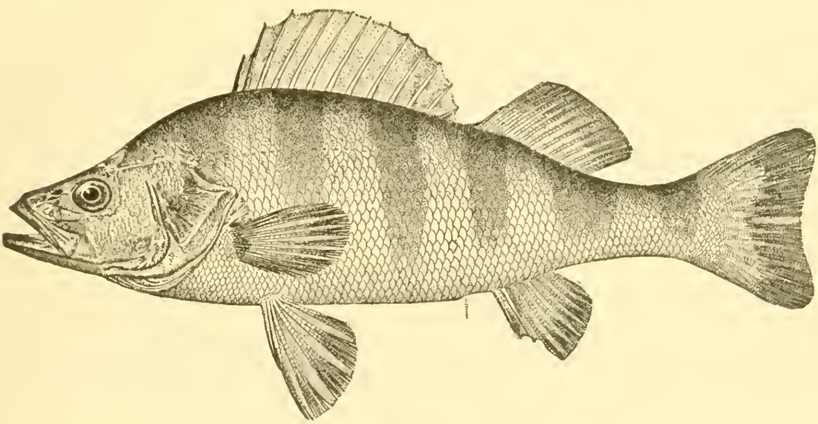

FIG. 9.—Yellow perch.

and in coastwise streams and lakes from Nova Scotia to North Carolina.

In 1919 this fish was found by the senior author to abound in Goose and Feather Lakes in the park. Its presence there is apparently traceable to an unofficial, unauthorized plant made many years ago by a Montana citizen, who is said to have obtained a consignment of yellow perch from the State of Washington, into which State the species had been introduced some years before.

In the park lakes the yellow perch attains a length of a foot and is most readily caught by the use of small spinners cast from shore and rapidly drawn in. Only a few of the park authorities have been aware of the occurrence of this fish in local waters. It can not be regarded as a desirable addition to the fish life of the park, and its spread to other waters than those now inhabited should be prevented. It is not usually reputed to be a game fish, and its voracious habits make it a menace to young trout. When fresh from cold water, it is one of the best of pan fishes, being firm-meated and of delicious flavor.

10. Blob (*Cottus punctulatus*).

This little sculpin belongs in the Missouri Basin and abounds in some of the waters of the park. It has been reported to swarm in the grassy-bottom portions of the Madison and Gibbon Rivers and in Canyon Creek and to be numerous in the Gibbon above the falls. It

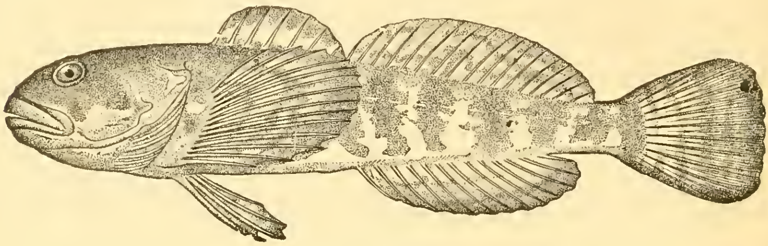

Fig. 10.—Blob.

is known also from the Firehole below the falls. The presence of this fish in the Gibbon River above the falls is a freak in distribution that has not been explained. The blob is probably justly accused of being destructive to the eggs of other fishes and appears to be of little use, unless possibly as bait for large trout. It can be taken with a small baited hook. It attains a length of 5 inches.

11. Longnose Sucker (*Catostomus catostomus*).

This species is of wide natural distribution in northern waters, its geographical range being from the Pacific to the Atlantic coasts and into the Arctic regions. It attains a length of 18 inches and a weight of several pounds. Its spawning time is spring and early summer

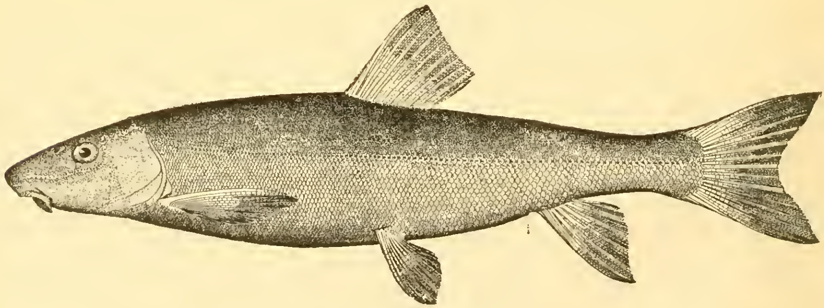

Fig. 11.—Longnose sucker.

when the males have their anal fin profusely covered with tubercles and the side of the body with a broad red stripe more or less diffuse on the edges. It is not sought as a game fish, but sometimes takes a baited hook and fights fairly well. When taken from cool water and cooked at once it is a good-flavored pan fish, although somewhat bony. It is abundant in Yellowstone and Gardiner Rivers below the Osprey, Undine, and Rustic Falls.

12. Rosyside Sucker (*Catostomus ardens*).

This sucker is abundant in the Snake River Basin above Shoshone Falls. It is reported from Heart Lake and Witch Creek and is said to ascend the latter into very warm water flowing from Heart Lake Geyser Basin. Like the longnose sucker, it spawns in spring

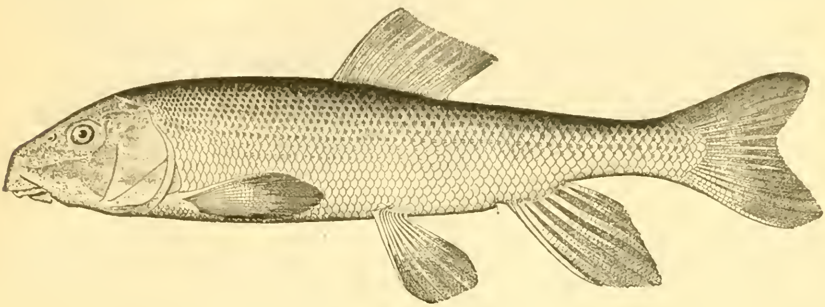

Fig. 12.—Rosyside sucker.

or early summer. It will also take a baited hook and is edible but not as palatable as the other sucker. In Heart Lake and Witch Creek the alimentary tract of this sucker is infested by parasitic worms, which, although offensive to the eye, do not render the fish harmful as food. Affected fish, however, are likely to be lean and unpalatable.

13. Chub (*Leuciscus lineatus*).

This chub, known in the books as Utah Lake chub, is one of the most widely distributed of the genus and abounds in the Snake River Basin above Shoshone Falls; also in Yellowstone Lake and other places in the park. Chubs from cool water are not to be despised

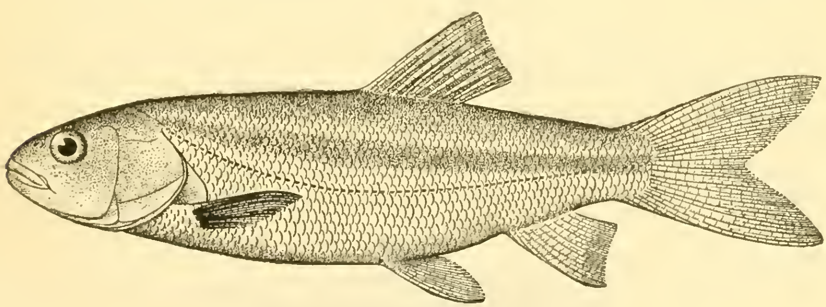

Fig. 13.—Chub.

in game and food qualities. The species reaches a length of 12 or 15 inches or more and is said to be destructive to the eggs and young of trout. No worms have been found in its alimentary canal. It spawns in spring and early summer.

Dr. Jordan says: "Chubs ascend Witch Creek until they reach water fairly to be called hot, and the sucker is not far behind," enduring a temperature of 88° F.

14. Silverside Minnow (*Leuciscus hydrophlox*).

This little fish is too small to be of much use for other than food or bait for trout, attaining a length of only 3 to 5 inches. It occurs

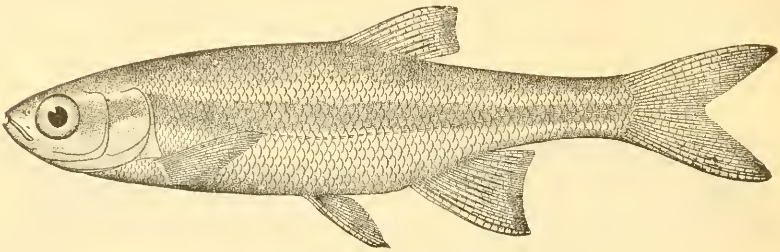

Fig. 14.—Silverside minnow.

in some of the sources of the Snake River in the park, particularly Heart Lake and Witch Creek. It spawns in spring.

15. Longnose Dace (*Rhinichthys dulcis*).

This little minnow, attaining a maximum length of only about 5 inches, is food for trout and useful as bait. It is found in Heart

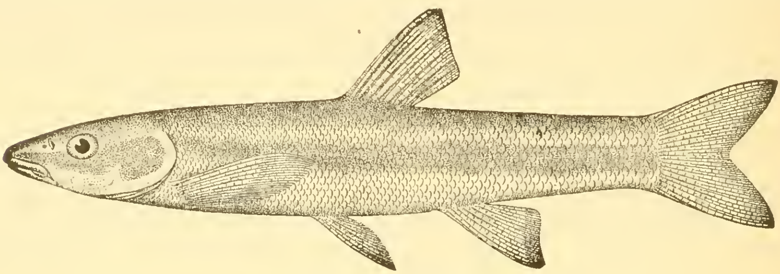

Fig. 15.—Longnose dace.

Lake and Witch Creek and also in Gardiner River below Osprey, Undine, and Rustic Falls.

16. Dusky Dace (*Agosia nubila*).

The little dusky dace, seldom over $3\frac{1}{2}$ inches in length, is extremely abundant and widely distributed in the Columbia River Basin. In

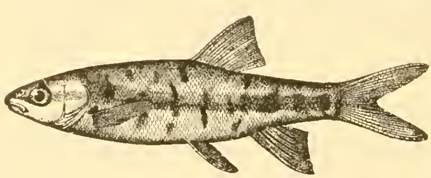

Fig. 16.—Dusky dace.

the park it has been recorded from Heart Lake and Witch Creek. It is useful as food for larger fishes and as bait for trout.

O

FOOD OF YOUNG WINTER FLOUNDERS.[1]

By Edwin Linton,

Temporary Investigator, U. S. Bureau of Fisheries.

Contribution from the U. S. Fisheries Biological Station, Woods Hole, Mass.

In connection with work on the parasites of fishes it has been the author's practice to keep a record of the food of the fishes which were being examined for Entozoa. Such miscellaneous data, while not without value, are lacking in that definiteness which is afforded by quantitative studies. It was therefore suggested by the Bureau of Fisheries that an intensive study of the food of one or two families or groups of fishes, preferably those of economic importance, be undertaken.

During the summers of 1915 and 1916 the author spent a part of his time in the examination of small winter flounders (*Pseudopleuronectes americanus*) for their food. The fish were seined by Vinal N. Edwards at 36 stations at Woods Hole, Mass., and vicinity, on dates ranging from May 2 to November 2. The total number of fish examined was 398.

Fishes collected in the months of May, June, September, October, and November were preserved in formaldehyde and examined in the summer of 1916. Fish seined in July and August were brought to the laboratory soon after they were taken from the water. If taken at some distance from the laboratory, they were placed in a strong preservative as soon as they were taken from the water. At first the smaller fish were preserved entire in 95 per cent alcohol, after opening the abdominal cavity. The viscera of the larger fish were removed and kept in dishes of formaldehyde. It was soon found that the formaldehyde material was the more satisfactory for study, and, when well washed in water, could be looked over without discomfort. In each case the alimentary canal was opened throughout its entire length and examined in alcohol or water. The material was separated with the aid of a dissecting lens, the compound microscope being used when necessary for the identification of material. Quantitative estimates were then made, using the smallest lot as a unit.

It often happens that much of the contents of the alimentary canal of the fish does not admit of satisfactory separation into distinct lots, even when its general character is more or less identifiable. For example, in cases where annelids, having much sand in their intestines, have been eaten, what at first appeared to be a mass of

[1] Appendix IV to the U. S. Report of the Commissioner of Fisheries for 1921. B. F. Doc. 907.

sand, upon closer examination proved to contain setæ of annelids, with occasional shreds of cuticle. As the body of the annelid is being digested, the intestine, gorged with sand and mud, often remains in a condition that admits of identification as annelid remains. It is doubtless true that much of the material recorded as ostracodes and small univalve shells has been introduced with annelids.

In the beginning of this work the author was often greatly puzzled when attempting to determine the quantitative values to be placed on the different food materials. After some practice, however, one develops a method which takes into account such material as can readily be separated and classified, and often makes it possible to reduce the unidentified débris to small proportions. In view of the nature of the food of many annelids it is to be noted that the percentage of materials counted as annelid does not always indicate similar percentage of food ingested. Doubtless, also, especially in the beginning of these studies, the estimated percentage of débris is sometimes larger than it should be, due to the fact that portions of the mucous membrane, which are detached when the contents of the alimentary canal are removed, become mixed with the food proper.

Plant material was noted in only 20 of the flounders, approximately 5 per cent of the whole number examined for food. In all instances where plant remains were noted in the contents of the alimentary canal, the amount was always both absolutely and relatively small. Usually it consisted of a few fragments of filamentous algæ, the presence of which could be accounted for as material which had accidentally been taken in along with the proper food of the fish. No place, therefore, was given for plant remains in the table of quantitative estimates.

It would seem, however, that the winter flounders may, on occasion, make use of plant food. From unpublished food notes made in connection with the examination of winter flounders for parasites, mostly by Vinal N. Edwards, out of 82 examinations, 23 records note the presence of plant remains in the alimentary canal. In some cases considerable amounts of plant material were present. Thus, on three dates—April 14, November 7, and 12—the record reads, "Stomachs filled with eelgrass;" on August 31, "Stomach and intestine filled with green seaweed;" on September 30, "Stomach full of algæ (Ulva)." It is likely that the eelgrass is eaten for the incrustations of the tunicate *Botryllus gouldii*.

A detailed account of the results of the examination of each of the 398 small flatfish would make a very bulky report, and is considered unnecessary. Illustrative details, omitting some of the notes on Entozoa, are here given for one station only.

Food and Entozoan Parasites of Small Winter Flounders.

STATION 19. KATAMA BAY, JULY 27, 1915.

[Fish seined in water 1 to 4 feet in depth. Bottom, sand with red seaweed and other algæ. The bay had been closed on the ocean side for the preceding six years; there was, therefore, little current produced by the tide. Winter flounders, few. Figures referring to food represent average per cent of volume; lengths are given in millimeters.]

1. *Length, 28.*—Food: Copepods, 95; débris, 5. Entozoa: 141 appendiculate distomes, 1 ivory-white sporozoan cyst on intestine.
2. *Length, 30.*—Food: Alimentary canal empty. Entozoa: 317 appendiculate distomes in stomach, 6 in intestine.

3. *Length, 31.*—Food: Copepods, 95; débris, 5. Entozoa: 247 appendiculate distomes in stomach.
4. *Length, 31.*—Food: Copepods, 30; débris, mostly sand, 70; alimentary canal nearly empty. Entozoa: 115 appendiculate distomes in stomach.
5. *Length, 37.*—Food: Amphipods, 50; copepods, 10; débris, 40. Entozoa: 3 appendiculate distomes in stomach.
6. *Length, 37.*—Food: Annelids, 40; copepods, 10; zoeæ, 10; ostracodes, 10; amphipods, 10; débris, 20; small fragment of Sagartia. Entozoa: 12 appendiculate distomes in stomach, 4 small nematodes.
7. *Length, 40.*—Food: Amphipods, 20; cumacea, 20; copepods, 5; Crepidula, 5; ostracodes, 5; annelids, 30; débris, 15. A small fragment of the body wall of a synapta was noted. Entozoa: 200 appendiculate distomes in stomach.
8. *Length, 43.*—Food: Amphipods, 10; zoeæ, 10; copepods, 10; annelids, 60; débris, 10. Entozoa: 24 appendiculate distomes in stomach.
9. *Length, 44.*—Food: Amphipods, 65; copepods, 10; ostracodes, 4; Sagartia, 5; nemerteans, 5; Crepidula, 5; débris, 6. Entozoa: 24 appendiculate distomes in stomach, 3 in intestine; 4 small nematodes, length 5.
10. *Length, 44.*—Food: Amphipods, 25; ostracodes, 25; copepods, 25; Crepidula, 5; débris (fragments of crustacea), 20; 1 zoea noted. Entozoa: 80 appendiculate distomes in stomach, 3 small nematodes.
11. *Length, 48.*—Food: Amphipods, 90; débris, 10; one small insect larva (Chironomus) noted. Contents of alimentary canal almost completely digested, its nature revealed only when the compound microscope was used. Entozoa: 4 distomes.
12. *Length, 49.*—Food: Amphipods, 90; débris, 10; 1 insect larva noted.
13. *Length, 52.*—Food: Amphipods, 80; Crepidula, 20.
14. *Length, 58.*—Food: Amphipods, 100.
15. *Length, 115.*—Food: Amphipods, 50; Crepidula, 10; débris, 40; 1 small annelid noted. Entozoa: A few sporozoan cysts on wall of intestine.
16. *Length, 120.*—Food: Amphipods, 95; crabs, 1; Crepidula, 2; débris, 2. Entozoa: Sporozoan cysts on intestine.
17. *Length, 120.*—Food: Amphipods, 80; crabs, 10; Crepidula, 2; débris, 8. Entozoa: A few sporozoan cysts on intestine.
18. *Length, 120.*—Food: Amphipods, 15; crabs, 15; Limulus, 15; Crepidula, 5; annelids, 45; débris, 5.
19. *Length, 125.*—Food: Annelids, 95; débris, 5.
20. *Length, 130.*—Food: Limulus, 2; clams, 50; Crepidula, 15; annelids, 3; débris, 30; a few strands of algæ. Entozoa: 1 distome.
21. *Length, 135.*—Food: Amphipods, 98; crabs, 2. Entozoa: 2 distomes.
22. *Length, 135.*—Food: Amphipods, 60; crabs, 30; shrimp, 5; gastropods, 5.
23. *Length, 140.*—Food: Amphipods, 5; crabs, 2; Limulus, 1; bivalve mollusks, 2; annelids, 90. The mollusks were a small Crepidula and fragments of a small clam. Entozoa: 3 distomes.
24. *Length, 150.*—Food: Amphipods, 8; spider crabs, 3; clam, 1; annelids, 80; débris, 8.
25. *Length, 170.*—Food: Nothing in alimentary canal that could be identified except a few fragments of algæ and what appeared to be remains of the mantles of clams. Entozoa: 1 distome.
26. *Length, 190.*—Food: Amphipods, 5; mollusks (small clam and small gastropod), 15; annelids, 75; débris, 5. Entozoa: 2 distomes.

Summarized Record of Food and Parasites of 398 Small Winter Flounders (Pseudopleuronectes americanus) Collected at Woods Hole, Mass., and Vicinity, 1915 and 1916.

[Figures referring to food represent average per cent of volume; figures referring to parasites, where not otherwise indicated, represent numerical average. The lengths are given in millimeters. The stations have been arranged according to dates as if of one year.]

STATION 1. GREAT HARBOR, MAY 2, 1916.

Length, 26 to 50.—Number examined, 1. Food: Amphipods, 85; Cumacea, trace; insect larvæ, 1; débris, 14. Parasites: Distomes, 4.

Length, 51 to 75.—Maximum length, 72; minimum, 64; average, 70.8. Number examined, 4. Food: Amphipods, 48.8; annelids, 17.5; copepods, trace; insect larvæ, 1.5; débris, 32.2. Parasites: Distomes in each, average 16; Sporozoa, 8 small cysts on intestinal walls of one.

Length, 76 to 100.—Maximum length, 97; minimum, 76; average, 87.7. Number examined, 3. Food: Amphipods, 20; annelids, 48.3; shrimp, 30; débris, 1.6. Parasites: Distomes, 2.3; nematodes, 1 young Ascaris in stomach of one fish.

STATION 2. EEL POND, MAY 16, 1916.

Length, 51 to 75.—Maximum length, 68; minimum, 58. Number examined, 2. Food: Amphipods, 67.5; annelids, 12.5; Cumacea, 10; isopods, trace; débris, 10. Parasites: Distome, 1, in one fish.

Length, 101 to 125.—Maximum length, 125; minimum, 102; average, 113.2. Number examined, 5. Food: Amphipods, 79; annelids, 4.6; Cumacea, 0.2; insect larvæ, 2.4; isopods, trace; débris, 13.8. Parasites: Distomes, 1 in one fish; nematodes, 1 in one fish; Sporozoa, masses of cysts on lower half of intestinal wall of three.

STATION 3. GREAT HARBOR, JUNE 27, 1916.

[Bottom, sandy.]

Length, 25 to 50.—Maximum length, 42; minimum, 25; average, 34.9. Number examined, 12. Food: Amphipods, 20.4; annelids, 24; copepods, 4.7; débris, 51. Parasites: Distomes in each fish, average 35.4.

STATION 4. SHEEP-PEN COVE, JUNE 27, 1916.

[Bottom, muddy with some eelgrass.]

Length, under 25.—Length, 24. Number examined, 1. Food: Amphipods, 1; annelids, 22; copepods, 73; débris, 4. Parasites: Distomes, 10.

Length, 26 to 50.—Maximum length, 38; minimum, 28; average, 33.8. Number examined, 13. Food: Amphipods, 59.7; annelids, 11.8; copepods, 6.3; ostracodes, 0.8; Cumacea, trace; débris, 21.4. Parasites: Distomes, 21.4.

STATION 5. WAREHAM RIVER, JUNE 30, 1916.

[Bottom, mud and eelgrass.]

Length, 26 to 50.—Length, 32. Number examined, 1. Food: Amphipods, 10; annelids, 50; débris, 40. Parasites: Distomes, 18.

Length, 100 to 125.—Maximum length, 120; minimum, 113; average, 116.2. Number examined, 5. Food: Amphipods, 4.2; annelids, 54.8; bivalve mollusks, 0.2; insect larvæ, trace; débris, 40.8. Parasites: Distomes, 10.2; Sporozoa, numerous cysts on intestine of one fish, 1 cyst on intestine of another.

STATION 6. HADLEY HARBOR, JULY 1, 1916.

[Bottom, eelgrass and sand.]

Length, under 25.—Length, 23. Number examined, 1. Food: Amphipods, 5; copepods, 90; débris, 5. Parasites: Nematodes, 1.

Length, 25 to 50.—Maximum length, 44; minimum, 25; average, 35.2. Number examined, 13. Food: Amphipods, 63.4; annelids, 0.4; copepods, 25.7; ostracodes, 2.9; shrimp, 0.5; débris, 6.6 Parasites: Distomes, 0.5.

STATION 7. HEAD OF LACKEY'S BAY, JULY 1, 1916.

[Bottom, eelgrass and mud.]

Length, under 25.—Maximum length, 23; minimum, 21. Number examined, 2. Food: Amphipods, 16; annelids, 2.5; copepods, 70; Cumacea, 0.1; insect larvæ, 1.5; ostracodes, 3.5; débris, 6.5.

Length, 25 to 50.—Maximum length, 42; minimum, 27; average, 35.2. Number examined, 12. Food: Amphipods, 32.3; annelids, 15.9; copepods, 13.5; Cumacea, 0.1; insect larvæ, 0.2; ostracodes, 1; débris, 37. Parasites: Distomes, 6.2.

STATION 8. SHEEP-PEN COVE, JULY 11, 1916.

[Bottom, mud and eelgrass.]

Length, under 25.—Length, 22. Number examined, 1. Food: Copepods, 50; débris, 50.

Length, 25 to 50.—Maximum length, 50; minimum, 29; average, 37.7. Number examined, 13. Food: Amphipods, 33.9; annelids, 7; copepods, 22.1; Cumacea, 0.8; insect larvæ, 0.2; ostracodes, 0.8; débris, 36.2. Parasites: Distomes in each fish, maximum, 484; minimum, 17; average, 155.3.

STATION 9. HEAD OF GREAT HARBOR, JULY 11, 1916.

[Bottom, sandy.]

Length, under 25.—Length, 24. Number examined, 1. Food: Amphipods, 10; copepods, 10; débris, 80. Parasites: Distomes, 27.

Length, 25 to 50.—Maximum length, 50; minimum, 26; average, 33.7. Number examined, 10. Food: Amphipods, 18; annelids, 25.6; copepods, 17.2; larval Crustacea, trace; débris, 39.1 Parasites: Distomes in each fish, maximum, 154; minimum, 3; average, 46.9. One fish (50 mm. in length) had nothing in the alimentary canal except distomes, of which there were 154 in the stomach.

Length, 51 to 75.—Maximum length, 57; minimum, 51; average, 54.3. Number examined, 3. Food: Amphipods, 81.6; annelids, 6.7; copepods, 6.7; débris, 5. Parasites: Distomes in each fish, maximum, 125; minimum, 30; average, 92.6.

STATION 10. TARPAULIN COVE, JULY 14, 1916.

[Soft bottom, with eelgrass.]

Length, 25 to 50.—Maximum length, 50; minimum, 44; average, 48.1. Number examined, 7. Food: Amphipods, 82.1; copepods, trace; isopods, 2.5; ostracodes, trace; débris, 15.3.

Length, 51 to 75.—Maximum length, 55; minimum, 54. Number examined, 2. Food: Amphipods, 72.5; isopods, 2.5; débris, 25.

STATION 11. MENEMSHA BIGHT, JULY 14, 1916.

[Bottom, sand and eelgrass.]

Length, 101 to 125.—Maximum length, 120; minimum, 101; average, 109. Number examined, 5. Food: Amphipods, 74.2; annelids, 7.2; bivalve mollusks, 1.6; insect larvæ, 0.4; débris, 16.4. Parasites: Distomes, 0.6; Acanthocephala, 1 in one fish; nematodes, 0.6; Sporozoa, 1 cyst on intestine of one fish and a few scattering cysts on the intestine of another.

STATION 12. LAGOON POND, VINEYARD HAVEN, JULY 17, 1916.

[Sandy bottom.]

Length, 25 to 50.—Maximum length, 50; minimum, 30; average, 43.1. Number examined, 10. Food: Amphipods, 18.8; annelids, 49.2; copepods, 0.1; insect larvæ, 0.1; débris, 31.9. Parasites: Distomes in each fish, maximum, 400 (approximate); minimum, 2; average, 70.7.

Length, 51 to 75.—Maximum length, 56; minimum, 54; average, 55. Number examined, 4. Food: Amphipods, 14.3; annelids, 51.3; insect larvæ, 0.2; ostracodes, trace; débris, 34.2. Parasites: Distomes in each, average, 39.2.

STATION 13. HEAD OF GREAT HARBOR, JULY 20, 1916.

[Bottom, sand and eelgrass.]

Length under 25.—Maximum length, 24; minimum, 22. Number examined, 2. Food: Amphipods, 5; annelids, 40; copepods, 12.5; larval Crustacea, 7.5; ostracodes, trace; débris, 35. Parasites: Distomes, 25.

Length 25 to 50.—Maximum length, 42; minimum, 26; average, 33.1. Number examined, 9. Food: Amphipods, 45; annelids, 8.3; copepods, 9.6; gastropod mollusks, trace; ostracodes, 0.1; débris, 36.9. Parasites: Distomes in each fish, 38.3.

Length, 51 to 75.—Maximum length, 59; minimum, 58. Number examined, 3. Food: Amphipods, 13.3; annelids, 50; young fish (80 per cent in one fish), 26.6; débris, 10. Parasites: Distomes in each, 93.3.

STATION 14. HEAD OF GREAT HARBOR, JULY 22, 1915.

[Sandy bottom.]

Length, 25 to 50.—Maximum length, 50; minumum, 45; average, 47.6. Number examined, 3. Food: Amphipods, 15; annelids, 61.6; copepods, 0.3; isopods, 1; ostracodes, 0.3; débris, 21.6. Parasites: Distomes, 2.3.

Length, 51 to 75.—Maximum length, 75; minimum, 51; average, 63.5. Number examined, 17. Food: Amphipods, 12; annelids, 72; copepods, 0.1; insect larvæ, trace; isopods, 0.6; ostracodes, 1.3; univalve mollusks, 0.1; débris, 14. Parasites: Distomes, 6.2; nematodes, 1, in one fish.

Length, 101 to 125.—Length, 120. Number examined, 1. Food: Amphipods, 20; annelids, 30; ostracodes, 5; univalve mollusks, 20; débris, 25.

STATION 15. GREAT POND, EAST FALMOUTH, JULY 22, 1915.

[Low tide, 1 to 2 feet of water; bottom, sand and mud with clams; seining done along edge of eelgrass halfway up the pond; water clear, 78° F.; flounders, abundant.]

Length, 51 to 75.—Maximum length, 72; minimum, 52; average, 66. Number examined, 9. Food: Amphipods, 20; annelids, 50; Cumacea, trace; isopods, 6.6; débris, 23.4. Parasites: Distomes in each fish, average, 22.6.

Length, 76 to 100.—Maximum length, 96; minimum, 78; average, 88.2. Number examined, 4. Food: Amphipods, 15; annelids, 51.2; isopods, 20; débris, 13.8. Parasites: Distomes in each fish, average, 16.2.

Length, 101 to 125.—Maximum length, 125; minimum, 105; average, 115. Number examined, 3. Food: Amphipods, 18.3; annelids, 58.3; isopods, 3; ostracodes, 0.3; débris, 20. Parasites: Distomes in each fish, average, 12.6; Sporozoa, cysts in intestinal wall of one fish (length, 125 mm.).

Length, 126 to 150.—Length of each, 135. Number examined, 2. Food: Amphipods, 5; annelids, 87.5; clams, 6.2; débris, 1.2. Parasites: Distomes in each fish, average, 1.5; Sporozoa, numerous cysts in intestinal walls of one fish.

Length, 151 to 175.—Maximum length, 175; minimum, 155; average, 168.3. Number examined, 3. Food: Annelids, 65; clams, 16.6; débris, 18.3. Parasites: Distomes in each fish, average, 15.3; Sporozoa, cysts very numerous in intestinal wall of one fish.

STATION 16. EEL POND, JULY 25, 1916.

[Bottom, eelgrass and mud.]

Length, 51 to 75.—Maximum length, 72; minimum, 58; average, 59.8. Number examined, 5. Food: Amphipods, 51.2; annelids, 1; Cumacea, 13; débris, 34.8. Parasites: Distomes, 2; nematodes, one small Filaria in one fish.

STATION 17. CUTTYHUNK, JULY 26, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 50; minimum, 36; average, 43.7. Number examined, 7. Food: Amphipods, 38.5; annelids, 22.8; copepods, 5.3; ostracodes, 0.8; débris, 32.4. Parasites: Distomes, 6.5.

Length, 51 to 75.—Maximum length, 75; minimum, 52. Number examined, 2. Food: Amphipods, 56; annelids, 25; insect larvæ, trace; débris, 24. Parasites: Distomes, 23; nematodes, 2.5. The débris consisted of annelid and crustacean fragments, and diatoms; the latter were interpreted as having been introduced with the amphipods.

STATION 18. NAUSHON, BUZZARDS BAY SHORE, JULY 26, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 40; minimum, 37. Number examined, 2. Food: Amphipods, 35: annelids, 20; copepods, trace; débris, 45. Parasites: Distomes, 6.5.

Length, 51 to 75.—Maximum length, 65; minimum, 52; average, 55.6. Number examined, 6. Food: Amphipods, 77.1; annelids, 15; copepods, trace; insect larvæ, 0.1; ostracodes, trace; débris, 7.6. Parasites: Distomes, 10.8; nematodes, 0.5; Sporozoa, 1 cyst on serous membrane, between stomach and liver of one fish.

STATION 19. KATAMA BAY, MARTHAS VINEYARD, JULY 27, 1915.

[Bottom, sand, with much algæ. The bay had been closed on the ocean side for the preceding six years. There is, therefore, but little current produced by the tides. Flounders, few.]

Length, 26 to 50.—Maximum length, 49; minimum, 28; average, 38.5. Number examined, 12. Food: Amphipods, 32.7; annelids, 11.8; Cumacea, 1.8; copepods, 26.3; côelenterates (Sagartia), 0.5; univalve mollusk (Crepidula), 1.3; larval Crustacea, 1.8; nemerteans, 0.5; ostracodes, 4; débris, 19.1. Parasites: Distomes, maximum, 317; minimum, 3; average, 99.7; Sporozoa, 1 cyst on intestine of smallest fish. In one fish (32 mm. in length), the alimentary canal was empty except for the presence of distomes, of which there were 317 in the stomach.

Length, 51 to 75.—Maximum length, 58; minimum, 52. Number examined, 2. Food: Amphipods, 90; mollusks (Crepidula), 10.

Length, 101 to 125.—Maximum length, 125; minimum, 115; average, 120. Number examined, 5. Food: Amphipods, 48; annelids, 28; crabs, 5.2; Limulus, 3; mollusks (Crepidula), 3.6; débris, 12. Parasites: Sporozoa, a few cysts on the intestines of three fish.

Length, 126 to 150.—Maximum length, 150; minimum, 130; average, 138. Number examined, 5. Food: Amphipods, 34.2; annelids, 35.6; bivalve mollusks, 10; crabs, 7.4; Limulus, 0.6; ostracodes, trace; shrimp, 0.9; univalve mollusks, 4.6; débris, 7.6. Parasites: Distomes, 1.2.

Length, 176 to 200.—Length, 190. Number examined, 1. Food: Amphipods, 5; annelids, 75; clams, 15; débris, 5. Parasites: Distomes, 2.

STATION 20. KATAMA BAY, JULY 28, 1916.

[Bottom, sand and gravel.]

Length, 26 to 50.—Length, 45. Number examined, 1. Food: Amphipods, 65; annelids, 15; copepods, 5; débris, 15. Parasites: Distomes, 50.

Length, 51 to 75.—Maximum length, 74; minimum, 52; average, 63.2. Number examined, 13. Food: Amphipods 65; annelids, 11.2; bivalve mollusks, 0.1; copepods, 0.1; isopods, 0.1; ostracodes, 0.1; débris, 23.4. Parasites: Distomes in each fish, average 20.1; Sporozoa, 1 cyst, 2 mm. in diameter, on intestine of one fish (61 mm.).

STATION 21. MONUMENT BEACH, AUGUST 1, 1916.

[Bottom, sand and eelgrass.]

Length, 25 to 50.—Maximum length, 50; minimum, 35; average, 41.8. Number examined, 5. Food: Amphipods, 40.6; annelids, 26; copepods, 4.8; Cumacea, 1; débris, 27.6. Parasites: Distomes, 3.4.

Length, 51 to 75.—Maximum length, 75; minimum, 52; average, 60.3. Number examined, 6. Food: Amphipods, 14.1; annelids, 48.3; débris, 37.5. Parasites: Distomes, 1.1; Sporozoa, 1 cyst, 2 mm. in diameter, on intestine of one fish (59 mm.).

Length, 76 to 100.—Length, 80. Number examined, 1. Food: Amphipods, 50; crabs, 2; isopods, 12; shrimp, 2; débris, 34. Parasites: Nematodes, 2.

STATION 22. MENEMSHA POND, AUGUST 2, 1916.

[Bottom, sand and eelgrass.]

Length, 26 to 50.—Maximum length, 50; minimum, 43; average, 47.2. Number examined, 5. Food: Amphipods, 32.4; annelids, 38; copepods, trace; débris, 29.6. Parasites: Distomes, 4.6.

Length, 51 to 75.—Maximum length, 74; minimum, 57; average, 65.5. Number examined, 7. Food: Amphipods, 6.7; annelids, 58; débris, 35.2. Parasites: Distomes, 1.8.

STATION 23. MENEMSHA, INSIDE BREAKWATER, AUGUST 2, 1915.

[Bottom, sand and pebbles.]

Length, 25 to 50.—Maximum length, 42; minimum, 35. Number examined, 2. Food: Amphipods, 17.5; ostracodes, 20; débris, 62.5. Parasites: Distomes, 24.5.

Length, 101 to 125.—Length, 110. Number examined, 1. Food: Amphipods, 3; isopods, 2; shrimp, 75; débris, 20.

Length, 126 to 150.—Maximum length, 140; minimum, 127; average, 130.2. Number examined, 4. Food: Amphipods, 27.5; annelids, 10; isopods, trace; mollusks (siphons of clams), 7.5; shrimp, 47.5; débris, 7.5.

STATION 24. MOUTH OF TRURO HARBOR, CAPE COD BAY, AUGUST 8, 1916.

[Bottom, sandy.]

Length, 25 to 50.—Maximum length, 50; minimum, 44; average, 46.7. Number examined, 4. Food: Amphipods, 1; annelids, 80; insect larvæ, 0.5; débris, 18.5.

Length, 51 to 75.—Maximum length, 62; minimum, 60. Number examined, 2. Food: Annelids, 82.5; débris, 17.5. The indigestible residue in this lot of fish, as in all cases where annelids form the bulk of the food, is sand, and has doubtless been introduced with the annelids.

STATION 25. MENEMSHA, AUGUST 10, 1915.

[Inside harbor, on grassy and gravelly bottom.]

Length, 51 to 75.—Length, 70. Number examined, 1. Food: Amphipods, 50; annelids, 25; débris, 25.

Length, 101 to 125.—Maximum length, 125; minimum, 115. Number examined, 2. Food: Amphipods, 25; annelids, 72.5; débris, 2.5. Parasites: Sporozoa, many cysts on intestine of smaller fish.

Length, 126 to 150.—Maximum length, 150; minimum 130; average, 140. Number examined, 4. Food: Amphipods, 21.5; annelids, 71.2; bivalve mollusks, 0.1; fish, 0.5; isopods, 0.3; débris, 6.6. Parasites: Distomes, 50.

Length, 151 to 175.—Maximum length, 175; minimum, 153; average, 161.2. Number examined, 4. Food: Amphipods, 1.6; annelids, 95; bivalve mollusks, 0.3; univalve mollusks, 0.1; débris, 3. Parasites: Distomes, 45; Sporozoa, 1 cyst on intestine of fish measuring 153 mm.

STATION 26. LACKEY'S BAY, AUGUST 3, 1915.

[Muddy bottom, fish collected at high tide.]

Length, 51 to 75.—Maximum length, 74; minimum, 55; average, 64.8. Number examined, 6. Food: Amphipods, 13.1; annelids, 27.3; copepods, 0.1; insect larvæ, 2.5; ostracodes, 0.1; débris, 56.6 (consisting of a little vegetable material and sand). Parasites: Distomes, 3.8.

Length, 76 to 100.—Maximum length, 100; minimum, 76; average, 83.5. Number examined, 4. Food: Amphipods, 31.2; annelids, 57.5; insect larvæ, 3.4; ostracodes, 0.9; débris, 6.7. Parasites: Distomes, 3.2; Sporozoa, many cysts on lower part of intestine of fish 100 mm. in length.

Length, 101 to 125.—Maximum length, 122; minimum, 115; average, 119. Number examined, 3. Food: Amphipods, 15; annelids, 5; bivalve mollusks, 0.3; ostracodes, trace; univalve mollusks, 0.3; débris (some vegetable material), 79.3. Parasites: Nematodes, 0.3; large numbers of cysts of Sporozoa on intestine of fish measuring 120 mm.

Length, 126 to 150.—Maximum length, 142; minimum, 126; average, 136. Number examined, 4. Food: Amphipods, 8.5; annelids, 25.2; bivalve mollusks (young Mya and Solenomya), 5; ostracodes, 0.2; débris (a little vegetable material, with fragments of amphipods, setæ of annelids, and sand), 61. Parasites: Distomes, 1.5; nematodes, 1.

STATION 27. EEL POND, SEPTEMBER 2, 1915.

[Bottom, eelgrass and mud.]

Length, 51 to 75.—Length, 62. Number examined, 1. Food: Amphipods, 95; ostracodes, trace; débris, 5. Parasites: Nematodes, 2 small Filaria and 1 immature Ascaris.

Length, 126 to 150.—Maximum length, 142; minimum, 130; average, 138. Number examined, 3. Amphipods, 95; bivalve mollusks, 0.3; ostracodes, 0.3; débris (trace of vegetable material), 4.3.

Length, 151 to 175.—Maximum length, 172; minimum, 154; average, 144.6. Number examined, 6. Food: Amphipods, 48.3; annelids, 7; bivalve mollusks (Venus, small), 5; Cumacea, trace; ostracodes, trace; univalve mollusks (Bulla, etc.), 4.1; débris, 35.6. Parasites: Nematodes (Filaria), 4.3; many cysts on rectum of one fish (150 mm.), a few cysts on mesentary of another (172 mm.).

Length, 176 to 200.—Maximum length, 192; minimum, 182. Number examined, 2. Food: Amphipods, 27.5; annelids, 25; univalve mollusks (Bulla), 5; débris, 42.5.

Length, 201 to 225.—Maximum length, 225; mimimum, 212. Number examined, 2. Food: Amphipods, 5; annelids, 5; bivalve mollusks, 1; univalve mollusks (Bulla), 42.5; débris (some vegetable material), 46.5. Parasites: Nematodes, 1 (Filaria).

STATION 28. SHEEP-PEN COVE, SEPTEMBER 9, 1915.

[Bottom, mud and sand; high tide; depth, 3 feet; temperature of water, 67° F.]

Length, 51 to 75.—Maximum length, 73; minimum, 58; average, 66. Number examined, 4. Food: Amphipods, 50; annelids, 33.7; débris, 16. Parasites: Distomes, 4.7.

Length, 76 to 100.—Maximum length, 90; minimum, 85. Number examined, 2. Food: Amphipods, 75; annelids, 20; débris, 5. Parasites: Distomes, 10.

Length, 101 to 125.—Length, 104. Number examined, 1. Food: Amphipods, 2; annelids, 88; débris, 10. Parasites: Distomes, 2.

Length, 126 to 150.—Length, 132. Number examined, 1. Food: Amphipods, 1; annelids, 95; débris, 4.

STATION 29. MENEMSHA BIGHT, SEPTEMBER 10, 1915.

[Sandy bottom with eelgrass; depth of water, 6 feet; temperature, 68° F.]

Length, 51 to 75.—Length, 70. Number examined, 1. Food: Amphipods, 4; annelids, 48; débris, 48. Parasites: Distomes, 5; nematodes (Filaria), 2.

Length, 126 to 150.—Maximum length, 150; minimum, 140. Number examined, 2. Food: Amphipods, trace; annelids, 50; bivalve mollusks, 2.5; débris, 47.5. Parasites: Distomes, 1; Acanthocephala, 1 in one fish.

Length, 151 to 175.—Maximum length, 162; minimum, 152; average, 156.3. Number examined, 3. Food: Amphipods, 9; annelids, 26.3; bivalve mollusks (broken shells, probably introduced with annelids), 3.3; shrimp, 10.6; débris, 50.6. Parasites: Distomes, 2; nematodes, 1 small Filaria in one fish.

STATION 30. GREAT HARBOR, SEPTEMBER 14, 1915

[Sandy bottom.]

Length, 51 to 75.—Maximum length, 72; minimum, 62; average, 66.5. Number examined, 4. Food: Amphipods, 69.5; annelids, 10; ostracodes, trace; débris (sand, with annelid setæ), 19.5. Parasites: Distomes, 1.5; sporocysts, few, 0.5 mm. in diameter, on intestine of one fish.

Length, 76 to 100.—Maximum length, 96; minimum, 84; average, 88.3. Number examined, 3. Food: Amphipods, 14.3; annelids, 69.6; Cumacea, 1.3; débris (some red alga in one fish), 14.6. Parasites: Distomes, 1.

Length, 126 to 150.—Length, 128. Number examined, 1. Food: Amphipods, 15; débris (sand, with annelid setæ, alimentary canal nearly empty), 85. Parasites: Sporozoa, large numbers of cysts, 1 mm. and less in diameter, on intestine.

STATION 31. EEL POND, SEPTEMBER 18, 1915.

[Bottom, mud and eelgrass; temperature of water, 70° F.]

Length, 51 to 75.—Length each, 70. Number examined, 3. Food: Amphipods, 91.7; annelids, 8.3. Parasites: Distomes, 1 in one fish; nematodes, 1 in one fish; Sporozoa, wall of intestine of one fish thickly beset with small cysts, 0.4 mm., more or less, in diameter, and 1 cyst, 2 mm. in diameter, on intestine of another.

Length, 76 to 100.—Maximum length, 90; minimum, 87; average, 98. Number examined, 3. Food: Amphipods, 97.6; bivalve mollusks. 0.3; ostracodes, 2. Parasites: Distomes, 2.

STATION 32. EEL POND, OCTOBER 18, 1915.

[Muddy bottom; temperature of water, 55° F.]

Length, 101 to 125.—Length, 104. Number examined, 1. Food: Amphipods, 80; annelids, trace; bivalve mollusks, trace; ostracodes, trace; débris, 20. Parasites: Nematodes, 1 (Filaria).

Length, 126 to 150.—Maximum length, 150; minimum, 130; average, 136.6. Number examined, 3. Food: Amphipods, 53.3; annelids, 3.3; bivalve mollusks, 0.3; ostracodes, 0.3; débris (some vegetable material, scales and bits of muscle tissue of fish, and crustacean fragments), 42.6. Parasites: Nematodes, 1 (Filaria) in one fish; Sporozoa, large numbers of cysts on intestine of each fish, 1 mm. and less in diameter. The alimentary canal of one fish, 150 mm. in length, was nearly empty; the tissue of the intestinal wall was almost completely replaced by cysts. In each case the cysts were closely crowded together and the intestine was easily broken.

Length, 151 to 175.—Maximum length, 158; minimum, 155. Number examined, 2. Food: Amphipods, 12.5; annelids, 30; ostracodes, trace; débris, 57.5.

STATION 33. QUISSET HARBOR, OCTOBER 19, 1915.

[Muddy bottom; temperature of water, 55° F.]

Length, 76 to 100.—Maximum length, 96; minimum, 82; average, 88.6. Number examined, 3. Food: Amphipods, 16.6; annelids, 11.6; shrimp, 30; débris (contents of intestines of annelids), 41.6. Parasites: Sporozoa, a few cysts, 2 mm. in diameter and less, on intestine of smallest fish.

Length, 101 to 125.—Maximum length, 124; minimum, 110; average, 116. Number examined, 9. Food: Amphipods, 2.9; annelids, 32.4; bivalve mollusks, 0.8; isopods, 0.1; shrimp, 24; univalve mollusks (Bulla), 12.1; débris (largely from annelids), 27.6. Parasites: Distomes, 0.2; nematodes (Filaria), 1.

STATION 34. QUISSET HARBOR, OCTOBER 22, 1915.

[Sandy bottom; temperature of water, 55° F.]

Length, 51 to 75.—Length, 62. Number examined, 1. Food: Amphipods, 2; débris, 98.

Length, 76 to 100.—Maximum length, 98; minimum, 80; average, 90.2. Number examined, 4. Food: Amphipods, 21.5; annelids, 43.5; bivalve mollusks, 0.5; débris, 34.5. Parasites: Distomes, 2 in one fish (98 mm.); nematodes, 1 (Filaria) in one fish (80 mm.).

Length, 101 to 125.—Length, 110. Number examined, 1. Food: Amphipods, 2; annelids, 68; débris, 30.

STATION 35. BUZZARDS BAY SHORE, NEAR WOODS HOLE, OCTOBER 26, 1915.

[Bottom, white sand; temperature of water, 55° F.]

Length, 51 to 75.—Maximum length, 74; minimum, 54; average, 63.6. Number examined, 5. Food: Amphipods, 10.2; annelids, 60; débris (sand with algæ, and annelid setæ), 29.8. Parasites: Distomes, 1.4.

Length, 76 to 100.—Maximum length, 96; minimum, 78; average, 84. Number examined, 3. Food: Amphipods, 1.6; annelids, 43.3; shrimp, 13.3; débris (sand, algæ, and annelid setæ), 41.6. Parasites: Distomes, 4.6; Sporozoa, numerous cysts, 1.5 mm. and less in diameter, on intestine of one fish.

STATION 36. EEL POND, NOVEMBER 2, 1915.

[Muddy bottom.]

Length, 76 to 100.—Maximum length, 100; minimum, 78; average, 90.2. Number examined, 5. Food: Amphipods, 76; annelids, 9; isopods, 5; ostracodes, 0.4; débris, 9.6. Parasites: Distomes, 0.6; nematodes, 0.4; Sporozoa, 1 cyst, 3.5 mm. in diameter, on intestine of one fish (100 mm.), numerous cysts, 1 mm. or less in diameter, clustered on lower half of intestine of one fish (92 mm.). In a fish measuring 86 mm. the intestine was densely covered and its walls filled with cysts 1 mm. or less in diameter. The intestine was easily broken in the formalin specimen. The alimentary canal was nearly empty. The same condition was noted under station 32.

FOOD AND PARASITES OF 398 SMALL WINTER FLOUNDERS DISTRIBUTED ACCORDING TO SIZE OF FISH, NUMBER OF FISH, AND NUMBER OF STATIONS.

[Figures referring to food represent average per cent of volume; figures referring to parasites represent numerical average except under Sporozoa, where they indicate the number of fish in which cysts were found.]

	Number.	Average length in millimeters.	Fish.	Crabs.	Shrimp.	Larval crustacea.	Amphipods.	Isopods.	Cumacea.	Ostracodes.	Copepods.	Insect larvae.
Size of fish, in millimeters:												
Under 25	8	22.9	......	......	....	1.8	6.1	......	......	0.6	50.9	0.3
25 to 50	112	36.4	......	......	0.05	.14	38	0.15	0.25	1.1	11	.01
51 to 75	113	61.8	0.7	......	....	......	38	.61	.79	.23	.23	.21
76 to 100	35	88.4	......	0.02	6.31	......	37.2	3.3	.13	.31	([1])	.38
101 to 125	45	114.1	......	.6	6.4	......	33.9	.66	([1])	.13	......	.31
126 to 150	30	136.6	.07	1.27	6.38	......	26.6	([1])	......	.08	......	......
151 to 175	19	161.6	......	......	1.7	......	18.3	......	......	([1])	......	......
176 to 200	4	186	......	......	....	......	15	......	......	......	......	......
201 to 225	2	218.5	......	......	....	......	5	......	......	......	......	......
Number of fish	......	......	2	8	16	4	329	30	19	80	99	27
Number of stations	......	......	2	2	8	3	36	11	11	19	16	10

	Number.	Average length in millimeters.	Limulus.	Bivalve mollusks.	Univalve mollusks.	Annelids.	Nemerteans.	Cœlenterata.	Débris.	Sporozoa.	Trematodes.	Nematodes.	Acanthocephala.
Size of fish, in millimeters:													
Under 25	8	22.9	......	......	......	10.7	......	......	30.1	......	7.7	0.2	......
25 to 50	142	36.4	......	......	1.0	18.85	0.03	0.03	29.1	2	30.9	......	......
51 to 75	113	61.8	......	([1])	.2	34.6	......	......	23.37	7	11.4	.21	......
76 to 100	35	88.4	......	0.05	......	34.2	......	......	17.4	6	3.8	.2	......
101 to 125	45	114.1	0.33	.38	3.40	29.9	......	......	25.4	12	1.02	.34	0.02
126 to 150	30	136.6	.08	4.14	.8	35.4	......	......	24.6	7	9.2	.03	.03
151 to 175	19	161.6	......	4.8	1.34	39.7	......	......	28.7	3	12.3	1.4	.05
176 to 200	4	186	......	......	6.25	31.2	......	......	47.5	1	......	......	......
201 to 225	2	218.5	......	1	42.5	5	......	......	46.5	......	......	1	......
Number of fish	......	......	3	27	34	241	1	1	360	38	216	32	3
Number of stations	......	......	1	11	9	31	1	1	35	19	19	14	3

[1] Trace.

It will be seen from the table that small winter flounders feed principally upon amphipods and other small Crustacea, and upon annelids. At the same time they are not restricted to Crustacea and annelids but evidently can utilize a variety of alternative material.

The habits of the flounder—as one may observe its behavior in an aquarium which is provided with sufficient sand—while strictly those of a bottom fish (so far, at least, as its position is concerned) are in reality those of an active and predatory fish. The food to which it will most readily react must be in the shape of objects which are in motion. Although it is by no means a swift swimmer it is capable of very quick movements within a limited range. In its favorite position it lies flat on the bottom, often partly covered with sand. When not concealed by a covering of sand, it quickly assumes a color and marking which cause it to blend indistinguishably with its surroundings. From this natural ambush it makes sudden dashes—with surprising quickness—upon objects which move near it. Thus it is easily explained why it is that the principal food of this bottom fish is not such objects as would be obtained by rooting or grubbing in the sand and mud, but crustaceans and annelids, the capture of which requires considerable agility.

The presence of the siphons of pelecypod mollusks, which are occasionally found in the stomachs of flounders, is accounted for when it is recalled that flounders often bite off the extended siphons of mollusks. The appearance of such siphons as I have found in the stomachs of flounders would indicate this origin rather than that they represent the least digestible parts of the mollusk.

Vinal Edwards's record shows that 628 adult winter flounders were examined on 82 dates. The following data from his unpublished food notes are appended: Annelids are recorded on 9 dates, in 50 fish; Crustacea, on 10 dates, in 67 fish; ascidians, on 26 dates, in 126 fish; and mollusks, on 11 days, in 56 fish. The ascidian which Mr. Edwards records is *Botryllus gouldii*, which occurs abundantly on eelgrass, where it forms translucent, fleshy incrustations. The small flounders which the author has examined did not contain any tunicate material.

An increase in the ratio of annelids to Crustacea with the size of the fish is observable in fishes under 200 mm. in length. Thus the percentages are: In 150 fish, 50 mm. and under, Crustacea 51.45, annelids 18.10; in 148 fish, 51 to 100 mm. in length, Crustacea 41.21, annelids 34.47; in 75 fish, 101 to 150 mm. in length, Crustacea 34.74, annelids 32.10; in 23 fish, 151 to 200 mm. in length, Crustacea 14.17, annelids 36.91.

FIG. 1.—NEW ENGLAND STEAM TRAWLER.

FISHERY INDUSTRIES OF THE UNITED STATES.

REPORT OF THE DIVISION OF STATISTICS AND METHODS OF THE FISHERIES FOR 1920.[1]

By Lewis Radcliffe, *Assistant in Charge*.

CONTENTS.

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[1] Appendix V to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 908.

INTRODUCTION.

During the period of the war the production and consumption of fishery products were stimulated, receiving much encouragement from governmental and other agencies as a war measure. This resulted in making provision for a considerable expansion of facilities for the capture, preservation, and marketing of fishery products, the fulfillment of which extended into the postwar period. In this readjustment period a heavy decline in the consumption of fish not only in the United States but in other countries has been apparent. Added to this advancing prices of labor and materials, curtailment in export trade, and other factors, such as labor difficulties, produced in some respects one of the most difficult and threatening situations in the history of the industry. Even in 1919, while provisions for greater production were being fulfilled, the effects of these conditions were felt and the curtailment in production in certain of our important fisheries as compared with the previous year was quite marked. For example, many of the large New England trawlers were tied up for lack of markets. The catch of the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., in 1919 decreased more than 9,000,000 pounds as compared with 1918 and in 1920 there was a further decrease in excess of 16,000,000 pounds. The packs of salmon and sardines were materially curtailed in 1920, and increasing difficulty has been experienced in marketing such fish as groupers on the Gulf coast, considerable quantities being dumped for lack of markets.

These conditions have compelled a much closer, more serious study of the economic situation. As a result there has been an unusually heavy demand upon the Bureau for statistical and technological data, the conduct of investigations which promise improvement in practices and economies of operation, aid in stimulating the consumption of fish, and the extension of the use of fishery products in the arts and industries. Although the reduction in the division's appropriation for the fiscal year 1921 to $7,500 has compelled the practical abandonment of technological research for the current fiscal year, an effort has been made to render the industry the fullest possible measure of service for its betterment and the benefit of the consuming public.

SUMMARY OF OPERATIONS.

For effecting improvements and economies in the methods of conducting the fisheries, arrangements were perfected by the Bureau for an extended trial of seaplanes to determine their commercial value as an adjunct to the fisheries, and a fishery intelligence service was initiated in New England for supplying information as to the presence of schooling fish in the vicinity of advantageously located lightships and lighthouses. In addition, information regarding the construction and operation of lesser known fishing gear and methods has been obtained for the use of the fisheries. The need for improvements in the methods of handling, distributing, and marketing of fishery products has been felt, and improvements, such as the exercise of greater care in handling fish by eliminating the use of pitchforks, the avoidance of needless bruising of the fish, and the adoption of some form of precooling on the vessels, has been urged upon the producers. Much assistance has been given producers in the securing and transporting of materials such as salt, barrels, etc., which were required for immediate use in preserving fish in abundance.

In the field of fisheries technology practical application has been made of methods developed in the course of its fish-salting investigations, and studies have been made and reports prepared on the preservation of fish nets and methods of determining the fatness of certain fishes. The investigations of the problems of the commercial fish canner have been continued at San Pedro, Calif. The Bureau has continued its efforts to stimulate the saving of waste products of the fisheries and their conversion into marketable commodities with excellent success. The production of fish meal and fish leather, the saving of such articles as shark fins, and the utilization of fish scales have materially increased.

The statistical activities of the division have included the collection of detailed statistics of the vessel fisheries centering at Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., and the publication of the results in monthly and annual bulletins; and canvasses of the shad fishery of the Hudson River, of the shad and alewife fishery of the Potomac River, and of the Maine sardine industry, all for the calendar year 1920. A canvass of the fisheries of the New England States for the calendar year 1919 was undertaken and the field work completed about March 1, 1921. The results of these canvasses are contained in the present report, together with the detailed tables of the canvass of the fisheries of the South Atlantic States for 1918, a summary of the storage holdings of frozen fish during 1920, and the quantity of fishery products by species and by months for California in 1920. The report also contains statistical data on the production of fish oils, scrap, and meal, a summary of the fisheries of both coasts of Florida in 1918, a summary of the fisheries of the Gulf States for various years, certain sponge statistics, etc.

SERVICE.

Units of the Federal Government such as this division receive an appropriation for the rendering of service. It is usually difficult to ascertain on a monetary basis the value of the service rendered, and the organization is not infrequently criticized as not rendering service in proportion to the facilities supplied for its work or through misunderstanding of its limitations. It may therefore be of interest to refer to the appreciation expressed by competent persons of the value of several phases of its work.

Of the Bureau's new method of salting fish, a practical demonstration of which was given on the St. Johns River, Fla., one writer states:

> We consider the information and the demonstration worth thousands of dollars to us alone, not saying what it is worth to the industry at large on the St. Johns River.

Regarding the introduction of fish meal production on the Atlantic seaboard, one writes:

> We estimate that the work done by your force in behalf of fish meal increased the value of last season's fish products at this point considerably above $100,000, and I am frank to say that were it not for this new market I do not think it would be possible for us to operate our plants this season, owing to the very unsettled conditions in the fertilizer trade.

Of the Bureau's paper on Preservation of Fish Nets, an authority in the net and twine trade states:

> It was a surprise to find it had been possible to prepare such an interesting and instructive article, and the author is to be congratulated on his splendid work.

AID IN IMPROVING FISHING OPERATIONS.

Activities in this field have been confined mainly to aiding in the determination of the value of aircraft for spotting fish, to provision for supplying reports from certain lightships and lighthouses regarding the presence of schooling fish to the trade, and to studies of construction and operation of fishing apparatus, the use of which is limited.

FISHERY INTELLIGENCE SERVICE.

The search for fish in the sea is difficult and hazardous. In proportion to cash returns, the expenditure of time, labor, and materials is heavy. Vessels may seek catches of bluefish, mackerel, menhaden, or tuna for weeks without appreciable results. A vessel may discover good fishing but in the absence of means of communication can not advise other relatively near-by vessels operating unsuccessfully of the location of the schools. In a calling conducted under such handicaps it is important that use be made of every available aid and of every new development of science which promises to increase efficiency of operation without danger to the supply of the future.

As early as 1883 the aid of the United States Life Saving Service was enlisted by the United States Commission of Fish and Fisheries in reporting the presence of whales and other cetaceans and rare sharks and supplying information regarding them. At various times the Bureau's vessels have been employed in behalf of the fishing industry in locating schools of fish such as mackerel and tuna. In 1917, the Bureau of Fisheries, with the aid of the Washington-Alaska Military Cable and Telegraph System, operated by the War Department, inaugurated an intelligence service to communicate by telegraph to a number of coastal towns in Alaska the current prices of certain species of fishes offered at Seattle and Ketchikan. This service furnishes at a very small cost information which could not be gotten by private individuals without considerable effort and cost and is appreciated. Details of this service are to be found in Alaska Fisheries and Fur Industries reports of the Bureau for the years 1917 to 1921.

USE OF AIRCRAFT.

In April, 1919, attended by representatives of the New England fisheries, the Bureau of Fisheries, and the patrol division of Naval Aviation, a conference was held in Washington, D. C., at which tentative arrangements were made for a properly qualified observer to make flights over such parts of the Atlantic as seemed necessary for spotting schools of fish, such as mackerel, and for forwarding the information obtained to organizations of the fisheries. At this meeting the subject of direct communication between planes and fishing vessels by means of the radio telephone was considered. The possibility of employing seaplanes to advantage in the menhaden fishery was also called to the attention of operators in the Chesapeake region, but nothing resulted from either of these negotiations during the year.

On July 28, 1919, W. W. Welsh, scientific assistant, Bureau of Fisheries, made a flight of about 1½ hours in a naval seaplane from Cape May, N. J., to Five Fathom Bank. This flight was made at a speed of about 40 miles an hour at an altitude of 500 to 1,000 feet. Mr. Welsh reported that no schools of menhaden were breaking water at the surface but that large numbers of small schools were observed at estimated depths of from 2 to 10 feet or more. He stated that:

> The range of visibility of the menhaden schools varied according to the depth of the school and the angle of incidence of the sun's rays. Had the fish been ruffling the surface they could have been seen as far as the size of the school and the atmospheric conditions permitted. This was evident by the visibility of tide rips and cat's-paws of wind upon the surface. The deeper the school the more necessary it was to approach it in order to see it. The deepest schools observed were only visible from directly above. When the sun's rays were reflected from the surface, it was impossible to see anything, and the visibility improved as the eye was diiected away from the angle of incidence of the sun. On the particular day in question the majority of the schools of fish were at such depth that they were invisible at a greater angle than 45 or 50° from the nadir, and then only on the side of the plane away from the sun. But some schools nearer the surface could be seen much farther off. Besides the general value of such observations, in no other way can such a clear idea be obtained of the abundance or scarcity of schooling fish and the characteristic appearance of the schools. * * *
>
> The most evident opportunity for the practical use of aircraft in the commercial fisheries at the present time lies in their employment as scouts for the purse-seine fishermen in the pursuit of such species as menhaden, mackerel, bluefish, bluebacks, kyacks, and other schooling fish. In the case of the spring mackerel fishery it is believed that the use of aircraft would save much time in locating the fish upon their first appearance and in enabling the fishermen to keep in touch with the fish as they appeared farther north.

In January, 1920, representatives of the Naval Aviation Service and the Bureau of Fisheries again discussed the possibility of using seaplanes in locating fish on the north Atlantic coast, and on February 25, at the request of the Secretary of Commerce, the Secretary of the Navy authorized the experiment, and the proposal was placed before various fishery organizations. The menhaden fishermen showed constructive interest in the subject, and the commandant of the Fifth Naval District detailed two Navy seaplanes, with pilots, and the fishing companies provided observers familiar with the species.

The fishing areas in Chesapeake Bay and along the coast between Assoteague and Bodie Island Lights were blocked off into lettered sections and numbered subdivisions for expediency in transmitting information as to the location of schools sighted. At first this information was communicated to the fishing vessels by signal flags suspended from the plane. Later after the installation of radio equipment on two vessels and at the shore station of one of the companies, a radio operator accompanied the plane to transmit the messages as soon as the fish were located. These daily patrols were continued from June 14 to October 1, when the Navy Department abandoned them on the ground that the experiment had fully demonstrated the commercial value of planes in this fishery. This first thorough test of aviation as an adjunct to the commercial fisheries has proved of great benefit to the industry, and the purchase of planes by the fishing companies is being seriously considered.

In December, 1919, as a result of arrangements between the naval authorities, the fishing interests, and the State commission, naval seaplanes were given trials at San Diego, Calif., for spotting schools of fish. They are reported to have been of some value in locating schools of sardines, but their usefulness in locating albacore, tuna, and yellowtail remains to be more definitely established. In the summer of 1920 a hydroairplane was operated for a time at San Pedro, but was not entirely successful. A dirigible trip was also made at San Diego by an official of the State commission for the same purpose. The aviation service of the United States Coast Guard, Treasury Department, has shown an interest in the utility of fish spotting in connection with its air patrol and training, and the Bureau of Fisheries is endeavoring to effect cooperation between the aviation station of that service at Morehead City, N. C., and the fishermen of that region.

The work done has yielded results of value, but should be continued for the purpose of ascertaining the value of aircraft in other fisheries, such as mackerel, bluefish, tuna, and herring.

NEW ENGLAND FISHERY INTELLIGENCE SERVICE.

In the summer of 1920 the Bureau investigated the possibilities of securing useful information daily from keepers of certain lightships and lighthouses as to the presence of schooling fish, such as mackerel and pollock. Through the courtesy of the Director of Naval Communications and the Commissioner of Lighthouses, the Bureau of Fisheries made arrangements to have the occurrence of such fishes reported by the keepers of *Pollock Rip*, *Nantucket Shoals*, and *Fire Island* lightships. This service was initiated about November 1, 1920, messages reporting any observations made during the preceding 24 hours being sent by radio at noon daily from these vessels to shore stations and forwarded to the Bureau's agent at Boston for dissemination and transmittal to agents in Gloucester and Portland. It was appreciated that the service was being established near the close of the season, but it was desired to have it in efficient working order on the resumption of more active fishing in the spring. If the service proves of value it is planned to increase the number of stations from which reports are received.

NOTES ON FISHING GEAR.

The following descriptions of fishing gear employed in the California fisheries have been furnished by R. A. Coleman, agent, Bureau of Fisheries. The use of the paranzella and lampara nets in American waters is practically restricted to southern California.

PARANZELLA NET.

The paranzella is the net chiefly used in deep water and bottom fishing on the California coast, especially by the large fishing companies operating with steam and power boats. This type of net (the

Italian word "paranzella" means a sloop or fishing boat propelled by sails, and this net was always used with such boats) has been in use on the Mediterranean for a long period. It is said to have been introduced in California in 1876. It is a heavy and strongly constructed net, intended for dragging the bottom in a manner similar to the otter trawl, although it is of quite different make. It proves an efficient means of taking fish.

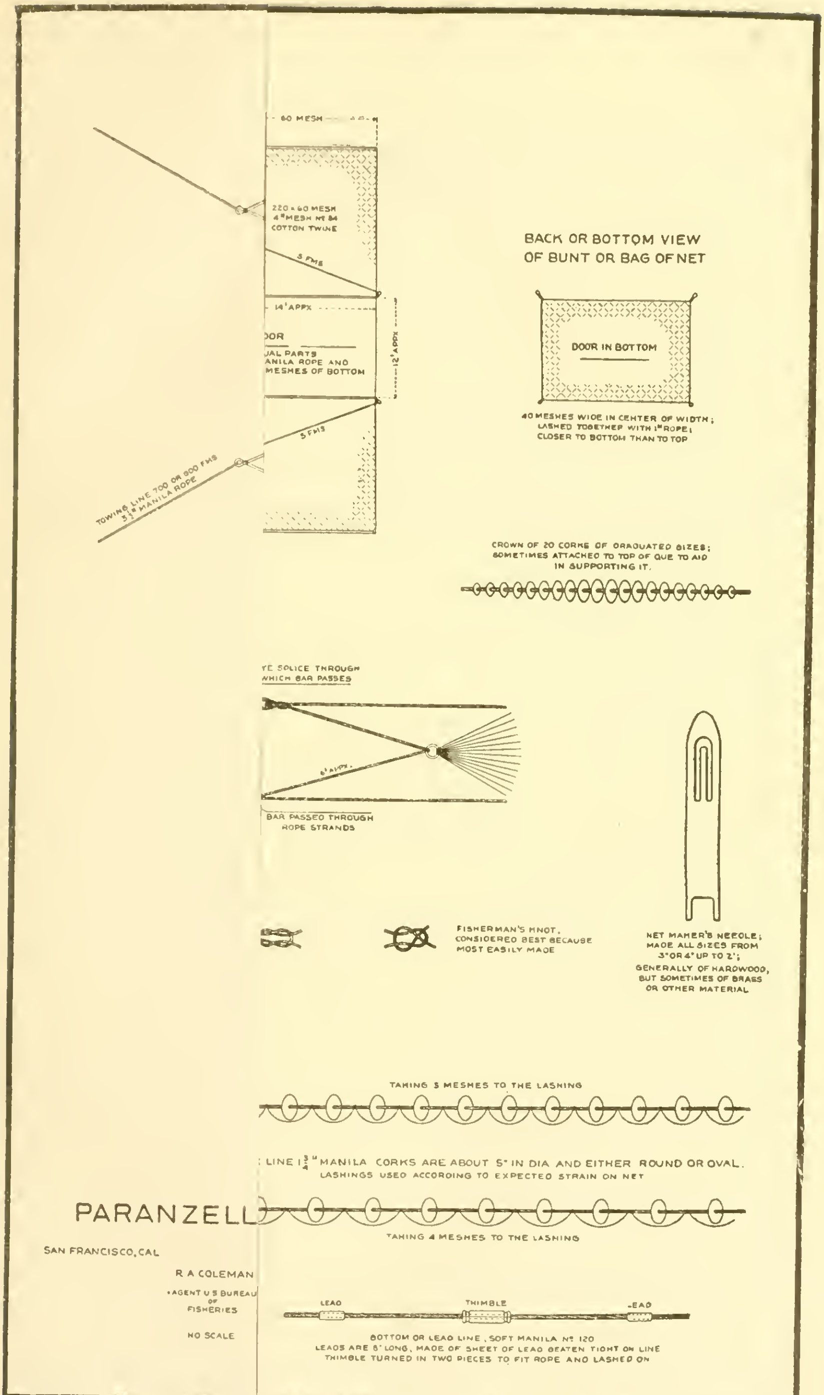
There is no strict uniformity in the method of construction. The differences are, however, relatively slight, and the type is constant. The nets differ in length from 25 to 35 fathoms and in form according to the use to be made of them and individual fancy. They are made in several sections or "pieces," varying from four to eight.

The net illustrated (fig. 2) and on which the discussion is based is the true type of the paranzella and has eight pieces. The first, the wings, which are 150 meshes (3-inch) in length by 300 in width, are made of No. 9 or 12 cotton twine. The wings are often more extended, if it is desired to obtain greater sweep, and may reach considerable length. The second piece is 200 meshes (2½-inch) in length by 300 in width, of No. 9 twine. The third is 100 meshes in length (2½-inch) by 250 in width, of No. 12 twine. The fourth is 60 meshes in length (2½-inch) by 225 in width, of No. 18 twine. The fifth is 18 or 20 meshes (3¼ or 3½ inch) in length by 270 in width, of No. 42 or 60 twine, and is practically a portion of the bunt. Many nets omit this piece entirely. The sixth piece forms the bag, or bunt, proper. It is 60 meshes (4-inch) in length by 220 in width, of No. 84 twine. Sometimes the top is made of 3½-inch mesh, No. 42 twine, while the sides and bottom are 4-inch mesh, of No. 84 twine or rope. The other pieces are the ques (*scagnetto*, in Italian), which serve to strengthen the net, and especially to help carry the weight of the bag. The top que is 62 meshes (4-inch) wide at the front end, tapering to 30 meshes at the back end, reduction being made at the center, 9 fathoms long. The bottom que is 42 meshes (8-inch) wide in front, tapering to 30 meshes at the other end, reduction being made in the center, and is 8 fathoms long, No. 64 twine being used for both ques. It will be noted that the bottom que is about a fathom behind the top que.

The head of the top que is attached to the rope (3½-inch soft manila, which carries the wings and takes the strain of the net) in a special manner, as illustrated in the drawing of the net. It does not follow the curve, but its end is straight and is lashed to the rope (using No. 60 or 84 twine), gradually lengthening at the sides of the que to accommodate the curve. Two meshes are picked up by the needle, an overhand knot is made in them, and the lashing led to the rope, when three round turns are taken and fastened.

A crown of about 20 corks, graduated in size, is sometimes attached to the front end of the top que to assist in sustaining it when the strain is expected to be heavy.

For convenience in removing the fish from the bag, either two or three openings, or "doors," are left in the top. These are 20 or more meshes in length and are trimmed with 1 or 1½ inch manila rope and lashed together with No. 9 or No. 12 thread rope. There is also a bottom, or end, door to the bag, trimmed as the others. It is closer to the bottom of the net than to the top.


60 MESH
220 x 60 MESH
4" MESH Nº 84
COTTON TWINE
5 FMS
14' APPX
12' APPX
MESHES OF BOTTOM
5 FMS
TOWING LINE 700 OR 900 FMS
3½" MANILA ROPE
BACK OR BOTTOM VIEW
OF BUNT OR BAG OF NET
DOOR IN BOTTOM
40 MESHES WIDE IN CENTER OF WIDTH;
LASHED TOGETHER WITH 1" ROPE;
CLOSER TO BOTTOM THAN TO TOP
CROWN OF 20 CORKS OF GRADUATED SIZES;
SOMETIMES ATTACHED TO TOP OF QUE TO AID
IN SUPPORTING IT.
WHICH BAR PASSES
6' APPX.
BAR PASSED THROUGH
ROPE STRANDS
FISHERMAN'S KNOT,
CONSIDERED BEST BECAUSE
MOST EASILY MADE
NET MAKER'S NEEDLE;
MADE ALL SIZES FROM
3" OR 4" UP TO 2';
GENERALLY OF HARDWOOD,
BUT SOMETIMES OF BRASS
OR OTHER MATERIAL
TAKING 5 MESHES TO THE LASHING
CORKS ARE ABOUT 5" IN DIA AND EITHER ROUND OR OVAL.
LASHINGS USED ACCORDING TO EXPECTED STRAIN ON NET
PARANZELL
TAKING 4 MESHES TO THE LASHING
SAN FRANCISCO, CAL
R A COLEMAN
AGENT U S BUREAU
OF
FISHERIES
NO SCALE
LEAD
THIMBLE
LEAD
BOTTOM OR LEAD LINE, SOFT MANILA Nº 120
LEADS ARE 5" LONG, MADE OF SHEET OF LEAD BEATEN TIGHT ON LINE
THIMBLE TURNED IN TWO PIECES TO FIT ROPE AND LASHED ON

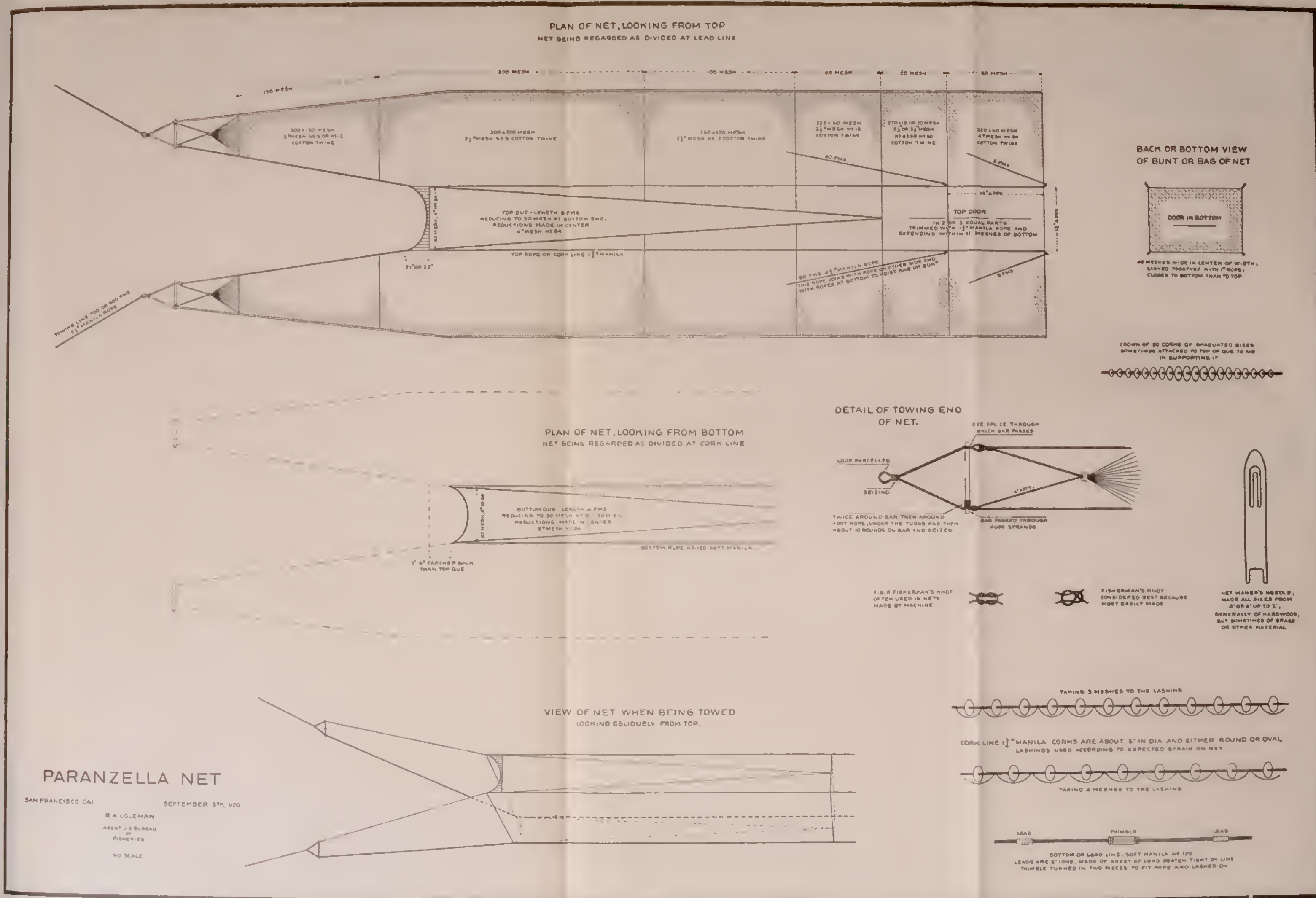


FIG. 2.—PARANZELLA NET.

The cork line is about 35 fathoms long, of 1¼-inch manila rope. It carries about 35 corks on each side. These corks are either round or oval and are about 6 inches in diameter, perforated in the center for reeving on the line.

The lead line, which really carries the weight and strain of the whole net, is of soft manila, and varies in circumference from 3½ to 4½ inches, according to size of net and preference of maker. The lead line bounds not only the longitudinal bottom of the net, but likewise the entire four sides of the end of the bunt, thus giving great strength and lifting power to that part. It is also practically continuous over the front of the net, being carried along the lower sides of the wings to the towing bar, and thence around the top of the wings and front, or top que, and of the net, making a complete circuit. Sometimes the portion bounding the upper sides of the wings and top que is a half inch or so less circumference (of soft manila) than the lead line proper. This upper portion of the line carries 6 or 8 wooden thimbles to the side, similar to those on the lead line, though generally more rounded in shape. These are intended to prevent chafing when the net is hoisted aboard.

The lead line proper carries 6 to 10 leads on each side. These leads weigh 1 pound each. They come in flat pieces and are beaten into place about the line. (Some fishermen say that leads are not necessary at all, as the weight of the net holds it well at the bottom.) In addition there are on each side 4 wooden thimbles about 8 inches long. They are turned in two pieces to fit the rope and are lashed about it. Their purpose is to lessen the chafing.

The towing bar is about 24 inches in length by 2 inches in diameter, of pine or hardwood. For details of the method of its use, and also for the method by which the weight and strain of the net is taken at the towing end, reference is directed to the illustration. The ring by which the net head is attached to the towing bar hangs about 6 feet behind the bar.

The net is hung from the cork line by lashings, or seizings, at intervals of either three or four meshes, according to expected strain, and the loops are allowed to fall about 6 inches below the cork line.

From the front top corners of the bag two 60-fathom, 4½-inch hard manila ropes are attached. These are led to the winch when the net is being hauled, in order to carry the weight of the bag with its load of fish. Two 5-fathom ropes of the same size, or sometimes 3½-inch, are attached to the top back corners of the bag, and when it is desired to hoist the bag on board these are bent onto the 60-fathom ropes at the front end of the bag, which is thus hoisted from its four corners.

The fish are taken from the net through the doors with a heavy scoop net of 2½ or 3 feet diameter, with strong wooden handle. These scoops are sometimes so heavy that it requires two men to operate them.

The net is towed by two 60-foot, or more, seagoing fishing boats. The towing lines or warps are of 3½-inch hard manila 700 or 800 fathoms in length.

Operations are carried on in the following manner: When it has been determined by sounding that a suitable bottom has been found, the boat which carries the net slows down. The other boat comes alongside and passes its towing line to the first. This is attached to one wing of the net. The boats then separate, the net is shot, and they begin paying out their respective warps through special shackles at the stern. After 50 or 60 fathoms have passed out an iron weight, or sinker, weighing 25 to 35 pounds is attached to each line, in order to sink the net, and the remainder of the rope, 450 or 500 fathoms, is payed out. The towing speed varies from 2½ to 4 knots per hour. The opening in the net is about 12 fathoms from one towing bar to the other. Ordinarily the boats tow about 800 feet apart. In stormy weather this distance is somewhat reduced, and in fine weather is extended.

In some instances fishermen prefer to purchase the bunt of their nets ready-made, in which case it is usually made by machinery. Sometimes, also, other parts of the net are purchased. A figure-eight knot is generally used in machine-made nets, but the parts made by hand are almost always made with the customary fisherman's knot. The illustration is not drawn to scale.

LAMPARA NET.

This net originated in the Mediterranean, where it has long been in use. It is said to have been brought to California about 1900. The lampara is so called from the Italian word "lampo," meaning lightning, because used chiefly in taking sardines, anchovies, and other small fishes which move with great quickness in the water, flashing as they swim. These fish are usually taken at night, in the "dark of the moon," since by day, or even on moonlight nights, they see the nets and avoid them. The lampara differs from the paranzella in that it is intended to take fish at the surface or at but a short distance below, while the paranzella is dragged on the bottom.

Although the lampara nets are used chiefly for taking sardines and other small fish, especially for bait, some nets of large dimensions—up to 2,000 feet in length by 150 in depth—have been constructed of strong, heavy twine for the capture of larger fish, such as sea bass, barracuda, yellowtail, etc. In these cases the range of size of mesh may vary from 2-inch stretched mesh in the bag to 20-inch at end of wings. So far, however, such nets have not proved a general success, as they are awkward to handle on account of their large size, and the fish captured in them are so powerful that they often tear the net.

The accompanying drawing (fig. 3) and description of the lampara net are based on information supplied by E. M. Nielsen, assistant to the California Fish and Game Commission at Monterey, and were taken from a net of average size and make owned by a local fisherman.

Referring to figure 3 and its legend, it will be noted that section 3 is of heavy netting to withstand wear and tear when the fish are taken out of the net and section 4 acts as a wall to prevent the fish from escaping. Section 5 is light and of small mesh so that the fish do not gill in it; the net is usually fished in the dark of the moon, and the phosphorescence in the water tends to deflect the fish from the wings backward toward the bag of the net. The lead line is ⅞-inch diameter hemp rope and carries lead weights to a weight of about 150 pounds, the leads being about 18 inches apart.

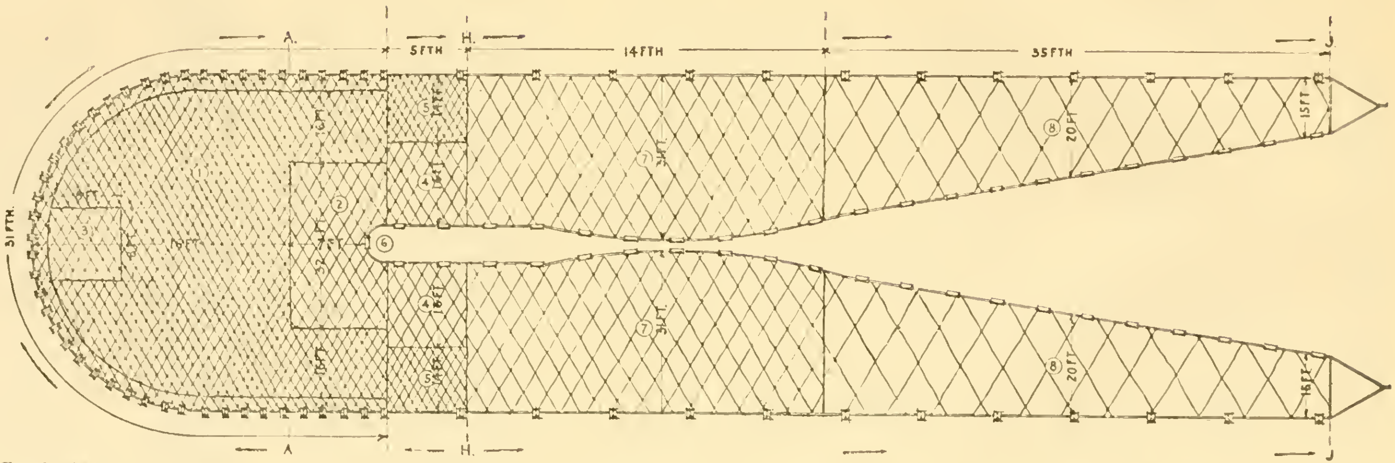


FIG. 3.—Lampara net. Section 1, 26-6 thread, $\frac{7}{8}$-inch mesh; 2, Mendocino or key of net 6-ply, 3-inch mesh; 3, heavy netting, 6-ply, 1-inch mesh, 8 by 8 feet; 4, 6-ply, 3-inch mesh; 5, part of bag of 26-6 thread, $\frac{7}{8}$-inch mesh; 6, horseshoe, where wings divide; 7, wing-section of 5-inch mesh; 8, wing-section of $8\frac{1}{2}$-inch mesh; *A*, strip of netting 10 inches wide, 16-ply, 1-inch mesh of heavy mesh, to hold bag to cork line and withstand wear and tear; *H-H*, cork line of $\frac{5}{8}$-inch diameter hemp rope, 500 corks in pairs, 6-inch interspace between pairs; *H-J*, wing cork lines, 500 corks in pairs on each wing, interspaces about 3 feet.

The lampara net is made of cotton twine and may be operated either with one large boat or with two boats. The operation with one boat is carried out as follows: When a school of fish is located, one end of the net is thrown out with a buoy attached, sometimes anchored; then the boat is pulled around the fish in a circle, paying out the net until the boat is back to the buoy from which it started. Then an anchor is generally put over the side away from the net to hold the boat off. Then the fishermen start hauling both ends of the net from the bow and the stern, until the bag is hauled up alongside. After getting the wings into the boat and the bag alongside, the fish are dipped out into the well or box. The net is then overhauled and made ready for another lay. From three to five men are required to operate in this way.

When two boats are used, the bag is dropped first; then the fish are circled by the boats pulling in opposite directions, paying out the coiled net until they meet, passing one another, one end of the net being passed over the other and the boats anchored. The wings are crossed while the net is being hauled in. The bag is thus hauled up between the boats, when the fish are taken out. Six to eight men are required to operate in this way.

A modification of the lampara has sometimes been used of late, consisting of a purse, or semipurse attachment. It is in all respects a lampara net except that a purse line is added to the bunt of the net, which enables the operators to pull the lead line in more quickly after the net is partly in, thus impounding the fish in the bunt of the net. It is claimed that by this device it is easier to catch the fish in the daytime without their sounding and getting under the net when operating in deep water. A shallower net may be used, thus making its operation quicker and more economical. This device has not, however, been generally adopted.

HERRING GILL NET.

The herring gill net used in San Francisco Bay, Calif., is usually about 50 fathoms in length by 2 in depth. It is made of 2-inch mesh, 2-ply cotton twine. The top strip of meshes, 3 or 4 inches wide, abutting the cork line, is made of 4 or 5 ply twine to give it greater strength. The cork line is one-half inch diameter manila, with corks, 2 inches in diameter, at intervals of 2 feet. The lead line is three-eighths-inch manila, and the leads, weighing about 4 ounces, are 3 feet apart. The net is operated from one boat and is handled by two men. These nets are generally purchased ready-made.

SMELT NET.

Smelt nets in use on San Francisco Bay are usually made of linen twine. They are 28 to 30 fathoms long by 10 to 12 feet in depth and are constructed of 1½ or 2 inch mesh. In other respects they resemble the herring nets.

TRAMMEL NET.

A three-web trammel net observed in use in southern California was 200 fathoms long by 2½ deep. The small web was of 7½-inch mesh, and the large outside webs of 18-inch mesh.

DEVELOPMENT OF IMPROVEMENTS IN METHODS OF HANDLING, DISTRIBUTING, AND MARKETING.

FRESH FISH.

One of the most important means for increasing the consumption of fish is to supply the consumer with a product closely approximating the quality of the fish as taken from the water. This necessitates reducing the amount of deterioration from "catch" to consumer to a minimum. Considering the length of time that elapses after the fish are taken from the water until they reach the consumer, some deterioration is inevitable, but that a marked degree of improvement in reducing the amount can be made is undoubtedly possible. With such improvement many persons who now enjoy freshly caught fish, but who rarely buy "fresh" fish in the market, will be added to the list of regular consumers. As deterioration sets in as soon as the fish are dead, the first step is to improve methods of handling the fish on boat or vessel and at the points of distribution.

It is important to handle fish with the greatest possible care, to avoid bruising or forking them, and to avoid warmth. Fish should be handled with the same care as fruits; they should not be forked, bruised, tread on, thrown about needlessly and roughly, or piled too deeply in boat, box, or barrel. Failure to observe these precautions will cause spoilage just as the spoilage of fruits is hastened by similar treatment. The temperature of fish is about the same as that of the water in which they live, usually slightly higher. Fish taken from warm water will therefore spoil more quickly than if taken from cold water. The warmer the water is the greater the care required to prevent spoilage. If the fish taken from warm water are piled deeply it is but natural that the temperature of the mass will shortly begin to rise, with resultant spoilage. It is therefore important to keep the fish away from warmth and to cool fish taken from warm water as quickly as possible.

The Bureau has impressed upon those in the fisheries the importance of avoiding the use of fork or pew as far as practicable, using where necessary only a one-tined fork and forking the fish in the head instead of the body, and has encouraged the installation of precooling devices to remove the body heat of the fish as speedily as practicable. It is believed that a cold brine circulatory system or an adaptation of the system of freezing fish in brine may be worked out for use on vessels or boats. In fact, some experiments have already been made to this end by those in the fisheries.

There is fully as great if not greater need for improving methods of distribution and the handling of the fish in the retail markets. The shipper should consider the advantages of packing the fish in shallow boxes instead of in barrels; and the retailer, in view of the length of time that has elapsed since the fish were caught, should observe every precaution which will retard deterioration as well as offer the fish for sale in an attractive manner and amid sanitary surroundings.

KIPPERED FISH.

The preservation of fish by smoking is a very ancient and widely known practice. The products preserved in this manner are among the tastiest of foods. The necessity for marketing the product within a short period of time has restricted the volume of production and confined the practice largely to the centers of consumption. To minimize these difficulties the canning of the smoked fish has received greater attention in recent years, much of the product being labeled as kippered fish. In the preparation of such fish a variety of practices have sprung up. For example, of 10 packs recently examined, in 1 pack the fish were split through the back, in 2 they were unsplit, and in the remaining 7 they were cut lengthwise into separate sections. Nine packs contained headless fish; one, tailless. In Service and Regulatory Announcements No. 26 of the Bureau of Chemistry, issued December 30, 1920, the following tentative definitions are recognized by that bureau:

Kipper.—A fish which has been split through the back from tail to head, eviscerated, lightly salted, and lightly smoked. Example, kippered herring. Kipper unsplit.—A fish which has been headed and eviscerated (but not split), lightly salted, and lightly smoked. Example, kippered herring unsplit.

The characteristic appearance of kippered herring and bloater herring as prepared for the smoked fish market are shown in figure 4.

INCREASING THE USE OF FISH AS FOOD.

A summary of the conditions affecting the marketing of fish has been given in the introduction to the present report and attention called to the handicaps under which the Bureau has labored in meeting the menacing situation which confronted the industry. Efforts to obtain additional funds for demonstrations in fish cookery and similar activities were unavailing and the Bureau's activities were limited almost wholly to the issuance of helpful economic circulars and placards and to furnishing informative matter.

THE HADDOCK.

With the recent increase in the number of trawlers operating in the New England fisheries, there has been a large increase in the catch of haddock, resulting in the production of this species in excess of the market demand. To illustrate, the vessel landings at Boston and Gloucester for the three-year period 1918 to 1920 increased about 50 per cent in comparison with the period 1908 to 1910, and for Boston, Gloucester, and Portland, the landings in 1920 were nearly 30 per cent greater than in 1916, while the increase in the price to the fishermen was but $0.006 per pound. The landings of the vessel fisheries at these ports in 1920 amounted to 73,345,581 pounds.

The Bureau has issued a placard and a small cookbook [2] recommending the use of this fish. In this economic circular attention is called to the fact that the haddock is abundant on the great fishing banks which stretch from Cape Cod to Newfoundland, and at certain seasons frequents the shores; that it is a relative of the cod, one of the "dry" fishes, and possesses many of the same qualities, the average constituents of the two fishes, based on a number of analyses, being as follows:

	Proteins.	Fats.	Ash.	Water.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Haddock	17.10	0.26	1.25	81.39
Cod	16.00	.30	1.24	82.46

[2] Moore, H. F.: The Haddock: One of the Best Salt-water Fishes. With Recipes for Cooking It. Bureau of Fisheries Economic Circular No. 47, 8 p., issued Aug. 18, 1920. Washington.

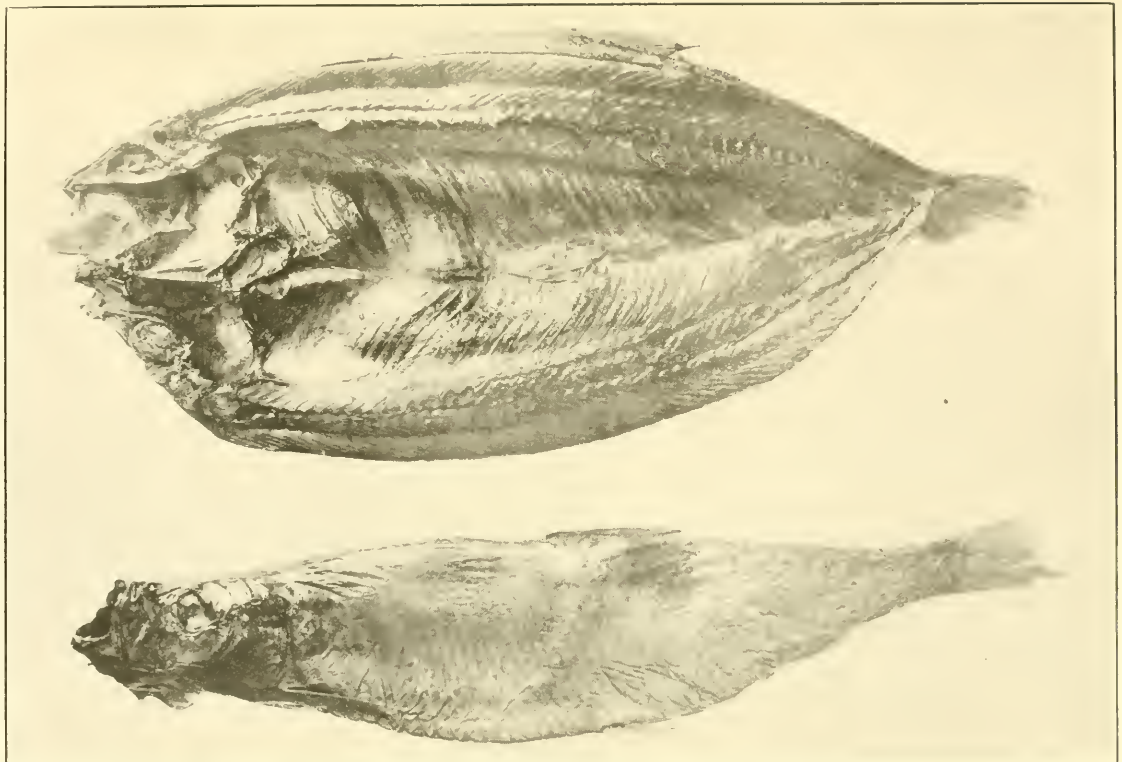


FIG. 4.—UPPER, KIPPERED HERRING; LOWER, BLOATER HERRING.

FROZEN FISH.

Freezing conserves fish in times of abundance and cheapness for use in times of scarcity. As a rule fish are now frozen under excellent conditions, usually within a short time after they are caught. If perfectly fresh when frozen, if properly stored, handled, and prepared for the table, they are often superior in quality, texture, and flavor to fresh fish shipped long distances packed in ice. Some of the important species frozen are whiting, halibut, cod, hake, haddock, pollock, ciscoes, salmon, mackerel, sablefish, squeteague, smelts, whitefish, lake trout, butterfish, croakers, shad, and yellow pike.

As an aid to increasing the consumption of frozen fish and removing certain prejudices, the Bureau has issued a poster and leaflet recommending this commodity. The leaflet stresses the importance of keeping frozen fish at a low temperature until used for food and of never thawing and refreezing or subjecting them to rises in temperature or bruising, and emphasizes the necessity of buying them frozen and placing them in an ice box or cool place for thawing before cooking. For statistics of the holdings of frozen fish by species and by months in 1920, see page 52.

TECHNOLOGICAL INVESTIGATIONS.

The small appropriation granted for the fiscal year beginning July 1, 1920, has made it impossible to conduct regular investigations in this field, limiting the work mainly to a review of literature of methods which will be helpful in future investigations and to certain minor activities which could be done at little expense. Appreciating the importance of the technological investigations in progress at the experimental plant at San Pedro to the fisheries of the Pacific coast, the California Fish and Game Commission has taken over the laboratory and is operating it for the current fiscal year.

SALTING RIVER HERRING.

The technological investigations of the basic principles governing the salting of fish which have been described in previous reports have revealed the possibilities of effecting certain refinements and improvements in common practice, of salting fish at higher temperatures and therefore in warm climates and of producing a product superior to much of that now marketed. In order to give practical application to the results, arrangements were made to initiate the salting of fish at points in Florida where previous attempts by usual methods had failed. A practical salter of long experience was employed, given instructions and opportunity to try out these improvements in the Bureau's Fishery Products Laboratory, and detailed to Welaka, Fla., for instructing local fishermen desirous of giving such methods a trial.

At Welaka the run of river herring lasts from about January 1 to March 15. During the early part of the season the catch is marketed without difficulty, but later when the fish appear at more northern points the demand diminishes and the price falls to a point at which it is unprofitable to continue fishing. The possibility of salting the fish taken at this period was welcomed by the local fishermen.

The instructions given resulted in the successful salting of 80,000 fish, and purchasers of the fish expressed a high appreciation of the quality of the product. Plans were developed for establishing local markets for the fish and for conducting the work on a large commercial scale.

A paper[3] by the Bureau's technologist, H. F. Taylor, has been published by the Bureau for the use of fish salters, and it points out the practical application of the principles developed by work in this field. These include the careful handling of fish before salting; thorough cleaning, especially the removal of all blood; the use of salt of a high degree of purity; and the application of salt in the dry condition.

REFRIGERATION OF FISH.

To supply authoritative technical data bearing on the refrigeration of fish, the relative merits of freezing fish in air and in brine and the like, the Bureau has assembled necessary equipment including electrical measuring apparatus. Lack of funds and the loss of technological workers have prevented the prosecution of this investigation. The demand for the Bureau's data on refrigeration, particularly freezing in brine by the various processes, has been heavy and it is believed has been highly appreciated by the trade. Practical application of the principles in the precooling and freezing of fish have been made and give promise of effecting important advances in the distribution of fish of excellent quality. The possibilities of precooling the catch as taken by the fishing vessels merit serious consideration. A number of demonstrations of brine freezing have been made by the Bureau during the year. As a result of demonstrations given for the benefit of representatives of the Bureau of Plant Industry, that bureau has made provision for the application of this method to the freezing of fruits and vegetables and is conducting investigations in its particular field.

CANNING OF PACIFIC COAST FISHES.

When the Bureau equipped its small experimental canning laboratory in southern California, one of the more pressing lines of investigation was the development of satisfactory methods of canning little utilized fishes to render available larger quantities of protein food and conserve meat. As a result much attention was given to the possibilities of developing suitable methods for canning such fishes as mackerel, bonito, barracuda, sea bass, and smelts and to improving the packs of pilchard, tuna, and yellowtail. Several hundred packs were put up and held in storage for examination periodically, and in a few cases methods which appeared unusually promising and for which there was an immediate demand have been released. The results of this work are being prepared for publication. With the lessening of the demand for greatly increasing production and in view of the underconsumption of fish and difficulties of marketing not only new fishes, but staple varieties, in recent months the laboratory has concerned intself with the more important work of developing standard methods

[3] Taylor, Harden F.: Improvements in Process of Salting River Herring, Especially Adapted to Warm Climates. Appendix II, Report, U. S. Commissioner of Fisheries for 1921, 7 p., B. F. Doc. 903. Washington, 1921.

of canning the usual species which will yield standard packs and to the solution of the practical problems of the canners. For example, it is making a careful investigation of the possibilities of recovering the fry bath oil and of keeping it free from the objectionable substances acquired by continued use. This problem is much more complex than was anticipated when the work was undertaken and, if it can be solved, it will be of marked value to the industry.

PRESERVATION OF FISH NETS.

Most of the investigations in the preservation of nets have been made in Norway, very little investigation or experimentation being noted in the fishery or scientific journals in other countries. This important means of economizing in the expense of nets appears to have been largely neglected in the United States, the principal preservative used being tar, which can be used only for the coarser kinds of nets. As the fishing gear employed by our fishermen represents an investment in excess of 15 million dollars, a large part of which is in twine, and in view of the increased cost of such netting, the importance of lengthening the life of such gear will be appreciated. To contribute to this end, a paper on the subject has been prepared,[4] reviewing the literature of the subject, presenting the fundamental principles so far as they are known, and giving for use those recipes which, from a chemical standpoint, seem best calculated to serve their purpose. In addition provision is being made for the conduct of additional tests for the purpose of affording still further aid to our fishermen.

INCREASING THE USE OF BY-PRODUCTS OF FISHERIES.

Although the Bureau's activities in this field during the year were practically confined to suggestions through correspondence or by personal visits, the results achieved have been exceedingly gratifying and important progress is to be noted in the saving of fish waste, the manufacture of fish meal, the production of fish leather, and the utilization of fish scales. The decline in value of fish oil and scrap to prewar levels will undoubtedly affect operations in 1921.

FISH OILS.

By converting the figures published by the Bureau of the Census in Animal and Vegetable Fats and Oils for calendar years 1919 and 1920, on the basis of $7\frac{1}{2}$ pounds to the gallon, the production of fish oils in gallons in 1920 was as follows: Menhaden oil, 3,676,453; whale oil, 3,073,574; sperm oil, 416,737; herring oil, 380,379; cod and cod-liver oil, 196,108; and all other, including marine animals, 1,060,322; a total of 8,803,574. On the basis of reports from the Pacific Coast States and Alaska, the production of fish oils in 1920 approximated 3,066,000 gallons.

Imports of fish oils entered for consumption for the calendar year 1919 amounted to 2,599,072 gallons, valued at $2,928,993. This

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[4] Taylor, Harden F.: Preservation of Fish Nets. Appendix IV, Report, U. S. Commissioner of Fisheries for 1920, 35 p., 1 fig., B. F. Doc. 898. Washington, 1921.

amount includes cod oil, 1,152,252 gallons, valued at $1,107,221; cod-liver oil, 235,805 gallons, valued at $665,080; herring and other fish oils, 542,112 gallons, valued at $437,836; seal oil, 23,121 gallons, valued at $21,598; sperm oil, 124,747 gallons, valued at $124,511; and other whale oil, 521,035 gallons, valued at $572,747. The exports of fish oils in 1919 amounted to 1,085,551 gallons, valued at $976,831. Of this amount 526,980 gallons, valued at $401,466 went to England; 409,122 gallons, valued at $353,221 to Scotland; and 59,722 gallons, valued at $70,309 to Canada.

FISH SCRAP AND MEAL.

The estimated production of fish and whale scrap and meal in 1920 was 130,000 tons, a material increase over previous years. Of this amount, 16,898 [5] tons are credited to the Pacific Coast States and Alaska. On the west coast, as a result of the heavy demand for fertilizer material, more than the usual amount of scrap was used for this purpose. In the menhaden industry of the Atlantic coast, the value of the Bureau's assistance in encouraging the production of fish meal has been greatly appreciated. At least 5,000 tons of meal was turned out by the producers in 1920 and considerable quantities of unground scrap are reported as sold to manufacturers interested in supplying stock feeds. The Bureau of Animal Industry of the Department of Agriculture has continued its hog-feeding tests, using various fish meals, and samples have been supplied to some 15 State experiment stations with satisfactory results. The experiments in progress include the feeding of meal of high oil content, samples without removal of natural oil with additional oil added, and meal made from decomposed fish. If these tests yield satisfactory results, the producers of fish meal should be reasonably assured of markets for their product as soon as the farmers have become acquainted with the merits of this commodity. The whaling companies have recently expressed an interest in the manufacture of whale meal and have provided material for a feeding test.

Considerable quantities of fish waste and waste fish incident to the New England fisheries remain unutilized, and in some cases its disposal is an item of no little expense to the producer. Lack of a regular supply makes the operation of the larger reduction plants impracticable, and the smaller plants appear to be not wholly satisfactory for the proper reduction of some of the raw materials in greatest abundance. The Bureau appreciates the need of solving the problems of this field and hopes to be in position to take them up in the near future.

FISH LEATHER.

Notwithstanding the increase in the usual supplies of materials for tanning into leather, the possibilities of employing the hides of sharks and other unutilized aquatic animals continues to attract attention, and the number of inquiries for detailed information is large. Several companies are interested in developing the industry and in the establishment of fisheries for these forms. The Bureau of

[5] See Pacific Fisherman Yearbook, January, 1921, p. 105–106.

Standards is continuing its investigations of the characteristics and qualities of these leathers. One sample of shark leather possessed a tensile strength in excess of 6,500 pounds per square inch exceeding that of calfskin tested. Wearing tests of shoes are also being made. For this purpose 11 pairs of shoes, one shoe of each pair of shark leather and its mate of calfskin; seven pairs of shoes, one of porpoise and mate of side leather; and two pairs of shoes, one shoe of whale leather and mate of calfskin, are being used. It is assured that leather of good quality can be made from shark hides, and ready markets thus far have been found for good grades. There is need for more attention to the subject of quantity-production, to the trial of small, easily movable reduction plants to care for the oil, scrap, and fins, and to developing the interest of fishermen to save and utilize their catch of sharks. A report is being prepared covering the investigations in this field.

SHARK FINS.

There is an apparent demand for a much larger supply of dried shark fins. San Francisco is the center of the industry in the United States, the receipts at that port amounting to about 5 tons per month. Much the larger portion is imported from the west coast of Mexico, the balance being received from California points and a few shipments from the Atlantic coast. The Chinese merchants are the largest buyers and export the bulk of the material to China, the balance being absorbed by the local trade.

Unlike conditions in the principal oriental markets, very little distinction as to the species of sharks from which the fins are taken is made, provided the fins are of good size, properly trimmed and cured. The fin should be cut off at the body, with all fleshy parts trimmed off, leaving only the true fin. The marketable fins are the dorsal on the back, the pectorals or anterior paired fins, and the anal. The large dorsal is preferred, while the caudal or tail is worthless. The fins must be at least 6 inches long, and those ranging from 8 to 14 inches are preferred.

For curing the fins should be thoroughly dried in the sun without salt or other treatment, then packed, preferably in cases or barrels weighing about 250 pounds, or put up in sacks to weigh 150 or 200 pounds. Choice grades have commanded as high as 65 to 75 cents per pound, but fins badly cured, improperly trimmed, etc., command much less.

PEARL ESSENCE OR FISH SCALE ESSENCE.

The art of using the silvery pigment from fish scales for ornamental purposes is said to have been discovered by the Chinese. In 1680 artificial pearls were first made in western Europe by Jacquin, a rosary maker in Paris, and the trade has been largely conducted in France, Germany, and Italy. The silvery coating of the scales of certain fishes, freed from organic matter and composed of minute, oblong bodies which en masse under suitable conditions supply an iridescent effect, is employed for the purpose. This material is known as essence d'orient, pearl essence, or fish-scale essence. In the manufacture of the artificial pearls the inner wall of the thin glass spheres is coated with this essence and the cavity filled with a hard white wax.

In the past the best scales for the purpose were obtained from one of the cyprinid fishes of Europe. The supply of pearl essence was curtailed by the outbreak of the Great War, and in 1915 and 1916 numerous inquiries were received by the Bureau concerning the fishes from whose scales the essence could be prepared and details of manufacture of the essence and of artificial pearls. Such information as could be found was supplied, and some experiments were made with the scales of native fishes. Promising samples, although never free from color, were made from the scales of the alewife, or river herring. After treating the scales with ammonia the lustrous particles were separated out by centrifugation. Samples submitted to American representatives of Parisian pearl manufacturers were pronounced off color and lacking in luster. Later one of the Bureau's technologists made some additional experiments, including the digestion of the proteinaceous material, leaving the lustrous particles and a pearly suspension produced, but the results were not wholly satisfactory. At about this time others had succeeded in making pearl essence from the scales of native fishes and the experiments were discontinued for more important investigations. According to report the scales of the alewife, or river herring, sea herring, and shad are employed. The scales are agitated in an ammonia solution and the lustrous particles separated by straining the liquid through several cloths. The material produced is reported to be fully the equal of the imported essence for the manufacture of artificial pearls. The fishermen receive from 15 to 50 cents per pound for the scales, and considerable quantities are now being used for the purpose.

NEW ENGLAND VESSEL FISHERIES.

GENERAL STATISTICS.

In the vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., during the past year the number of trips and the catch were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the products landed at Boston during the year, amounting to 14.67 per cent in quantity and 30.19 per cent in value, while at Gloucester there was a decrease of 34.51 per cent in quantity and 31.93 per cent in value, and at Portland a decrease of 40.22 per cent in quantity and 8.60 per cent in value. Statistics of these fisheries have been collected by the local agents and published in monthly bulletins showing by species and fishing grounds the quantities and values of fishery products landed by American and Canadian fishing vessels during the year at these ports. Two annual bulletins have been issued, one showing the catch by months and the other by fishing grounds.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at $6,136,569; at Gloucester, 2,381 trips, aggregating 46,740,296 pounds, valued at $1,460,336; and at Portland, 1,883 trips, aggregating 12,981,503 pounds, valued at $630,108. The total for the three ports amounted to 7,606 trips, aggregating 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of $8,227,013. This total includes 54 trips, 43 at Boston, 1 at Gloucester, and 10 at Portland, landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at $119,028. Of this quantity, 1,308,774 pounds, valued at $62,147, were landed at Boston; 271,580 pounds, valued at $13,606, at Gloucester; and 1,007,864 pounds, valued at $43,275, at Portland. There was an increase of 9 vessels and 15 trips, but a decrease of 707,929 pounds in the quantity of fish landed, with an increase of $12,767 in the value, as compared with the previous year. These fish were landed in accordance with an arrangement with the Canadian Government as an emergency war measure granting reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918, and the arrangement is still in operation.

Compared with the previous year there was a decrease of 663 trips, or 8.01 per cent, in the total number landed by the fishing fleet at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of $678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent, in quantity, and $354,630, or 91.59 per cent, in value; the mackerel catch increased 1,580,525 pounds, or 27.66 per cent, in quantity, and $215,852, or 39.44 per cent, in value; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, in quantity, and $281,834, or 132.71 per cent, in value. The catch of cod decreased 3,108,838 pounds, or 4.75 per cent, in quantity, but increased $54,456, or 2.10 per cent, in value; haddock decreased 7,436,708 pounds, or 8.99 per cent, in quantity, and $53,886, or 1.92 per cent, in value; pollock, 10,191,066 pounds, or 54.34 per cent, in quantity, and $118,387, or 31.11 per cent, in value; cusk, 208,459 pounds, or 10.10 per cent, in quantity, and $14,099, or 22.67 per cent, in value; and herring, 3,361,901 pounds, or 32.45 per cent, in quantity, and $73,487, or 30.64 per cent, in value. The catch of hake increased 381,880 pounds, or 8.80 per cent, in quantity, but decreased $27,177, or 15.01 per cent, in value. The catch of Newfoundland herring decreased 404,753 pounds, or 11.55 per cent, in quantity, and $79,626, or 41.95 per cent, in value. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, in quantity, and of $60,368, or 37.85 per cent, in value.

The following tables present in detail, by fishing grounds and by months, the products landed at Boston and Gloucester, Mass., and Portland, Me., by American and Canadian fishing vessels, for the calendar year 1920. The weights of fresh and salted fish given in these statistics represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades, or sizes, given for certain species are those recognized in the trade.

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920.

Fishing grounds.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.													
East of 66° W. longitude.													
By American vessels:													
La Have Bank	54	767,285	$51,941	...	...	615,401	$23,382	...	...	25,720	$360	...	...
Western Bank	85	1,101,050	61,002	...	...	456,395	18,094	...	...	3,375	80	...	...
Quereau Bank	9	43,840	1,628	...	...	6,300	212	...	...	...	...	...	...
Green Bank	3	...	...	...	...	...	...	...	...	...	...	...	...
Grand Bank	9	38,900	2,123	...	...	4,200	126	...	...	...	...	...	...
St. Peters Bank	4	3,100	186	...	...	...	...	...	...	...	...	...	...
Burgeo Bank	2	...	...	...	...	...	...	...	...	...	...	...	...
Cape North	1	16,950	1,526	...	...	35,600	952	...	...	5,500	110	...	...
Cape Shore	38	67,100	4,589	...	...	54,045	1,968	...	...	6,060	96	...	...
Roseway Bank	1	5,000	260	...	...	5,800	174	...	...	...	...	...	...
By Canadian vessels: La Have Bank	3	28,520	1,730	...	...	30,500	1,052	...	...	1,450	15	...	...
West of 66° W. longitude.													
By American vessels:													
Browns Bank	104	1,527,829	92,713	...	...	1,344,270	45,915	...	...	23,850	445	...	...
Georges Bank	807	10,054,075	618,606	...	...	4,775,817	172,304	...	...	21,825	361	...	...
Cashes Bank	3	14,855	932	...	...	5,000	201	...	...	...	...	...	...
Fippenies Bank	4	32,940	3,279	...	...	21,205	1,133	...	...	6,910	138	...	...
Middle Bank	58	106,257	11,399	...	...	74,220	4,533	...	...	27,585	447	...	...
Jeffreys Ledge	59	60,598	4,867	...	...	48,885	2,345	...	...	13,950	219	...	...
South Channel	560	2,582,571	166,365	...	...	2,241,185	75,734	...	...	46,780	765	...	...
Nantucket Shoals	121	120,365	7,113	...	...	259,695	8,532	...	...	2,110	39	...	...
Off Chatham	221	1,328,904	81,414	...	...	1,121,769	37,209	...	...	66,955	1,067	...	...
South	9	...	...	...	...	...	...	...	...	...	...	...	...
Shore, general	1,147	775,106	47,740	...	...	342,155	14,693	...	...	7,540	135	...	...
By Canadian vessels:													
Browns Bank	25	225,992	12,049	...	...	410,902	10,352	...	...	7,405	102	...	...
Georges Bank	15	102,855	6,351	...	...	154,355	4,354	...	...	1,700	16	...	...
Total	3,342	19,004,092	1,177,813	...	...	12,007,699	423,265	...	...	268,715	4,395	...	...

LANDED AT GLOUCESTER.													
East of 66° W. longitude.													
By American vessels:													
La Have Bank	20	401,440	11,628	36,183	$2,071	181,565	4,407	2,970	$154	1,155	11		
Western Bank	89	4,126,450	124,026	287,663	17,443	2,967,020	73,428	306,126	17,173	51,910	587	14,480	$605
Quereau Bank	73	3,710,340	105,672	801,232	44,130	4,091,229	93,400	1,182,225	58,741	14,870	173	76,632	2,786
Green Bank	5	83,435	2,410	59,805	3,275	12,660	295	6,610	331				
Grand Bank	25	470,567	14,246	355,695	21,088	56,560	1,447	75,120	4,105	2,430	69	3,215	121
St. Peters Bank	5	265,390	7,962	4,955	297	86,035	2,151	760	42	1,085	41		
Off Newfoundland	12												
Cape Shore	22	95,850	2,975			41,000	1,043			350	5		
The Gully	5	19,215	714	12,260	710	2,050	83	1,255	63				
By Canadian vessels: Quereau Bank	1			113,065	5,653			149,330	7,466			8,785	439
West of 66° W. longitude.													
By American vessels:													
Browns Bank	16	248,975	7,633			319,115	8,194			6,470	93		
Georges Bank	180	2,245,228	67,332	46,619	2,509	2,112,540	53,690	78,761	3,888	24,736	299	1,820	53
Jeffreys Ledge	1	6,000	165			7,660	172						
Ipswich Bay	1												
South Channel	38	136,170	4,065			456,033	11,382			27,398	363		
Nantucket Shoals	49	865	28			3,115	83						
Seal Island	4	80,850	2,396	21,300	1,169	37,820	1,005	8,960	467				
Shore, general	1,835	2,195,290	100,951	595	36	35,050	863			3,470	51		
Total	2,381	14,086,065	452,203	1,739,372	98,381	10,409,452	251,643	1,812,117	92,430	133,874	1,692	101,932	4,004
LANDED AT PORTLAND.													
East of 66° W. longitude.													
By American vessels:													
La Have Bank	5	17,715	522			7,475	151			270	3		
Western Bank	6	8,965	348	1,460	95	3,790	127	315	20				
Quereau Bank	3												
Green Bank	2	900	50										
Grand Bank	11	26,565	771	4,320	270	3,700	102						
St. Peters Bank	6	615	31										
Off Newfoundland	1												
Cape Shore	11	21,825	821			31,140	922			1,710	31		
The Gully	4												
By Canadian vessels:													
La Have Bank	2	56,540	1,930	2,085	156	20,060	502	575	37			370	17
Western Bank	3	50,000	1,000	62,218	3,532			98,046	5,393			24,500	1,348

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT PORTLAND—continued.													
West of 66° W. longitude.													
By American vessels:													
Browns Bank	1												
Georges Bank	17	31,300	$2,504			2,785	$223						
Cashes Bank	13	53,556	2,458			11,167	326			605	$8		
Platts Bank	46	101,916	6,695			51,815	2,304			26,227	267		
Jeffreys Ledge	57	41,674	3,117			34,280	1,683			10,825	152		
South Channel	2	510	20			649	16						
Shore, general	1,688	1,344,769	75,592	6,135	$134	417,870	15,716	1,375	$82	116,052	2,017	595	$18
By Canadian vessels: Georges Bank	5												
Total	1,883	1,756,850	95,859	76,218	4,487	584,731	22,072	100,311	5,532	155,689	2,478	25,465	1,383
Grand total	7,606	34,847,007	1,725,875	1,815,590	102,868	23,001,882	696,980	1,912,428	97,962	558,278	8,565	130,397	5,387

Fishing grounds.	Haddock.						Hake.							
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).			
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.														
East of 66° W. longitude.														
By American vessels:														
La Have Bank	756,030	$36,377					10,700	$623			34,395	$1,362		
Western Bank	1,540,445	66,615					1,585	108			10,100	474		

Quereau Bank	300	5												
Grand Bank							7,700	194						
St. Peters Bank	700	42					12,000	440			3,235	82		
Cape North	8,000	480												
Cape Shore	113,700	4,092					730	22			3,350	133		
Roseway Bank	1,650	132									300	12		
By Canadian vessels: La Have Bank	46,410	2,174												
West of 66° W. longitude.														
By American vessels:														
Browns Bank	1,055,260	42,689					20,540	1,015			12,250	442		
Georges Bank	20,809,185	850,624			3,550	$132	19,160	802			30,065	968		
Cashes Bank							1,610	98			13,160	446		
Fippenies Bank	4,555	312					12,080	763			28,735	1,194		
Middle Bank	321,925	20,252					26,915	2,115			158,790	7,014		
Jeffreys Ledge	287,463	18,813			1,170	32	43,985	1,964			138,908	6,226		
South Channel	34,748,683	1,231,340			22,210	515	459,870	15,666			1,103,845	33,993		
Nantucket Shoals	1,177,669	46,299			875	26	675	27			3,365	110		
Off Chatham	3,159,665	127,203			2,875	48	132,125	5,373			259,716	9,011		
Shore, general	586,133	25,555			770	19	64,745	2,365			133,710	4,058		
By Canadian vessels:														
Browns Bank	44,415	1,451									1,000	20		
Georges Bank	55,250	1,601												
Total	64,720,438	2,476,056			31,450	772	814,450	31,575			1,934,954	65,575		
LANDED AT GLOUCESTER.														
East of 66° W. longitude.														
By American vessels:														
La Have Bank	111,570	1,139					82,465	1,236	2,805	$72				
Western Bank	1,115,205	16,118			29,187	368	119,530	1,794	3,492	94				
Quereau Bank	394,120	5,005	18,550	$557			16,095	244	7,365	178				
Green Bank	240	4					10,470	157	3,680	99				
Grand Bank	1,836	27	9,750	297			63,885	958	19,710	567			455	$9
St. Peters Bank	11,920	178					24,120	487						
Cape Shore	15,850	198												
The Gully							1,565	22	7,930	191				
West of 66° W. longitude.														
By American vessels:														
Browns Bank	129,500	1,508					19,710	295						
Georges Bank	2,505,070	38,681			6,840	51	45,635	680						
Jeffreys Ledge	19,200	192					440	7						
South Channel	2,224,225	26,985			110,100	1,377	31,800	465						
Nantucket Shoals	45,000	675			47,035	588								
Seal Island							28,400	426	6,200	117				
Shore, general	1,798,495	85,381					306,125	16,138						
Total	8,372,231	176,091	28,300	854	193,162	2,384	750,240	22,909	51,182	1,321			455	9

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Haddock.						Hake.							
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).			
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT PORTLAND.														
East of 66° W. longitude.														
By American vessels:	*Pounds.*	*Value*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank	23,125	$534									1,790	$31		
Western Bank											515	17		
Green Bank											470	6		
Grand Bank	390	6					10,190	$153	1,910	$49				
St. Peters Bank							255	10			90	4		
Off Newfoundland							2,000	30						
Cape Shore	28,260	1,324			4,320	$65	230	14			3,720	111		
The Gully											1,000	35		
By Canadian vessels:														
La Have Bank	605	12					2,000	42			5,295	79	1,375	$45
Western Bank	454,500	9,090	16,143	$184										
West of 66° W. longitude.														
By American vessels:														
Georges Bank	131,640	3,748												
Cashes Bank	555	18					2,765	153			36,261	859		
Platts Bank	25,757	2,030			508	11	29,931	1,001			232,315	5,375		
Jeffreys Ledge	255,895	19,423			12,622	417	12,402	778			196,987	5,841		
South Channel	391,568	9,861												
Shore, general	575,651	36,592			9,357	280	58,839	2,471			569,423	14,873	282	10
Total	1,890,946	82,638	16,143	484	26,807	773	118,612	4,652	1,910	49	1,047,866	27,731	1,657	55
Grand total	71,983,615	2,734,785	44,443	1,338	251,419	3,929	1,683,302	59,136	53,122	1,370	2,982,820	93,306	2,112	64

Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
East of 66° W. longitude.												
By American vessels:												
La Have Bank	39,695	$1,391			79,745	$2,351			83,766	$19,229		
Western Bank	89,240	4,131			6,035	271			213,958	40,500		
Quereau Bank	870	20			880	22			218,389	12,551		
Green Bank									96,701	19,773		
Grand Bank					600	18			271,785	50,431		
St. Peters Bank									108,163	19,906		
Burgeo Bank	28,000	5,600							43,357	8,486		
Cape Shore	6,800	137			3,430	59			41,979	4,163	5,000	$150
Roseway Bank					1,000	20			249	63		
By Canadian vessels: La Have Bank	555	16			2,500	50			1,327	463		
West of 66° W. longitude.												
By American vessels:												
Browns Bank	108,515	4,275			133,105	4,257			115,871	26,617		
Georges Bank	692,874	24,375			91,790	2,996			1,101,946	220,320		
Cashes Bank	4,240	167			6,408	176			1,185	329		
Fippenies Bank	8,365	216			27,780	480			31	10		
Middle Bank	89,090	3,154			67,925	1,522			3,193	981		
Jeffreys Ledge	76,320	2,621			75,750	2,340			2,519	676		
South Channel	622,825	24,139			133,987	2,969			120,507	27,785		
Nantucket Shoals	19,127	612			385	15			4,513	1,110		
Off Chatham	239,084	9,209			58,820	2,005			36,153	8,760		
Shore, general	1,260,529	40,821			38,000	1,101			31,630	3,568	7,000	700
By Canadian vessels:												
Browns Bank	38,060	1,018			14,687	421			2,017	566		
Georges Bank	12,885	456			2,800	34			1,290	298		
Total	3,337,071	122,421			745,627	21,110			2,500,532	196,615	12,000	1,150
LANDED AT GLOUCESTER.												
East of 66° W. longitude.												
By American vessels:												
La Have Bank	12,120	141	780	$20	166,515	2,709	1,256	$16	30,813	6,189	70	7
Western Bank	147,785	2,002	560	16	174,020	3,389			52,758	9,707	75	9
Quereau Bank	89,010	1,195	12,725	366	28,380	601	220	8	8,291	1,121	4,715	605
Green Bank	50	1			4,595	89	1,610	58			2,596	389
Grand Bank	1,085	14	2,005	60	18,705	386	1,055	37			1,880	177
St. Peters Bank					22,565	370	70	2				
Cape Shore	600	8										
The Gully			120	3	520	8	185	6				
By Canadian vessels: Quereau Bank											400	48

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT GLOUCESTER—continued.												
West of 66° W. longitude.												
By American vessels:												
Browns Bank	10,505	$137			36,250	$718						
Georges Bank	114,669	2,023			99,381	1,910	242	$6	14,485	$2,112		
Jeffreys Ledge	3,110	39										
South Channel	48,555	634			10,530	186			90	14		
Nantucket Shoals	9,340	126										
Seal Island	1,710	20	590	$15	26,915	680	685	67				
Shore, general	3,745,246	112,252			9,854	195			622	152		
Total	4,183,785	118,592	16,780	480	598,230	11,271	5,353	230	107,089	19,598	9,736	$1,235
LANDED AT PORTLAND.												
East of 66° W. longitude.												
By American vessels:												
La Have Bank	1,065	11			3,560	105			60,722	12,402		
Western Bank					125	4			157,827	29,256		
Quereau Bank									104,485	23,095		
Green Bank									68,093	11,683		
Grand Bank					600	14			286,651	51,886		
St. Peters Bank									162,339	33,929		
Off Newfoundland					2,000	50			11,225	2,070		
Cape Shore	340	5			10,320	176			497	100		
The Gully									83,504	17,731		
By Canadian vessels:												
La Have Bank	760	9	2,370	77	42,155	633			40,131	6,200		
Western Bank	53,975	1,406							576	128		
West of 66° W. longitude.												
By American vessels:												
Georges Bank									39,488	7,446		
Cashes Bank	3,383	88			23,099	630			6,846	1,418		
Platts Bank	30,855	843			121,405	2,858			1,776	360		
Jeffreys Ledge	13,467	419			77,380	2,393			1,629	317		
South Channel	955	20										
Shore, general	913,207	17,671	2,885	86	221,625	8,588	260	8	134,184	25,202		
Total	1,018,007	20,472	5,255	163	505,269	15,451	260	8	1,159,973	223,223		
Grand total	8,538,865	261,485	22,035	643	1,849,126	47,832	5,613	238	3,767,594	739,435	21,736	2,385

Fishing grounds.	Mackerel.											
	Large (over 2¼ pounds).				Medium (1½ to 2¼ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
East of 66° W. longitude.												
By American vessels: Cape Shore	1,149,153	$113,532	180,200	$15,454			20,000	$1,800				
West of 66° W. longitude.												
By American vessels:												
Georges Bank	67,148	15,474			23,975	$3,403			1,947	$496		
Middle Bank									5,960	1,529		
South Channel	38,675	4,254			37,075	3,988			3,500	385		
Nantucket Shoals	1,117,220	93,037	27,400	2,331	633,315	67,329	1,800	189	63,030	8,832		
Off Chatham	787	246			128,646	24,808			158,864	30,315		
South	384,630	32,222	9,000	630								
Shore, general	1,686,882	172,701	5,700	477	401,676	48,448	1,000	70	106,437	18,545		
Total	4,444,495	431,466	222,300	18,892	1,224,687	147,976	22,800	2,059	339,738	60,102		
LANDED AT GLOUCESTER.												
East of 66° W. longitude.												
By American vessels: Cape Shore	16,550	790	461,687	39,428								
West of 66° W. longitude.												
By American vessels:												
Georges Bank			333	50								
Nantucket Shoals	11,881	1,339	231,884	23,997	55,145	3,991	66,988	7,081			1,200	$102
Shore, general	66,709	11,409										
Total	95,140	13,538	693,904	63,475	55,145	3,991	66,988	7,081			1,200	102
LANDED AT PORTLAND.												
East of 66° W. longitude.												
By American vessels: Cape Shore	73,625	6,392	2,000	175								
West of 66° W. longitude.												
By American vessels:												
Georges Bank	13,322	2,689										
Shore, general	13,542	1,768			23,750	3,319			1,085	69		
Total	100,489	10,849	2,000	175	23,750	3,319			1,085	69		
Grand total	4,640,124	455,853	918,204	82,542	1,303,582	155,286	89,788	9,140	340,823	60,171	1,200	102

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.										
East of 66° W. longitude.										
By American vessels:										
La Have Bank	7,919	$736			2,420,656	$137,755			2,420,656	$137,755
Western Bank	10,297	1,158			3,432,480	192,433			3,432,480	192,433
Quereau Bank	328	85			270,907	44,523			270,907	44,523
Green Bank	250	100			96,951	19,873			96,951	19,873
Grand Bank	120	30			323,305	52,922			323,305	52,922
St. Peters Bank					127,198	20,656			127,198	20,656
Burgeo Bank					71,357	14,086			71,357	14,086
Cape North					66,050	3,068			66,050	3,068
Cape Shore	11,818	1,980			1,458,165	130,771	205,200	$17,704	1,663,365	148,475
Roseway Bank					13,999	661			13,999	661
By Canadian vessels: La Have Bank					111,262	5,500			111,262	5,500
West of 66° W. longitude.										
By American vessels:										
Browns Bank	103,227	5,029			4,444,717	223,397			4,444,717	223,397
Georges Bank	2,419,339	431,268			40,112,696	2,342,129			40,112,696	2,342,129
Cashes Bank					46,488	2,349			46,488	2,349
Fippenies Bank	200	8			142,804	7,563			142,804	7,563
Middle Bank	39,893	2,709			924,753	55,655			924,753	55,655
Jeffreys Ledge	14,802	810			764,350	40,913			764,350	40,913
South Channel	881,360	47,580			43,043,073	1,635,478			43,043,073	1,635,478
Nantucket Shoals	65,632	5,098			3,467,976	238,269	29,200	2,520	3,497,176	240,789
Off Chatham	235,264	13,034			6,929,627	349,702			6,929,627	349,702
South					384,630	32,222	9,000	630	393,630	32,852
Shore, general	3,015,503	128,144			8,450,846	507,896	13,700	1,247	8,464,546	509,143
By Canadian vessels:										
Browns Bank	31,814	3,305			776,292	29,284			776,292	29,284
Georges Bank	90,085	14,253			421,220	27,363			421,220	27,363
Total	6,927,851	655,327			118,301,802	6,114,468	257,100	22,101	118,558,902	6,136,569

LANDED AT GLOUCESTER.										
East of 66° W. longitude.										
By American vessels:										
La Have Bank					987,673	27,460	44,064	2,370	1,031,737	29,830
Western Bank					8,783,865	231,419	612,396	35,340	9,396,261	266,759
Quereau Bank					8,352,335	207,714	2,103,664	107,371	10,455,999	315,085
Green Bank					111,450	2,956	74,331	4,152	185,781	7,108
Grand Bank					615,068	17,147	468,885	26,461	1,083,953	43,608
St. Peters Bank					411,115	11,189	5,785	341	416,900	11,530
Off Newfoundland			[1] 3,097,024	$110,157			3,097,024	110,157	3,097,024	110,157
Cape Shore					170,200	5,019	461,687	39,428	631,887	44,447
The Gully					23,350	827	21,750	976	45,100	1,803
By Canadian vessels: Quereau Bank							271,580	13,606	271,580	13,606
West of 66° W. longitude.										
By American vessels:										
Browns Bank					770,525	18,578			770,525	18,578
Georges Bank	3,924	754			7,172,508	167,562	127,775	6,506	7,300,283	174,068
Jeffreys Ledge					36,410	575			36,410	575
Ipswich Bay	26,600	466			26,600	466			26,600	466
South Channel					3,044,901	45,471			3,044,901	45,471
Nantucket Shoals					172,381	6,830	300,072	31,180	472,453	38,010
Seal Island					175,695	4,527	37,735	1,835	213,430	6,362
Shore, general	98,016	5,445			8,258,877	332,837	595	36	8,259,472	332,873
Total	128,540	6,665	3,097,024	110,157	3,9112,953	1,080,577	7,627,343	379,759	46,740,296	1,460,336
LANDED AT PORTLAND.										
East of 66° W. longitude.										
By American vessels:										
La Have Bank	300	75			116,022	13,834			116,022	13,834
Western Bank					171,222	29,752	1,775	115	172,997	29,867
Quereau Bank	310	78			104,795	23,173			104,795	23,173
Green Bank					69,463	11,739			69,463	11,739
Grand Bank					328,096	52,932	6,260	319	334,356	53,251
St. Peters Bank	451	75			163,750	34,049			163,750	34,049
Off Newfoundland					15,225	2,150			15,225	2,150
Cape Shore	40,584	8,860			216,571	18,821	2,000	175	218,571	18,996
The Gully					84,504	17,766			84,504	17,766
By Canadian vessels:										
La Have Bank					167,546	9,407	6,775	332	174,321	9,739
Western Bank					559,051	11,624	200,907	10,757	759,958	22,381

[1] Herring. Other items under "Miscellaneous" include bluebacks, 31,650 pounds, value $530; butterfish, 13,087 pounds, value $2,561; flounders, 3,637,774 pounds, value $166,895; herring, 3,900,960 pounds, value $56,144; rosefish, 67,613 pounds, value $2,030; shad, 115,792 pounds, value $6,322; sharks, 15,262 pounds, value $105; skates, 4,425 pounds, value $98; smelt, 10,940 pounds, value $1,216; sturgeon, 3,301 pounds, value $630; swordfish, 2,531,669 pounds, value $494,202; tuna, 12,001 pounds, value $944; whiting, 800 pounds, value $4; wolffish, 170,729 pounds, value $4,926; squid, 1,980 pounds, value $36; lobster, 100 pounds, value $33; livers, 772,329 pounds, value $24,715; sounds, 6,383 pounds, value, $320; and spawn, 121,776 pounds, value $8,167.

STATEMENT, BY FISHING GROUNDS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, CALENDAR YEAR 1920—Continued.

Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT PORTLAND—continued.										
West of 66° W. longitude.										
By American vessels:										
Browns Bank	10,466	$2,198			10,466	$2,198			10,466	$2,198
Georges Bank	122,235	22,273			340,770	38,883			340,770	38,883
Cashes Bank	350	8			138,587	5,966			138,587	5,966
Platts Bank	10,713	232			633,218	22,476			633,218	22,476
Jeffreys Ledge	21,137	804			678,298	35,344			678,298	35,344
South Channel	265	13			396,947	9,930			396,947	9,930
Shore, general	4,081,784	62,415			8,484,138	266,573	11,532	$638	8,495,670	267,211
By Canadian vessels: Georges Bank	73,585	11,155			73,585	11,155			73,585	11,155
Total	4,362,180	108,186			12,752,254	617,772	229,249	12,336	12,981,503	630,108
Grand total	11,418,571	770,178	3,097,024	110,157	170,167,009	7,812,817	8,113,692	414,196	178,280,701	8,227,013

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920.[1]

Month.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT BOSTON.													
January	209	947,700	$88,987			716,380	$37,070			40,355	$901		
February	195	2,075,600	164,798			547,332	29,240			6,895	170		
March	315	3,333,703	182,451			906,045	36,193			5,485	127		
April	214	1,353,829	69,357			617,078	21,289			16,090	267		
May	254	1,565,234	71,246			1,030,387	33,451			24,885	368		
June	271	1,570,580	89,377			1,299,085	41,024			8,760	126		

July	314	1,363,398	79,121			1,371,48	39,663			5,020	63		
August	355	1,746,450	90,245			1,593,327	49,710			4,480	45		
September	344	1,548,565	92,425			1,136,314	38,364			19,180	264		
October	289	1,582,428	92,570			1,061,248	33,569			11,505	123		
November	329	1,147,438	94,290			989,522	40,537			51,530	702		
December	253	769,167	62,946			739,495	32,155			74,530	1,239		
Total	3,342	19,004,092	1,177,813			12,007,699	423,265			268,715	4,395		
LANDED AT GLOUCESTER.													
January	194	206,935	13,722	1,000	$60	18,645	492	540	$27	3,205	46		
February	112	154,300	10,712			8,125	259			85	2		
March	332	1,085,210	41,214			142,200	3,445			845	8		
April	452	2,375,320	80,192	4,110	247	655,775	17,124	600	30	5,180	58		
May	286	2,739,765	83,620	17,625	1,065	1,845,590	46,792	8,325	458	19,130	286	330	$12
June	99	2,294,832	69,458	327,443	19,839	2,178,833	53,186	308,206	17,290	51,868	610	14,215	598
July	90	2,218,950	66,066	365,010	21,833	2,233,894	54,064	137,770	7,394	10,895	126	4,305	164
August	73	1,583,575	41,318	156,852	8,460	1,918,220	42,310	133,885	6,531	20,241	250	955	32
September	83	514,483	15,362	302,264	16,512	693,131	17,213	446,501	20,919	8,830	110	17,282	509
October	211	494,915	14,250	377,975	20,494	418,825	9,675	570,575	29,359	7,705	133	48,970	1,875
November	221	188,285	6,632	179,788	9,469	182,525	4,434	205,075	10,390	3,175	35	18,785	814
December	228	229,495	9,657	7,305	402	113,689	2,649	640	32	2,715	28		
Total	2,381	14,086,065	452,203	1,739,372	98,381	10,409,452	251,643	1,812,117	92,430	133,874	1,692	104,932	4,004
LANDED AT PORTLAND.													
January	90	48,271	4,564			53,181	2,997			18,132	439		
February	59	64,735	5,059			21,917	1,632			4,899	170		
March	172	101,225	6,253	1,460	95	58,903	2,530	315	20	7,696	192		
April	234	243,170	10,287	4,405	275	127,173	3,685			7,484	111		
May	234	193,011	8,550			57,208	1,587			5,378	73		
June	377	225,766	12,246	50	3	27,632	887	45	2	3,829	54		
July	154	262,688	15,011	1,345	101	43,816	1,184	330	21	1,668	23		
August	133	254,424	11,366	2,085	156	21,801	691	575	37	3,877	42	370	17
September	113	108,584	5,868	66,873	3,857	38,284	1,285	98,996	5,449	12,701	445	25,055	1,365
October	130	128,667	6,209			38,975	1,195	50	3	11,166	116	40	1
November	110	64,811	5,323			37,529	1,848			19,178	202		
December	77	58,498	5,123			58,312	2,551			59,681	611		
Total	1,883	1,756,850	95,859	76,218	4,487	584,731	22,072	100,311	5,532	155,689	2,478	25,465	1,383
Grand total	7,606	34,847,007	1,725,875	1,815,590	102,868	23,001,882	696,980	1,912,428	97,962	558,278	8,565	130,397	5,387
Grounds east of 66° W. long	520	11,427,557	400,091	1,740,941	98,720	8,712,525	224,018	1,823,332	93,525	115,885	1,581	127,982	5,316
Grounds west of 66° W. long	7,086	23,419,450	1,325,784	74,649	4,148	14,289,357	472,962	89,096	4,437	442,393	6,984	2,415	71
Landed at Boston in 1919	2,754	20,134,589	1,039,220			9,038,012	321,434			385,344	7,788		
Landed at Gloucester in 1919	2,965	18,508,512	567,307	3,065,779	171,873	8,616,805	229,526	1,562,770	74,811	137,801	2,202	94,502	4,077
Landed at Portland in 1919	2,550	2,856,747	131,202			874,935	31,644	208	6	98,416	2,091		

[1] The above statistics for the year 1920 include 54 trips landed by Canadian fishing vessels, 43 at Boston, 1 at Gloucester, and 10 at Portland, amounting to 2,588,218 pounds of fish, value $119,028.

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

Month.	Haddock.						Hake.							
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).			
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.														
January	5,996,213	$330,008			4,800	$175	13,163	$898			31,241	$2,770		
February	6,214,746	309,801					11,759	1,254			9,415	828		
March	8,910,530	302,420			645	15	17,940	1,145			17,200	1,033		
April	4,531,355	165,729			17,980	437	15,160	738			16,680	693		
May	5,099,480	181,700			4,075	90	24,795	1,156			65,195	2,353		
June	4,412,980	150,987			2,260	23	33,070	1,629			79,020	2,803		
July	3,677,270	120,113			290	6	30,880	1,114			220,315	5,282		
August	4,658,175	121,035			100	2	93,845	3,016			290,554	7,914		
September	5,780,368	144,946					59,370	2,600			269,255	11,070		
October	6,067,915	154,611					279,074	7,561			302,385	7,125		
November	4,756,689	246,401					200,990	7,784			400,024	13,267		
December	4,614,717	248,305			1,300	24	34,404	2,650			233,670	10,437		
Total	64,720,438	2,476,056			31,450	772	814,450	31,575			1,934,954	65,575		
LANDED AT GLOUCESTER.														
January	80,275	4,318					24,290	1,344	100	$3			455	$9
February	235,675	14,056					10,085	1,026						
March	1,331,725	35,737					15,785	1,159						
April	1,470,680	49,157	890	$32			17,820	1,059						
May	944,050	19,230			166,515	2,082	48,890	795	2,052	51				
June	1,159,150	16,873	50	1	19,807	251	27,990	420	30	1				
July	348,631	4,957	18,740	562			76,775	1,276	2,570	67				
August	839,590	9,150					138,800	2,081	1,440	43				
September	1,381,910	13,801	4,185	126	6,840	51	88,475	1,869	10,235	233				
October	491,095	4,844	3,290	99			88,990	1,558	22,135	611				
November	26,895	747	1,145	34			64,265	2,125	8,160	200				
December	62,555	3,221					148,075	8,197	4,460	112				
Total	8,372,231	176,091	28,300	854	193,162	2,384	750,240	22,909	51,182	1,321			455	9

LANDED AT PORTLAND.														
January	102,880	8,385			2,967	111	2,109	164			12,916	716		
February	137,535	11,467			6,165	260	2,273	238			24,427	1,755		
March	158,860	11,536			5,515	164	7,748	615			75,713	3,956		
April	268,253	13,091			6,474	100	14,090	726	1,940	49	147,360	4,633		
May	181,099	6,088			1,871	46	20,781	553			167,171	3,677		
June	15,234	1,167			456	10	8,419	245			63,458	1,365		
July	4,046	281			96	6	16,996	496			67,888	1,255	282	10
August	852,479	19,119			265	7	6,582	173			36,179	624	1,375	45
September	6,611	330	16,143	484	485	11	2,211	79			16,242	458		
October	19,710	849			785	15	23,770	484			157,109	2,669		
November	57,331	4,051			1,385	35	8,366	471			188,161	3,589		
December	86,908	6,274			343	8	5,267	408			91,242	3,034		
Total	1,890,946	82,638	16,143	484	26,807	773	118,612	4,652	1,940	49	1,047,866	27,731	1,657	55
Grand total	74,983,615	2,734,785	44,443	1,338	251,419	3,929	1,683,302	59,136	53,122	1,370	2,982,820	93,306	2,112	64
Grounds east of 66° W. long	4,624,856	143,552	44,443	1,338	33,507	433	365,520	6,534	46,922	1,253	64,2[illegible]0	2,346	1,830	54
Grounds west of 66° W. long	70,358,759	2,591,233			217,912	3,496	1,317,782	52,602	6,200	117	2,918,560	90,960	282	10
Landed at Boston in 1919	55,556,950	2,128,151			2,291,254	59,886	808,379	39,706			1,497,928	64,720		
Landed at Gloucester in 1919	17,150,377	396,149	155,162	6,240	538,421	6,718	746,097	24,130	39,070	1,269	500	8		
Landed at Portland in 1919	6,954,764	195,183			69,257	1,611	188,887	11,934			1,058,165	39,271	450	15

Month.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
January	53,695	$3,634			97,890	$4,481			30,859	$9,908		
February	19,860	1,692			27,300	1,543			83,713	19,634		
March	34,296	2,459			24,435	1,081			121,167	24,550		
April	64,475	4,488			56,540	1,960			232,726	52,352		
May	154,533	6,692			34,690	991			502,851	84,970		
June	232,805	7,722			41,133	1,374			388,058	65,420	12,000	$1,150
July	250,974	10,446			29,885	776			274,798	49,847		
August	479,310	24,567			32,660	860			299,100	62,392		
September	514,250	16,024			25,278	623			241,928	52,403		
October	640,112	15,193			51,161	1,077			189,309	41,415		
November	511,479	15,919			136,875	2,588			111,992	25,319		
December	381,285	13,585			184,780	3,756			21,031	8,375		
Total	3,337,074	122,421			745,627	21,110			2,500,532	496,615	12,000	1,150

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

Month.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
LANDED AT GLOUCESTER.												
January	373,154	$23,327			4,905	$123			622	$152		
February	37,780	3,649			895	23			23,370	4,173		
March	46,090	3,401			1,525	35						
April	66,065	3,971			10,100	205						
May	78,030	1,754	200	$85	58,360	1,147			23,178	4,741	75	$9
June	107,490	1,465	140	4	10,305	222			20,675	2,895	65	7
July	52,875	717	2,485	71	166,700	3,454	1,891	$68			2,985	264
August	29,530	430	8,735	261	154,781	3,104	315	11	8,401	1,448		
September	140,140	2,290	1,780	40	64,410	1,216	962	74			3,971	554
October	1,191,897	14,927	3,220	93	95,659	1,222	2,000	71			2,065	332
November	1,004,959	25,739	220	6	12,410	220	185	6	30,843	6,189	575	69
December	1,055,775	36,922			18,180	300						
Total	4,183,785	118,592	16,780	480	598,230	11,271	5,353	230	107,089	19,598	9,736	1,235
LANDED AT PORTLAND.												
January	3,077	161			19,566	1,333			33,149	7,194		
February	3,123	229			12,937	998			53,998	10,710		
March	8,697	526			50,200	2,665			84,218	15,989		
April	22,159	1,123			93,281	2,334			105,674	24,230		
May	86,502	2,879			71,690	1,579			155,961	25,209		
June	429,008	5,659			13,202	458			117,021	18,597		
July	31,659	609			39,971	1,046			136,547	25,092		
August	38,034	775	2,370	77	28,507	645			91,639	18,788		
September	166,525	4,149	2,770	83	8,383	366	260	8	101,163	21,506		
October	126,955	2,099	115	3	51,243	1,132			122,120	22,654		
November	68,459	1,293			73,277	1,660			153,455	32,230		
December	33,809	970			43,012	1,235			5,028	1,024		
Total	1,018,007	20,472	5,255	163	505,269	15,451	260	8	1,159,973	223,223		
Grand total	8,538,866	261,485	22,035	643	1,849,126	47,832	5,613	238	3,767,594	739,436	21,736	2,385
Grounds east of 66° W. long	471,950	16,090	18,560	542	568,250	11,325	4,426	157	2,147,616	411,365	14,736	1,685
Grounds west of 66° W. long	8,066,916	245,395	3,475	101	1,280,876	36,507	1,187	81	1,619,978	328,071	7,000	700
Landed at Boston in 1919	3,000,781	105,036			736,654	22,986			1,329,384	250,112	2,000	320
Landed at Gloucester in 1919	14,598,786	248,205	55,101	1,400	608,957	13,373	37,962	1,658	357,460	54,820	12,600	1,770
Landed at Portland in 1919	1,096,784	25,859	515	15	679,625	24,152			413,217	80,169		

Month.	Mackerel.											
	Large (over 2¼ pounds).				Medium (1½ to 2¼ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
May	1,311,600	$119,557	9,000	$630								
June	2,323,096	203,205	197,700	16,934	310,350	$23,247	21,000	$1,870	21,190	$1,283		
July	514,385	50,756	15,600	1,328	625,860	71,202	1,800	189	64,130	10,410		
August	32,244	7,173			119,827	21,626			65,857	12,028		
September	42,235	11,214			56,600	11,747			179,601	34,852		
October	36,465	6,915							5,960	1,529		
November	178,290	30,920			108,260	19,109						
December	6,180	1,726			3,790	1,045						
Total	4,444,495	431,466	222,300	18,892	1,224,687	147,976	22,800	2,059	339,738	60,102		
LANDED AT GLOUCESTER.												
June	16,550	790	461,687	39,428								
July	10,801	1,080	230,084	23,779	45,260	2,263	65,800	6,952			1,200	$102
August			1,800	218	1,400	280	800	88				
September					8,485	1,448	388	41				
October	13,691	2,908	333	50								
November	54,098	8,760										
Total	95,140	13,538	693,904	63,475	55,145	3,991	66,988	7,081			1,200	102
LANDED AT PORTLAND.												
June	82,259	7,249	2,000	175	3,515	400						
July	12,146	2,045			1,466	183						
August	1,707	419			1,417	116			410	6		
September	3,542	940							125	8		
October									550	55		
November	835	196			17,352	2,620						
Total	100,489	10,849	2,000	175	23,750	3,319			1,085	69		
Grand total	4,640,124	455,853	918,204	82,542	1,303,582	155,286	89,788	9,140	340,823	60,171	1,200	102
Grounds east of 66° W. long	1,239,328	120,714	643,887	55,057			20,000	1,800				
Grounds west of 66° W. long	3,400,796	335,139	274,317	27,485	1,303,582	155,286	69,788	7,340	340,823	60,171	1,200	102
Landed at Boston in 1919	2,621,081	237,742	166,000	13,556	179,125	13,899			1,063,778	108,019	3,200	442
Landed at Gloucester in 1919	221,129	34,211	1,183,959	102,223	1,035	98	6,400	950	21,898	838	34,288	2,538
Landed at Portland in 1919	188,050	29,881	4,559	427	12,800	1,461			5,874	955	20	2

STATEMENT, BY MONTHS, OF QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., BY AMERICAN AND CANADIAN FISHING VESSELS, 1920—Continued.

Month.	Miscellaneous.[2]				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.										
January	299,732	$17,499			8,232,028	$496,331			8,232,028	$496,331
February	377,747	21,069			9,374,367	550,029			9,374,367	550,029
March	578,038	30,369			13,949,484	581,843			13,949,484	581,843
April	462,526	17,546			7,384,439	334,856			7,384,439	334,856
May	365,681	9,892			10,183,406	512,466	9,000	$630	10,192,406	513,096
June	259,563	14,997			10,987,950	603,217	230,700	19,954	11,218,650	623,171
July	1,115,278	174,053			9,543,969	612,852	17,400	1,517	9,561,369	614,369
August	1,345,219	202,010			10,761,148	593,653			10,761,148	593,653
September	756,457	101,593			10,629,401	518,125			10,629,401	518,125
October	475,278	18,999			10,702,840	380,687			10,702,840	380,687
November	366,873	17,705			8,959,962	514,571			8,959,962	514,571
December	525,459	29,595			7,592,808	415,838			7,592,808	415,838
Total	6,927,851	655,327			118,301,802	6,114,468	257,100	22,101	118,558,902	6,136,569
LANDED AT GLOUCESTER.										
January	61,856	3,346	1,564,228	$70,374	773,887	46,870	1,566,323	70,473	2,340,210	117,313
February	36,300	2,110			506,615	36,010			506,615	36,010
March					2,623,380	84,999			2,623,380	84,999
April					4,600,910	151,766	5,600	309	4,606,540	152,075
May					5,923,508	160,447	28,667	1,600	5,952,175	162,047
June					5,887,500	146,170	1,111,866	77,168	6,999,366	223,338
July					5,164,781	134,003	832,840	61,256	5,997,621	195,259
August	26,600	466			4,721,138	100,837	304,782	15,644	5,025,920	116,481
September	3,784	743			2,910,488	54,103	787,568	39,008	3,698,056	93,111
October					2,802,777	49,517	1,030,563	52,984	3,833,340	102,501
November					1,567,455	54,881	413,933	20,988	1,981,388	75,869
December			1,532,796	39,783	1,630,484	60,974	1,545,201	40,329	3,175,685	101,303
Total	128,540	6,665	3,097,024	110,157	39,112,953	1,080,577	7,627,343	379,759	46,740,296	1,460,336
LANDED AT PORTLAND.										
January	10,033	378			306,281	26,442			306,281	26,442
February	16,089	668			348,098	33,186			348,098	33,186
March	18,041	599			579,816	45,025	1,775	115	581,591	45,140
April	14,678	408			1,049,796	60,728	6,345	324	1,056,141	61,052
May	329,163	5,034			1,269,835	55,275			1,269,835	55,275
June	3,132,993	47,778			4,122,792	96,115	2,095	180	4,124,887	96,295

July	133,495	23,430	....	....	752,482	70,661	1,957	132	754,439	70,793
August	132,102	15,125	....	....	1,469,423	67,896	6,775	332	1,476,198	68,228
September	314,132	11,855	....	....	778,988	47,300	210,097	11,246	989,085	58,546
October	239,828	2,092	....	....	920,878	39,569	205	7	921,083	39,576
November	15,465	687	....	....	705,604	54,205	....	....	705,604	54,205
December	6,161	132	....	....	448,261	21,370	....	....	448,261	21,370
Total	4,362,180	108,186	....	....	12,752,254	617,772	229,249	12,336	12,981,503	630,108
Grand total	11,418,571	770,178	3,097,024	110,157	170,167,009	7,812,817	8,113,692	414,196	178,280,701	8,227,013
Grounds east of 66° W. long.	72,377	13,177	3,097,024	110,157	29,843,631	1,351,226	7,584,083	369,601	37,427,714	1,720,830
Grounds west of 66° W. long.	11,346,194	757,001	....	....	140,323,378	6,461,591	529,609	44,592	140,852,987	6,506,183
Landed at Boston in 1919	4,565,511	300,048	11,400	285	103,208,770	4,698,747	182,600	14,603	103,391,370	4,713,350
Landed at Gloucester in 1919	443,809	9,415	3,501,777	189,783	61,621,587	1,587,000	9,749,370	558,592	71,370,957	2,145,592
Landed at Portland in 1919	7,215,670	113,563	....	....	21,713,191	688,976	5,752	465	21,718,943	689,411

[2] Includes herring from Newfoundland, 3,097,024 pounds salted, value $110,157.

The fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds; 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from fishing banks off the coast of Newfoundland, and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33 per cent of the value of the fishery products landed at these ports during the year. The herring were taken from the treaty coast of Newfoundland, and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds. The catch from each of these regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN AND CANADIAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., AND PORTLAND, ME., IN 1920, FROM FISHING GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland.		Canadian Provinces.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cod:								
Fresh	38,032,530	$1,802,329	1,056,142	$32,010	19,318,495	$597,081	58,407,167	$2,431,420
Salted	135,900	7,020	510,480	29,529	3,212,035	169,668	3,858,415	206,217
Haddock:								
Fresh	70,576,671	2,594,729	15,086	257	4,643,277	143,728	75,235,034	2,738,714
Salted			9,750	297	34,693	1,041	44,443	1,338
Hake:								
Fresh	4,207,942	143,136	134,415	2,521	323,765	6,785	4,666,122	152,442
Salted	282	10	25,785	724	29,167	700	55,234	1,434
Pollock:								
Fresh	8,065,206	245,375	29,135	5,615	444,525	10,495	8,538,866	261,485
Salted	2,885	86	2,005	60	17,145	497	22,035	643
Cusk:								
Fresh	1,253,961	35,827	49,065	927	546,100	11,078	1,849,126	47,832
Salted	502	14	2,765	97	2,346	127	5,613	238
Halibut:								
Fresh	1,619,978	328,071	1,048,314	198,164	1,099,302	213,201	3,767,594	739,436
Salted	7,000	700	4,476	566	10,260	1,119	21,736	2,385
Mackerel:								
Fresh	5,045,201	550,596			1,239,328	120,714	6,284,529	671,310
Salted	345,305	34,927			663,887	56,857	1,009,192	91,784
Herring:								
Fresh	3,900,960	56,144					3,900,960	56,144
Salted			3,097,024	110,157			3,097,024	110,157
Swordfish: Fresh	2,471,837	481,399	751	203	59,081	12,600	2,531,669	494,202
Miscellaneous: Fresh	4,973,397	219,458	70	2	12,475	372	4,985,942	219,832
Total	140,639,557	6,499,821	5,985,263	381,129	31,655,881	1,346,063	178,280,701	8,227,013

SPECIES.

COD.

In 1920 the fishing fleet landing fish at Boston, Gloucester, and Portland was not quite so large as in the previous year. There were 20 vessels in the salt-bank fishery, or 11 more than in the previous year, and 111 in the market fishery, the same number as in the previous year. These vessels landed their fares of cod and other ground fish at these ports during the year, and large quantities of cod were also landed by vessels fishing on the shore grounds. The total catch of cod landed at these ports during the year was 62,265,582 pounds, valued at $2,637,637, of which 58,407,167 pounds, valued at $2,431,420, were fresh, and 3,858,415 pounds, valued at $206,217, were salted. Cod ranked second among the various species landed.

HADDOCK.

The catch of haddock for the year ranked first in both quantity and value, exceeding that of cod by 13,013,895 pounds and $102,415. The quantity of haddock landed at these ports by fishing vessels during the year amounted to 75,279,477 pounds, valued at $2,740,052, all of which was fresh except 44,445 pounds, valued at $1,338. These fish were taken chiefly on Georges Bank and in South Channel, and the greater part of the catch, or 64,751,888 pounds, valued at $2,746,828, was landed at Boston.

HAKE.

The catch of hake amounted to 4,721,356 pounds, valued at $153,876, all landed fresh except 55,234 pounds, valued at $1,434, salted. There was an increase of 381,880 pounds, or 8.80 per cent, in the quantity, but a decrease of $27,177, or 15.01 per cent, in the value as compared with the previous year. The yield of this species has been comparatively small in recent years.

POLLOCK.

The catch of pollock amounted to 8,560,901 pounds, valued at $262,128, all landed fresh except 22,035 pounds, valued at $643, salted. This was the smallest catch of pollock in many years. There was a falling off in the catch of this species of over 10,000,000 pounds as compared with the previous year.

CUSK.

The catch of cusk amounted to 1,854,739 pounds, valued at $48,070, all of which was fresh, except 5,613 pounds, valued at $238, salted. The yield was 200,000 pounds less than in the previous year. The catch of this species has declined considerably in recent years.

HALIBUT.

The quantity of halibut landed was 3,789,330 pounds, valued at $741,821, all of which was fresh except 21,736 pounds salted, valued at $2,385. There was an increase of 1,674,669 pounds in quantity and $354,630 in value as compared with the previous year. The catch was the largest taken in any year in the past five years. The next largest catch in this period was in 1916, when 3,458,765 pounds were landed at these ports. There has been a large increase in the receipts of halibut at Portland, which amounted in 1920 to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a large increase in the receipts of halibut at Boston in recent years, but a decrease in those at Gloucester.

MACKEREL.

The total catch of fresh mackerel taken by the American fishing fleet in 1920 was 79,799 barrels, compared with 53,992 barrels in 1919, an increase of 25,807 barrels. The total catch of salted mackerel was 4,897 barrels, compared with 7,007 barrels the previous year, a decrease of 2,110 barrels. The quantity of mackerel landed at Boston, Gloucester, and Portland by the fishing fleet during the year was 7,293,721 pounds, valued at $763,094, of which 6,284,529 pounds, valued at $671,310, were fresh, and 1,009,192 pounds, valued at $91,784, were salted. These were all landed by American fishing vessels. There was an increase in the total catch of mackerel landed at these ports of 1,580,525 pounds in quantity and $215,852 in value over the previous year.

The season of 1920 was one of the best on record in the southern mackerel fishery for both the purse-seine and gill-net vessels. The fleet numbered about 50 seiners and 125 netters. The first fare, consisting of 3,600 pounds of large mackerel, was landed by a Gloucester vessel, April 14, at Cape May. Some of the best stocks made by the seiners in the southern fishery were from $9,153 to $26,449, the crews sharing from $197 to $649. The mackerel caught weighed from 1½ to 3½ pounds each, averaging about 2 pounds each, and sold from 8 to 22 cents per pound, according to market conditions. The schooner *Helen G. McLean*, from Nova Scotia, engaged in the southern mackerel fishery, and is said to be the only Canadian vessel to engage in this fishery for 25 years. The first arrival at Boston was a fare of 35,000 pounds of large and medium fresh mackerel on May 14, caught 35 miles south by west of Block Island, and sold at 18 cents per pound. In May there was a large body of mackerel off South Shoal Lightship, and the receipts at Boston landed by vessels were larger than for the same month in any recent year. The catch of mackerel on the Cape Shore was disappointing; the weather was foggy and the fish were well offshore, wild, and hard to catch. The first fares landed at Boston from this locality arrived on June 7. The fresh mackerel sold at 12 cents per pound and the salted mackerel at $17 to $17.50 per barrel. Later arrivals of fresh mackerel sold from 10 to 10½ cents per pound. The Cape Shore fleet consisted of 30 vessels, which landed 1,290,000 pounds of fresh mackerel and 3,217 barrels of salt mackerel, compared with 32 vessels, and 2,119,000 pounds of fresh and 6,275 barrels of salt mackerel the previous year. The total catch of mackerel up to July 1 was 60,842 barrels fresh and 3,357 barrels salted, compared with 38,787 barrels fresh and 6,452 barrels salted the previous year.

SWORDFISH.

The catch of swordfish amounted to 2,531,669 pounds, valued at $494,202. The number of vessels engaged in this fishery was 62, or 6 more than in the previous year, and there was a large increase in the catch.

FLOUNDERS.

The catch of flounders in the vessel fisheries amounted to 3,637,774 pounds, valued at $166,895, an increase of 1,185,918 pounds, or 48.36 per cent, in quantity, and $63,845, or 61.95 per cent, in value.

The catch taken by boats under 5 tons net tonnage is not included in these statistics.

HERRING.

The catch of herring amounted to 6,997,984 pounds, valued at $166,301. Of this quantity, 3,900,960 pounds, valued at $56,144, were taken off the coast of the United States and landed fresh, and 3,097,024 pounds, valued at $110,157, were salted Newfoundland herring.

VESSEL FISHERIES AT SEATTLE, WASH.

In the vessel fisheries at Seattle, Wash., there has been some increase in the total quantity and value of products landed by the fishing fleet, but considerable falling off in the products landed by collecting vessels as compared with the previous year. The increase in products landed by the fishing fleet was due to a larger catch of halibut, there being a marked decrease in the catch of sablefish, "lingcod," and rockfishes. Statistics of the vessel fisheries at Seattle have been collected by the local agent and published as monthly and annual statistical bulletins, giving the quantity and value of fishery products landed by American fishing and collecting vessels at that port.

In 1920 the fishing fleet at Seattle landed 822 trips, aggregating 14,355,450 pounds of fish, having a value to the fishermen of $1,992,759. This catch was taken from the various fishing grounds along the coast from Oregon to Portlock Bank, Alaska. The fishing areas from which the largest quantities of fish were obtained were Flattery Banks, west coast of Vancouver Island, and Hecate Strait. The products included halibut, 12,683,450 pounds, valued at $1,913,849; sablefish, 950,200 pounds, valued at $49,963; "lingcod," 513,035 pounds, valued at $21,153; and rockfishes, 208,765 pounds, valued at $7,794. Compared with the previous year there was an increase of 152 trips by fishing vessels, and of 704,430 pounds, or 5.16 per cent, in the quantity, and of $462,475, or 30.22 per cent, in the value, of the products landed. The catch of halibut increased 1,572,730 pounds, or 14.15 per cent, in quantity, and $491,330, or 34.53 per cent, in value, but there was a decrease in the catch of other species landed by fishing vessels. Sablefish decreased 603,400 pounds, or 38.83 per cent, in quantity, and $24,327, or 32.74 per cent, in value; "lingcod," 209,965 pounds, or 29.04 per cent, in quantity, and $3,280, or 13.42 per cent, in value; and rockfishes, 54,935 pounds, or 20.83 per cent, in quantity, and $1,248, or 13.80 per cent, in value.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year amounted to 9,813,966 pounds, valued at $881,066. These products included salmon, 7,911,820 pounds, valued at $765,145; herring, 345,100 pounds, valued at $5,714; sturgeon, 1,860 pounds, valued at $186; steelhead trout, 139,882 pounds, valued at $19,094; smelt, 521,201 pounds, valued at $29,795; perch, 47,520 pounds, valued at $3,002; rockfishes, 130,200 pounds, valued at $8,793; "lingcod," 44,904 pounds, valued at $2,324; flounders, 86,065 pounds, valued at $1,720; sole, 128,920 pounds, valued at $4,475; and crabs, 456,494 pounds, valued at $40,818. There was a decrease in the products landed by collecting vessels, compared with the previous year, of 1,995,484 pounds, or 16.89 per cent, in quantity, and $102,753, or 10.44 per cent, in value.

This was due to a large falling off in the catch of salmon, amounting to 2,475,883 pounds, or 23.83 per cent, in quantity, and $137,572, or 15.23 per cent, in value. The decrease in salmon was offset to some extent by a considerable increase in various less important species.

The following table and figure 5 present the most productive fishing grounds in the order of their importance visited by the fishing fleet at Seattle during the past five years, with the quantity of halibut and other species taken from these areas in 1920, and also the average production of these species for the 5-year period from 1916 to 1920, inclusive:

POUNDS OF HALIBUT AND OTHER FISH LANDED BY FISHING VESSELS AT SEATTLE, WASH., IN 1920, COMPARED WITH THE 5-YEAR AVERAGE, 1916 TO 1920, SHOWN BY FISHING GROUNDS.

Fishing grounds.	Halibut.	Other fish.	Total.
Hecate Strait:			
1920	4,645,300	208,300	4,853,600
5-year average	3,285,343	335,321	3,620,664
Flattery Banks:			
1920	2,661,000	806,500	3,467,500
5-year average	2,504,936	1,376,590	3,881,526
Vancouver Island (west coast):			
1920	1,873,600	387,800	2,261,400
5-year average	1,051,370	497,800	1,549,170
Portlock Bank:			
1920	952,050	1,600	953,650
5-year average	1,444,804	61,091	1,505,895
Yakutat grounds:			
1920	906,000	5,000	911,000
5-year average	2,137,458	95,531	2,232,989
All others:			
1920	1,645,500	262,800	1,908,300
5-year average	2,237,298	785,166	3,022,464

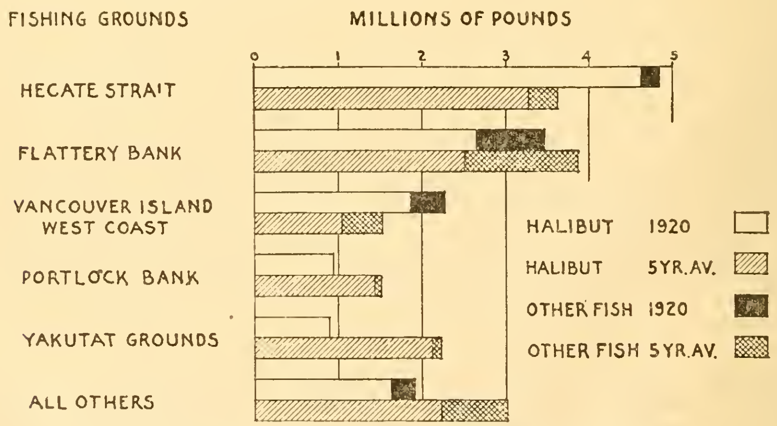


FIG. 5.—Quantities of halibut and other fish landed by fishing vessels at Seattle, Wash., in 1920, compared with the five-year average, 1916 to 1920, shown by fishing grounds.

The quantity and value of fishery products landed at Seattle by fishing and collecting vessels in 1920 are given in detail in the following table:

QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS (FRESH) LANDED AT SEATTLE, WASH., BY AMERICAN FISHING VESSELS, CALENDAR YEAR 1920.

	Number of trips.	Halibut.		Sablefish.	
BY FISHING GROUNDS.		*Pounds.*	*Value.*	*Pounds.*	*Value.*
Oregon coast	2	49,000	$7,137	....	....
Columbia River grounds	1	30,000	3,940	3,000	$150
Grays Harbor grounds	13	218,000	32,892	153,000	7,650
Flattery Banks	326	2,661,000	421,536	421,100	22,440
West coast, Vancouver Island	166	1,873,600	318,092	210,900	11,888
Cape Scott grounds	18	198,000	27,966	4,000	200
Queen Charlotte Islands grounds	20	581,500	86,187	30,000	1,500
Hecate Strait	221	4,645,300	702,994	98,200	4,505
Forrester Island grounds	14	497,000	72,993	25,000	1,330
Cape Spencer	3	72,000	11,145	....	....
Yakutat grounds	24	906,000	114,943	5,000	300
Portlock Bank	14	952,050	114,024	....	....
Total	822	12,683,450	1,913,849	950,200	49,963
BY MONTHS.					
January	7	191,700	30,130	9,000	460
February	28	563,900	75,410	31,500	1,555
March	68	935,000	128,394	59,800	2,970
April	88	977,200	154,618	22,200	1,020
May	119	1,717,600	234,024	29,500	1,425
June	100	1,769,050	265,044	70,600	3,125
July	105	1,932,000	276,791	235,800	11,790
August	111	1,802,800	269,672	213,000	10,650
September	76	1,094,600	178,657	115,000	7,285
October	64	740,800	147,894	108,000	6,480
November	46	917,000	144,075	50,000	2,855
December	10	41,800	9,110	5,800	318
Total	822	12,683,450	1,913,849	950,200	49,963

	"Lingcod."		Rockfishes.		Total.	
BY FISHING GROUNDS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Oregon coast	....	....	....	....	49,000	$7,137
Columbia River grounds	2,000	$60	1,000	$30	36,000	4,180
Gray's Harbor grounds	14,000	500	2,000	60	387,000	41,102
Flattery Banks	298,365	12,491	87,035	3,453	3,467,500	459,920
West coast, Vancouver Island	133,860	5,825	43,040	2,007	2,261,400	337,812
Cape Scott grounds	6,500	130	3,300	66	211,800	28,362
Queen Charlotte Islands grounds	8,000	300	6,000	180	625,500	88,167
Hecate Strait	45,710	1,676	64,390	1,878	4,853,600	711,053
Forrester Island grounds	3,000	140	2,000	120	527,000	74,583
Cape Spencer	....	....	....	....	72,000	11,145
Yakutat grounds	....	....	....	....	911,000	115,243
Portlock Bank	1,600	31	....	....	953,650	114,055
Total	513,035	21,153	208,765	7,794	14,355,450	1,992,759
BY MONTHS.						
January	8,000	530	....	....	208,700	31,120
February	25,000	1,140	8,000	580	628,400	78,685
March	48,900	1,507	20,800	644	1,064,500	133,515
April	93,535	2,408	46,665	1,204	1,139,600	159,250
May	29,000	580	13,800	276	1,789,900	236,305
June	23,600	591	19,000	360	1,882,250	269,120
July	26,000	560	16,000	360	2,209,800	289,501
August	57,000	2,200	15,500	595	2,088,300	283,117
September	141,000	8,497	49,000	2,655	1,402,600	197,094
October	48,500	2,730	16,000	940	913,300	158,044
November	9,500	410	4,000	180	980,500	147,520
December	....	....	....	....	47,600	9,488
Total	513,035	21,153	208,765	7,794	14,355,450	1,992,759

Fishery Products, by Months, Taken in Puget Sound and Landed at Seattle, Wash., by Collecting Vessels, 1920.

Species.	January.		February.		March.		April.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring	42,000	$2,440	144,000	$1,440	55,000	$550	...	...
Salmon:								
Chum or keta	120,000	8,000						
King or spring	14,000	1,400	...	...	...	...	47,200	$7,080
Coho or silver	...	...	...	...	...	...	60,000	9,000
Miscellaneous	4,000	400	...	...	...	...	...	...
Trout: Steelhead	...	...	...	...	...	...	21,600	3,190
Smelt	55,000	2,200	56,000	1,960	20,000	1,600	25,000	3,000
Perch	...	...	...	...	5,100	357	8,200	452
Rockfishes	8,400	504	16,600	1,162	15,650	782	11,000	770
"Lingcod"	6,000	300	12,000	720	8,000	400	...	...
Flounders	...	...	...	...	12,600	252	6,880	137
Sole	21,600	840	28,000	700	20,000	800	14,000	560
Crabs	56,078	4,678	48,000	3,491	70,620	4,865	19,260	1,400
Total	327,078	20,762	304,600	9,473	206,970	9,606	213,140	25,589

Species.	May.		June.		July.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Sturgeon	...	...	1,860	$186	...	...
Herring	...	...	12,300	246	3,300	$33
Salmon:						
Humpback or pink	...	...	...	...	31,750	1,905
Chum or keta	...	...	...	...	55,750	2,787
King or spring	248,000	$34,720	803,450	112,483	860,930	103,311
Coho or silver	...	...	38,440	4,612	126,730	12,673
Sockeye or red	...	...	80,000	9,600	26,680	2,668
Miscellaneous	42,000	5,880	...	...	...	...
Trout: Steelhead	24,000	3,360	29,660	3,559	5,300	530
Perch	...	...	6,320	379	4,000	240
Rockfishes	10,000	800	13,800	897	8,000	560
Flounders	9,600	192	17,500	350	10,600	212
Sole	15,000	600	9,640	289	...	...
Total	348,600	45,552	1,012,970	132,601	1,133,040	124,919

Species.	August.		September.		October.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring	18,000	$300	10,000	$100	...	...
Salmon:						
Humpback or pink	8,400	336	...	...	...	...
Chum or keta	158,540	6,340	250,800	12,740	1,438,280	$86,296
King or spring	895,800	107,496	320,150	35,216	59,540	7,144
Coho or silver	196,180	20,618	312,600	31,260	464,400	46,440
Sockeye or red	20,000	2,040	...	...	...	...
Trout: Steelhead	...	...	...	...	2,590	259
Smelt	80,600	4,030	28,999	1,680	76,660	4,597
Perch	...	...	5,300	318	4,600	276
Rockfishes	12,000	840	10,150	710	10,000	600
Flounders	...	...	12,000	240	7,225	144
Sole	6,680	266	...	...	...	...
Crabs	...	...	...	...	91,608	7,287
Total	1,396,200	142,266	949,999	82,264	2,154,903	153,043

Species.	November.		December.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Sturgeon	...	...	...	...	1,860	$186
Herring	...	...	60,500	$605	345,100	5,714
Salmon:						
Humpback or pink	...	...	...	...	40,150	2,241
Chum or keta	769,920	$38,496	359,000	43,080	3,152,290	197,739
King or spring	12,600	1,764	8,000	1,280	3,269,670	411,894
Coho or silver	49,080	3,926	29,600	4,154	1,277,030	132,683
Sockeye or red	...	...	...	...	126,680	14,308
Miscellaneous	...	...	...	...	46,000	6,280
Trout: Steelhead	10,452	1,254	46,280	6,942	139,882	19,094
Smelt	106,142	6,368	72,800	4,360	521,201	29,795
Perch	14,000	980	...	...	47,520	3,002
Rockfishes	8,600	688	6,000	480	130,200	8,793
"Lingcod"	12,424	645	6,480	259	44,904	2,324
Flounders	6,060	121	3,600	72	86,065	1,720
Sole	...	...	14,000	420	128,920	4,475
Crabs	79,200	11,880	91,728	7,217	[1] 456,494	40,818
Total	1,068,478	66,122	697,988	68,869	9,813,966	881,066

[1] 20,650 dozen.

FISHERY PRODUCTS RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C.[6]

The total receipts of fishery products at the Municipal Fish Wharf and Market, Washington, D. C., in 1920, were 8,573,984 pounds, a decrease of 2,159,102 pounds, or 20.11 per cent, as compared with 1919. The five most important products in terms of quantity were: Squeteagues or "sea trout," 1,925,334 pounds; oysters, 1,284,707 pounds, or 183,529 bushels; river herring, 1,068,660 pounds; shad, 1,035,822 pounds; and croaker, 743,415 pounds. These represent a total of 6,057,938 pounds, or 70.65 per cent of the entire receipts at this market for the year. Although differing in the order of their importance, these were the five principal species in 1919, representing 69.49 per cent of the entire receipts of the market for that year. The decrease in the total receipts of fish in 1920 as compared with the previous year is significant in view of the reported general decrease in the consumption of fishery products.

To supply local housewives with information as to species which are abundant in the Washington markets and seasons of abundance, the Bureau issued a post-card size fish calendar.

Fishery Products, in Pounds, Received at Municipal Fish Wharf and Market, Washington, D. C., 1920.

Species.	January.	February.	March.	April.	May.	June.	July.
Bass, black and sea	25,657	14,181	34,904	2,200	2,400	3,495	7,228
Bluefish	35				800	10,950	550
Butterfish	500			1,300	15,700	40,300	59,850
Carp	4,270	13,471	14,533	10,295	17,909	9,654	4,954
Catfish	1,499	8,989	47,676	26,727	16,083	24,022	8,806
Cod	4,400	6,400	5,700	2,900	7,100	9,050	1,900
Croaker	480	800	101,100	218,919	89,397	120,712	96,263
Eels			355	2,155	998	673	338
Flounders	4,802	11,105	15,872	11,807	14,514	10,040	2,700
Gizzard shad	29,963	2,864	1,000				
Haddock	6,867	43,450	26,200	3,420	2,750	3,100	1,300
Hake	2,500						
Halibut	28,427	10,700	3,950	200	2,700	6,596	4,960
Herring:							
River	72,400	80,200	276,256	539,671	99,221	112	
Sea	30,000						
Hickory shad or "jacks"	736	4,395	9,349	7,347	45		
Kingfish	200			400			
Mackerel	50,000	1,400	2,012	8,400	17,200	37,635	2,470
Mullet	1,519	312	593		150		
Perch	2,490	11,602	71,167	25,459	10,363	4,994	3,976
Pigfish	200						
Pike or pickerel	1,875	3,864	3,362	250	100	15	88
Pollock	2,700	1,800	4,100	2,000	600	1,000	900
Redfish or red drum		200	400	400			
Salmon	6,558		850			200	1,200
Scup or porgy						1,000	1,500
Shad	1,400	21,842	184,625	685,268	118,602	1,100	
Sheepshead	400		400				
Smelt	3,175	1,905	300				
Snappers							6
Spot	300		2,500	2,400	8,465	7,534	18,550
Squeteagues or "sea trout"	27,785	8,000	15,460	44,687	443,997	199,800	210,207
Striped bass	4,100	3,349	12,712	28,478	[1] 13,505	19,249	12,841
Sturgeon				1,600	1,331		
Tilefish				400	1,450	400	
Tullibee		1,000	2,000				
Whitefish				100			
Whiting	48,550	23,000	50,780				
Clams, hard	5,632	8,768	6,656	6,376	14,520	9,888	17,387

[1] Includes 100 pounds white bass.

[6] Daily reports of the quantity of fishery products received at this market are received by the Bureau for tabulation through the courtesy of the Health Department of the District of Columbia.

FISHERY PRODUCTS, IN POUNDS, RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C., 1920—Continued.

Species.	January.	February.	March.	April.	May.	June.	July.
Oysters:							
In the shell	74,018	56,021	98,819	32,508	3,871	518	194
Opened	137,259	91,550	77,958	28,342	3,218		
Scallops	80	160	240	400			
Crabs				126	3,504	5,930	15,690
Crabs, oyster	100						
Crabmeat	2,455	2,240	2,620	1,530	4,093	2,960	6,650
Frogs				21	43	231	
Lobster	2,000						
Shrimp	1,945	1,190	400	24,000		250	
Turtles	1,245	990		6	177	285	215
Total	588,522	435,748	1,074,849	1,720,092	914,806	531,693	480,723

Species.	August.	September.	October.	November.	December.	Total.
Bass, black and sea	2,293	280	1,386	16,044	32,001	142,069
Bluefish	10,975	11,695	13,875	600	1,500	50,980
Butterfish	63,600	66,850	27,100	22,400		297,600
Carp	5,694	8,585	8,633	5,235	17,167	120,400
Catfish	8,402	10,296	15,082	14,053	10,501	192,136
Cod	2,400	4,100	1,400	4,800	10,380	60,530
Croaker	69,066	5,537	19,459	16,152	5,530	743,415
Eels	79	458	2,111	1,378	509	9,054
Flounders	3,175	7,351	13,004	15,686	7,334	117,390
Gizzard shad					6,600	40,427
Haddock	2,600	7,800	[1] 4,625	5,400	[2] 12,650	120,162
Hake				13,500	6,950	22,950
Halibut	3,325	5,516	2,400	2,942	4,250	75,966
Herring:						
River					800	1,068,660
Sea						30,000
Hickory shad or "jacks"						21,872
Kingfish						600
Mackerel	5,600	11,500	2,200	10,300	13,450	162,167
Mullet	81	119	678	1,875	3,084	8,411
Perch	5,764	2,878	4,886	12,571	9,390	165,540
Pigfish						200
Pike or pickerel	280	850	2,144	2,754	5,094	20,676
Pollock	2,400	2,300	1,400	2,700	10,150	32,050
Pompano		1,000				1,000
Redfish or red drum		675	40	3,100		4,815
Salmon	715	5,525	10,580	300		25,928
Scup or porgy						2,500
Shad		200	785	1,750	20,250	1,035,822
Sheepshead						800
Smelt					1,450	6,830
Snappers		27			85	118
Spot	19,863	36,395	32,480	7,200	1,800	137,487
Squeteagues or "sea trout"	199,518	304,186	307,564	115,600	48,530	1,925,334
Striped bass	17,192	25,350	37,413	48,230	5,704	228,123
Sturgeon	53		107	200		3,291
Tilefish		900	5,300	1,700	900	11,050
Tullibee						3,000
Whitefish			100			200
Whiting				44,300	400	167,030
Clams, hard	8,864	5,871	4,526	1,760	1,344	91,592
Oysters:						
In the shell	323	3,588	103,898	164,374	147,539	[3] 685,671
Opened	413	30,116	52,431	82,436	95,313	[4] 599,036
Scallops						880
Crabs	15,550	24,213	6,525	375		71,913
Crabs, oyster						100
Crabmeat	7,290	2,700	135		45	32,718
Frogs						295
Lobster						2,000
Shrimp	50	400	815	437	298	29,785
Turtles	300	100	93			3,411
Total	455,865	587,361	683,175	620,152	480,998	8,573,984

[1] Includes 250 pounds smoked haddock.
[2] Includes 600 pounds smoked haddock.
[3] 97,953 bushels. The oysters have been reduced to pounds on the basis of 7 pounds of meat to a bushel and 8¼ pounds to a gallon
[4] 72,610 gallons.

SHAD FISHERY OF THE HUDSON RIVER.[7]

In 1920 there were 368 persons engaged in this fishery, an increase of 69 persons as compared with 1919. The investment amounted to $40,351, which includes 185 rowboats, valued at $10,011; 10 gasoline boats, valued at $2,050; 200 gill nets, valued at $23,710; 10 seines, valued at $1,655; and shore and accessory property to the value of $2,925.

The catch numbered 49,315 fish, or 199,844 pounds, valued at $56,309. Of this quantity the number of shad taken on the New York side of the river was 39,692, or 157,715 pounds, valued at $43,882, and on the New Jersey side, 9,623 shad, or 42,129 pounds, valued at $12,427. The catch with gill nets was 47,444 shad, or 96.2 per cent of the total catch. The average number of shad taken per gill net was 237.

Compared with 1919 there was a decrease in the number of shad taken of 40,986, or 45.38 per cent, and of $27,415, or 32.74 per cent, in the value. Compared with 1918 there was a decrease of 18,088, or 26.83 per cent, in the number of fish and an increase of $1,131, or 2.34 per cent, in the value.

SHAD FISHERY OF THE HUDSON RIVER, 1920.

Item.	New York.			New Jersey.			Total.		
	Number.	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*	*Number.*	*Pounds.*	*Value.*
Fishermen	352			16			368		
Rowboats	178		$9,486	7		$525	185		$10,011
Gasoline boats	7		1,100	3		950	10		2,050
Gill nets	190		21,810	10		1,900	200		23,710
Seines	10		1,655				10		1,655
Shore and accessory property			1,925			1,000			2,925
Total			35,976			4,375			40,351
Shad caught:									
With gill nets	37,821	150,658	42,089	9,623	42,129	12,427	47,444	192,787	54,516
With seines	1,871	7,057	1,793				1,871	7,057	1,793
Total	39,692	157,715	43,882	9,623	42,129	12,427	49,315	199,844	56,309

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER.[8]

In 1920 there were 753 persons engaged in this fishery, using 451 boats, valued at $83,889; 271 pound nets, valued at $126,455; 211 gill nets and 1 haul seine, valued at $39,620; and shore and accessory property to the value of $1,375.

The catch of shad was slightly smaller than in 1919, numbering 529,358, or 1,979,780 pounds, valued at $334,464. Of this quantity 80,944 shad, or 302,237 pounds, valued at $55,963, were taken by Maryland fishermen and 448,414 shad, or 1,677,543 pounds, valued at $278,501, by Virginia fishermen. The catch of river herring by Maryland fishermen numbered 1,077,775, or 538,888 pounds, valued at $13,940, and by Virginia fishermen 7,681,561, or 3,813,780 pounds, valued at $41,197, the total catch being 8,759,336, or 4,352,668 pounds, valued at $55,137. This represents a decrease of 108,566 in number and $5,879 in the value as compared with 1919.

[7] The canvass of this fishery was made by Rob Leon Greer, Statistical Agent, U. S. Bureau of Fisheries.
[8] The canvass of this fishery was made by G. W. Hoofnagle, apprentice fish-culturist, Edenton, N. C.

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER, 1920.

Item.	Maryland.			Virginia.			Total.		
	Number.	Pounds.	Value.	Number.	Pounds.	Value.	Number.	Pounds.	Value.
Fishermen	204			549			753		
Rowboats	87		$3,225	118		$4,047	205		$7,272
Gasoline	28		6,620	218		69,997	246		76,617
Pound nets	71		10,360	200		116,095	271		126,455
Gill nets and seines [1]	66		13,800	146		25,820	212		39,620
Shore and accessory property			300			1,075			1,375
Total			34,305			217,034			251,339
Shad caught:									
With pound nets and traps	7,144	26,487	4,263	356,552	1,326,923	211,039	363,696	1,353,410	215,302
With gill nets and seines [1]	73,800	275,750	51,700	91,862	350,620	67,462	165,662	626,370	119,162
Total	80,944	302,237	55,963	448,414	1,677,543	278,501	529,358	1,979,780	334,464
Alewives caught:									
With pound nets and traps	757,775	378,888	7,540	7,477,561	3,711,780	37,117	8,235,336	4,090,668	44,657
With gill nets and seines [1]	320,000	160,000	6,400	204,000	102,000	4,080	524,000	262,000	10,480
Total	1,077,775	538,888	13,940	7,681,561	3,813,780	41,197	8,759,336	4,352,668	55,137

[1] Includes 1 haul seine, with the catch, operated in Maryland.

FISH, FROZEN.

COLD-STORAGE HOLDINGS DURING 1920.

Beginning with October 15, 1917, the Bureau of Markets of the Department of Agriculture has issued monthly mimeographed reports of the storage holdings of frozen and cured fish and also a bulletin (No. 792) for holdings in 1918, in which the storage holdings are presented in diagrammatic form with discussions and tables. Brief summaries of holdings of frozen fish have appeared in The Market Reporter, published weekly by the same bureau. During 1920 the monthly mimeographed memoranda have contained the storage holdings on the fifteenth of the month by species, comparisons of holdings with other months, quantities frozen and quantities delivered since the fifteenth of previous month, comparisons with holdings at fifteenth of previous month, and storage holdings by geographic sections.

Appended is a summary of the holdings by species and by months for 1920, including totals for 1918 and 1919, which have been compiled from the reports of the Bureau of Markets:

COLD-STORAGE HOLDINGS OF FROZEN FISH, BY SPECIES FOR 1920, AND BY TOTALS FOR 1919 AND 1918,[1] GIVEN IN POUNDS.

Species.	Jan. 15.	Feb. 15.	Mar. 15.	Apr. 15.	May 15.	June 15.
Bluefish	301,383	232,912	135,296	91,190	108,967	219,121
Butterfish	459,374	334,741	253,706	206,915	181,621	200,877
Ciscoes	4,302,545	3,284,821	1,868,346	1,173,570	802,401	566,535
Cod, hake, pollock, and haddock	3,923,930	2,904,850	1,724,706	1,480,928	1,405,403	1,856,260
Croaker	82,314	37,952	10,528	31,111	33,944	64,023
Halibut	7,788,516	5,375,287	3,991,261	3,091,887	4,155,392	5,726,088
Herring	9,303,418	6,507,254	3,732,770	2,010,888	2,205,187	3,305,773
Lake trout	1,229,998	821,392	315,009	91,298	251,947	411,690
Mackerel	2,339,005	2,102,720	1,209,358	735,773	1,056,182	1,758,346
Rockfishes	400,880	290,888	234,771	178,661	139,704	162,537
Sablefish	1,354,336	765,428	508,469	306,910	253,414	177,546
Salmon	5,701,129	4,516,290	2,921,559	1,996,938	1,739,342	1,874,337
Sea bass	109,354	81,105	50,417	40,402	50,480	69,959
Shad	541,315	309,024	133,079	147,239	177,391	419,393
Shad roe	11,252	12,374	5,846	18,416	16,094	46,326
Smelt, eulachon, etc	610,700	689,722	387,922	202,832	142,963	110,246
Squeteague	439,011	291,179	95,709	57,188	38,462	123,598
Squid	422,208	282,791	183,922	95,895	93,745	517,814
Whitefish	2,220,140	1,964,965	1,371,491	822,721	381,594	287,471
Whiting	9,319,624	6,864,067	3,470,098	2,287,080	1,332,930	2,374,659
Miscellaneous	10,635,659	10,292,863	6,775,413	5,501,952	5,717,307	7,428,240
Total, 1920	61,499,121	47,962,625	29,379,676	20,569,824	20,284,470	27,730,842
Total, 1919	80,844,524	66,675,012	49,889,032	37,110,856	37,068,407	47,370,741
Total, 1918	49,562,848	35,907,071	28,457,301	26,548,472	31,403,425	50,298,027

Species.	July 15.	Aug. 15.	Sept. 15.	Oct. 15.	Nov. 15.	Dec. 15.
Bluefish	153,286	240,881	283,771	303,195	402,451	411,000
Butterfish	283,174	507,992	515,035	933,513	1,353,337	1,199,000
Ciscoes	620,704	2,152,253	4,868,638	6,306,065	6,045,595	6,533,000
Cod, hake, pollock, and haddock	1,690,736	2,113,959	2,577,704	3,040,676	3,785,894	3,538,000
Croaker	108,777	281,429	108,882	706,404	703,814	577,000
Halibut	6,609,561	8,629,889	10,340,381	10,661,832	9,761,076	8,691,000
Herring	5,342,182	5,480,143	5,430,419	6,083,108	6,582,737	7,738,000
Lake trout	463,036	554,365	554,590	953,691	1,675,026	2,108,000
Mackerel	3,064,809	3,014,641	2,677,822	2,620,092	2,788,666	2,405,000
Rockfishes	124,330	185,228	199,928	200,548	215,944	143,000
Sablefish	283,333	596,683	834,172	1,118,903	1,019,398	919,000
Salmon	2,563,384	3,467,706	4,676,452	6,771,546	8,094,984	7,128,000
Sea bass	85,493	121,771	109,134	106,504	123,598	130,000
Shad	433,773	473,731	502,435	493,734	475,704	310,000
Shad roe	62,328	49,416	42,973	41,984	41,772	42,000
Smelt, eulachon, etc	88,826	100,968	115,625	162,557	162,197	182,000
Squeteague	460,703	449,301	498,421	861,561	1,007,848	812,000
Squid	699,532	865,924	2,162,909	2,580,377	2,625,801	2,226,000
Whitefish	331,269	623,567	1,015,279	1,100,929	1,089,815	1,985,000
Whiting	4,395,069	8,630,018	9,648,503	9,536,391	9,412,377	7,811,000
Miscellaneous	7,928,975	8,563,480	8,439,277	9,854,135	10,459,900	10,466,000
Total, 1920	35,793,280	47,073,345	55,602,350	64,437,745	67,827,934	65,387,000
Total, 1919	59,363,929	64,740,173	69,554,969	76,138,809	78,477,504	73,936,025
Total, 1918	64,859,532	82,773,229	89,557,970	94,411,748	99,631,789	96,600,247

[1] The 1918 totals are taken from "Reports of Storage Holdings of Certain Food Products during 1918," by John O. Bell, U. S. Department of Agriculture Bulletin No. 792, and the 1919 and 1920 holdings from the mimeographed memoranda issued monthly by the Bureau of Markets.

QUANTITIES FROZEN IN 1920.

The quantities of fish frozen between January 15, 1920, and January 15, 1921, based on the monthly memoranda issued by the Bureau of Markets was 85,324,366 pounds. The principal varieties frozen were as follows: Halibut, 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, hake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds. The item of miscellaneous fishes amounted to

16,454,317 pounds and includes albacore, bonito, burbot, catfish, eels, flounders, German and buffalo carp, horse mackerel, Spanish mackerel, perch, pike, pickerel, pompano, red snapper, sheepshead, swordfish, tilefish, tuna, all kinds of fresh and salt water bass except sea bass, and all other frozen fish including soft crabs and bay scallops. The item of frozen shad of 411,398 pounds includes 31,063 pounds of shad roe. Figure 6 shows the relative amounts of each species frozen.

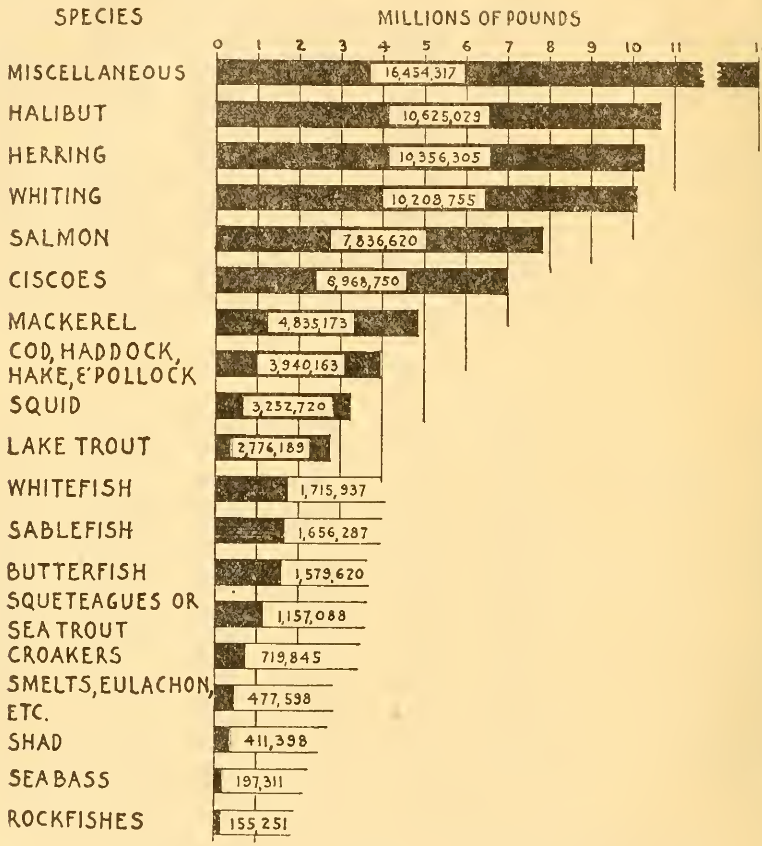


FIG. 6.—Quantities of fish frozen during 1920, shown by species.

FISHERIES OF CALIFORNIA IN 1920.

Through the courtesy of the California State Fish and Game Commission the Bureau has received copies of its monthly sheets showing the catch of fish by species and by localities for the calendar year 1920. In the appended table, page 57, these figures have been compiled by months and by species, such an arrangement being of value in ascertaining seasonal variation in catch. There has also been added a table, page 59, of the imports of fresh fish from Mexico to California centers during 1920.

COMMON AND SCIENTIFIC NAMES OF FISHES.

To provide a clearer understanding of the species to which reference is made in the tables and discussions, the following list of common and scientific names of the fishes of California, as accurately as it has been possible to ascertain them, is appended. As the reports do not in all cases distinguish between albacore and the species of tuna it is impracticable to separate the catch by species. Under flounders have been grouped the "bastard halibut" (*Paralichthys californicus*), the "turbot" (*Hypsopsetta guttulata*), sand dabs (*Citharichthys sordidus*), and a number of flounders locally designated as soles. The "hake" (*Merluccius productus*) of the west coast is closely related to the New England whiting, being a member of the same genus, and the adoption of the latter name would avoid confusion. *Menticirrhus undulatus* is designated as surffish, kingfish, and California whiting by the fishermen, and *Genyonemus lineatus*, another species belonging to the family of croakers, is commonly called kingfish. On the Atlantic seaboard the Bureau has recommended the adoption of the name king whiting for species of Menticirrhus. The "lingcod" is called cultus-cod on the California coast. Included with the catch of rockfishes are boccaccio (*Sebastodes paucispinis*) and chilipepper (*S. goodei* and *jordani*). The young of the white sea bass (*Cynoscion nobilis*) are designated as "sea trout" and the species of sharks as grayfish by the fishermen.

Albacore and tuna	*Germo alalunga.* *Germo macropterus.* *Thunnus thynnus.*
Anchovies	Engraulis (species). Anchovialla (species).
Barracuda	*Sphyræna argentea.*
Bluefish, California, or squeteague	*Cynoscion parvipinnis.*
Bonito or skipjack	*Sarda chilensis.*
Carp	*Cyprinus carpio.*
Catfish	Ameiurus (species).
Eels	*Lycodontis mordax.* Muræna (species).
Flounders	Pleuronectidæ (species).
Greenfish or rudderfish	*Girella nigricans.*
"Hake"	*Merluccius productus.*
Hardhead	*Orthodon microlepidotus.*
Herring	*Clupea pallasii.*
Kingfish	*Genyonemus lineatus.*
"Lingcod"	*Ophiodon elongatus.*
Mackerel	*Scomber japonicus.*
Mullet	*Mugil cephalus.*
"Perches," surf	Embiotocidæ (species).
Pike, Sacramento	*Ptychocheilus oregonensis.*
Pilchard	*Sardinia cærulea.*
Pompano, California	*Palometa simillima.*
Rockfishes	Sebastodes (species). Sebastichthys (species).
Sablefish	*Anoplopoma fimbria.*
Salmon	Oncorhynchus (species).
Sculpin	*Scorpæna guttata.*
Sea bass, black	*Stereolepis gigas.*
Sea basses or "rock bass"	*Paralabrax clathratus.* *Paralabrax maculatofasciatus.* *Paralabrax nebulifer.*
Sea bass, white or squeteague	*Cynoscion nobilis.*
Shad	*Alosa sapidissima.*
Sharks	All Selachii except Batoidei.

Sheepshead	*Anisotremus davidsonii.* *Caulolatilus princeps.* *Pimelometopon pulcher.*
Skates	Raja (species). *Platyrhinoides triseriatus.* *Rhinobatus productus.*
"Smelt"	Atherinidæ (species).
Splittail	*Pogonichthys macrolepidotus.*
Steelhead trout	*Salmo gairdneri.*
Striped bass	*Roccus lineatus.*
Stingarees or stingrays	*Dasyatis dipterura.* *Pteroplatea marmorata.* *Urolophus halleri.* *Myliobatis californicus.*
Suckers	*Catostomus occidentalis.*
Surffish	*Menticirrhus undulatus.*
Swordfish	*Xiphias gladius.*
Tomcod	*Microgadus proximus.*
Whitebait	Small fry of any fish.
Whitefish	*Caulolatilus princeps.*
Yellowtail	*Seriola dorsalis.*
Crabs	*Cancer magister.*
Shrimps	*Crago franciscorum.* *Crago nigricauda.* *Crago nigrimaculata.*
Sea crawfish or spiny lobster	*Panulirus interruptus.*
Abalones	Haliotis (species).
Clams:	
Hard	*Tivela stultorum.*
Soft	*Mya arenaria.*
Cockles	Cardium (species).
Limpets	Gastropoda (species).
Mussels	*Mytilus californianus.* *Mytilus edulis.*
Oysters:	
Eastern	*Ostrea virginica.*
Native	*Ostrea lurida.*
Scallops	*Pecten æquisulcatus.*
Snails	Gastropoda (species).
Octopus	*Polypus hongkongensis.*
Squid	*Loligo opalescens.*

PRODUCTS.

The total yield of the fisheries of California in 1920 amounted to 212,635,075 pounds. The principal products were as follows: Pilchards, 118,517,729 pounds; albacore and tuna, 36,144,340 pounds; salmon, 11,077,014 pounds; bonito or skipjack, 8,614,581 pounds; flounders, 7,792,626 pounds; rockfishes, 5,503,187 pounds; and barracuda, 4,584,476 pounds. These products represent a total of 192,233,953 pounds, or 90.40 per cent of the total quantity credited to the State. The catch of shad amounted to 1,408,980 pounds; of sharks, skates, and rays to 1,253,648 pounds; of shrimp to 818,042 pounds; of squid to 507,751 pounds; of sea crawfish or spiny lobster to 247,156 pounds; of oysters to 148,924 pounds or 21,275 bushels; of octopus to 70,740 pounds; and of cockles to 18,054 pounds.

The imports of fresh fish from Mexico in 1920 amounted to 8,121,225 pounds. The principal products imported were as follows: Barracuda, 3,615,947 pounds: flounders, 1,678,264 pounds; sea crawfish or spiny lobster, 942,020 pounds; tuna, 724,281 pounds; white sea bass, or squeteague, 252,462 pounds; yellowtail, 218,400 pounds; and bonito or skipjack, 216,344 pounds.

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920.

Species.	January.	February.	March.	April.	May.	June.	July.
Albacore and tuna	14,984	1,603	2,237		105	929,837	14,609,950
Anchovies	4,572	19,391	225	27,455	53,890	70,380	48,050
Barracuda	28,076	97,739	304,845	1,189,488	995,456	703,632	300,687
Bluefish, California, or squeteague	9,480	5,049	2,079				
Bonito or skipjack	32,261	25,711	21,133	1,165	5,644	2,457	44,330
Carp	15,458	19,772	43,513	21,972	14,685	3,224	7,177
Catfish	5,599	7,532	20,880	37,464	19,533		
Flounders	737,590	847,813	849,875	755,276	1,018,631	641,780	689,247
Greenfish or rudderfish		412					
"Hake"	5,500	2,030	3,170	6,527	13,138	17,860	14,510
Hardhead	2,753	3,565	4,688	1,380			
Herring	76,632	89,707	59,177	810			
Kingfish	125,104	18,269	46,779	85,637	58,502	16,742	7,774
"Lingcod"	160,109	45,729	52,324	19,332	37,203	37,149	90,166
Mackerel	104,689	176,424	75,667	466,318	242,550	270,228	136,205
Mullet	15,912	29	80			55	110
"Perches," surf	12,102	13,299	34,658	39,177	5,027	1,531	12,152
Pike, Sacramento	1,074	1,488	1,327	1,380	299	22	5
Pilchard	23,776,733	21,190,860	10,715,798	3,910,008	2,466,602	2,405,151	2,567,481
Pompano, California	2,523	2,607	6,435	6,250	1,880	689	594
Rockfishes	570,541	931,615	605,478	284,722	408,009	331,287	374,930
Sablefish	89,953	124,923	135,689	66,933	32,252	54,433	40,538
Salmon	27,048	70,042	238,160	783,721	1,108,955	1,097,138	2,648,203
Sculpin	2,387	515	2,866	3,978	7,882	1,076	419
Sea bass, black	5,533	6,031	14,565	19,284	3,085	5,418	7,935
Sea basses or "rock bass"	3,282	4,390	4,240	5,908	7,435	47,245	30,719
Sea bass, white or squeteague	15,423	285,230	109,340	364,401	313,808	256,675	200,232
Shad	925	3,093	91,529	597,259	713,905		
Sharks	65,142	141,428	15,105	44,727	141,749	113,439	64,429
Sheepshead	4,199	4,336	65	1,088	56	7	370
Skates	13,434	5,819	23,907	6,777	3,480	7,262	1,719
"Smelt"	41,990	62,209	83,963	48,441	50,942	34,363	70,268
Split-tail	3,653	3,553	4,869	514			
Steelhead trout				10			740
Striped bass	57,834	35,668	90,722	153,677	140,957	1,804	
Stingarees or stingrays				70,760	125,857	94,670	53,646
Suckers	695	444	429	563	30		
Surffish					10		
Swordfish	24					163	673
Tomcod	5,582	9,493	5,430	15	2,245	6,522	2,286
Whitebait		31	37	10	89	29	
Whitefish	1,092	1,738	571	6			
Yellowtail	55,943	20,497	189,208	231,788	216,719	173,808	48,404
Other fish	18,623	37,977	26,295	6,997	16,700	9,148	14,151
Crabs	307,780	146,542	104,038	73,018	161,106	55,132	6,292
Shrimps	68,204	52,545	62,147	117,711	90,569	42,729	86,696
Sea crawfish or spiny lobster	44,685	43,166					
Abalones	13,088		30,362	53,535	75,145	96,588	150,285
Clams	41,226	39,725	40,677	49,035	43,999	51,675	59,951
Cockles	2,218	2,708	4,385	2,240	1,913	1,601	320
Limpets		55	480	1,200	1,400	7,900	3,900
Mussels	1,082	1,352	3,747	2,066	3,413	10,505	6,847
Oysters:							
Eastern	9,999	9,344	6,040	7,974	6,205	4,629	4,200
Native	5,230	4,325	5,075	6,460	11,742	8,178	19,150
Scallops	50	246	217	212	34		
Snails	273	280					
Octopus	11,706	14,432	6,640	8,599	5,784	5,778	5,122
Squid	67,524	195,039	119,920		6,824	86,882	9,795
Total	26,687,519	24,827,820	14,271,086	9,583,289	8,635,444	7,706,821	22,431,658

PRODUCTS, IN POUNDS, OF THE FISHERIES OF CALIFORNIA, 1920—Continued.

Species.	August.	September.	October.	November.	December.	Total.
Albacore and tuna	14,819,308	3,801,885	1,954,324	8,948	1,159	36,144,340
Anchovies	16,485	199,577	87,561	28,405	14,695	570,686
Barracuda	219,553	308,899	285,362	53,022	97,717	4,584,476
Bluefish, California, or squeteague	54	....	6,724	6,045	2,798	32,229
Bonito or skipjack	3,058,975	3,784,239	1,474,619	112,557	51,490	[1] 8,614,581
Carp	340	150	302	1,614	6,213	134,420
Catfish	1,367	2,173	3,014	9,931	4,872	112,365
Eels	....	....	180	....	....	180
Flounders	563,746	515,164	371,617	389,434	412,453	7,792,626
Greenfish or rudderfish	....	....	....	....	....	412
"Hake"	7,110	14,079	16,207	29,925	11,925	141,981
Hardhead	470	....	....	....	467	13,323
Herring	....	....	130	303	47,605	274,364
Kingfish	3,442	8,728	23,477	30,989	35,968	461,411
"Lingcod"	72,105	47,725	50,019	45,847	30,246	687,954
Mackerel	306,088	383,946	306,474	188,653	340,066	2,997,308
Mullet	980	347	....	....	....	17,513
"Perches," surf	2,121	2,590	17,105	14,784	26,585	181,131
Pike, Sacramento	62	12	....	899	1,570	8,138
Pilchard	13,130,386	14,163,753	11,102,753	8,990,053	4,098,151	118,517,729
Pompano, California	75	858	6,436	1,060	719	30,126
Rockfishes	298,448	285,248	321,742	421,234	669,933	5,503,187
Sablefish	45,386	9,233	67,814	86,772	27,106	781,032
Salmon	2,862,287	1,879,429	152,691	172,114	37,226	11,077,014
Sculpin	22	1,610	7,451	2,367	5,101	35,674
Sea bass, black	4,215	4,784	6,552	7,026	5,441	89,869
Sea basses or "rock bass"	28,742	27,715	23,665	12,059	11,675	207,075
Sea bass, white or squeteague	443,558	263,553	42,526	45,651	35,896	2,376,293
Shad	1,169	188	....	639	282	1,408,980
Sharks	45,319	39,153	30,414	41,154	56,662	798,721
Sheepshead	280	107	877	1,027	1,990	14,402
Skates	437	6,774	1,020	6,650	11,652	88,931
"Smelt"	59,727	76,895	77,129	82,057	42,491	730,475
Split-tail	....	23	....	288	1,154	14,084
Steelhead trout	5,160	....	....	425	664	6,999
Striped bass	39,701	48,080	....	37,204	66,084	671,731
Stingarees or stingrays	14,195	5,383	665	....	820	365,996
Suckers	....	....	264	287	....	2,712
Surffish	....	....	....	....	....	10
Swordfish	2,600	5,812	2,598	370	....	12,240
Tomcod	606	128	....	1,884	3,046	37,237
Whitebait	....	....	8	147	387	738
Whitefish	90	....	20	1,517	2,385	7,419
Yellowtail	108,582	250,128	632,753	463,334	84,119	2,475,283
Other fish	18,921	6,082	28,988	54,002	19,054	256,938
Crabs	....	....	....	96,074	165,880	[2] 1,115,862
Shrimps	82,015	141,048	32,955	24,148	17,275	818,042
Sea crawfish or spiny lobster	....	....	40,509	68,861	49,935	247,156
Abalones	105,061	59,365	55,859	95,430	71,998	806,716
Clams	42,245	58,659	51,662	45,370	44,181	568,405
Cockles	550	167	75	76	1,801	18,054
Limpets	3,900	....	....	....	....	18,835
Mussels	3,070	139	140	224	125	32,710
Oysters:						
Eastern	5,229	6,751	8,976	8,997	10,839	[3] 89,183
Native	4,594	2,082	1,575	330	....	59,741
Scallops	....	....	....	....	....	759
Snails	....	....	175	60	....	788
Octopus	4,102	375	2,199	3,207	2,796	70,740
Squid	21,292	....	....	322	53	507,751
Total	36,454,270	26,413,036	17,297,606	11,693,776	6,632,750	212,635,075

[1] This item may include some striped tuna. [2] 50,721 in number. [3] 5,096,182 in number.

MEXICAN FISHERY PRODUCTS, IN POUNDS, IMPORTED INTO CALIFORNIA, 1920.

Species.	January.	February	March.	April.	May.	June.	July.
Barracuda	651,055	480,903	608,706	21,604			1,615
Bonito or skipjack	106,050	31,085	1,955	10,844			
Flounders	104,938	160,078	87,377	61,529	48,180	12,980	100,674
Mackerel	28,056	3,450	715	515			
"Perches," surf	40	250					
Pilchard			3,185				
Pompano, California	80	89	62				
Rockfishes	2,210	80,099	1,620			170	
Sea basses or "rock bass"	125	190	315			210	
Sea bass, black	8,063	9,757	9,398	550			2,412
Sea bass, white, or squeteague	23,900	23,343	5,478	3,505	1,560	4,780	26,497
Sharks			12,628				
"Smelt"	39						
Stingarees or stingrays			24,885				
Swordfish						273	
Tuna				122,316	375,647		
Whitefish		2,137	2,280				
Yellowtail	24,517	14,793	29,528	15,845		5,045	915
Other fish	630						
Sea crawfish or spiny lobster	77,440	103,508	136,008	131,030	118,408	71,305	
Abalones	20,200		9,750	1,509			16,642
Clams	12,900	5,600		4,827		2,230	
Turtles			2,180			38,399	34,039
Total	1,060,243	915,282	936,100	374,074	543,795	135,392	182,791

Species.	August.	September.	October.	November.	December.	Total.
Barracuda	147,511	173,622	531,107	543,124	456,700	3,615,947
Bonito or skipjack	798	11,028	18,539	20,038	16,007	216,344
Flounders	229,603	297,907	432,770	106,278	35,950	1,678,264
Kingfish			48			48
Mackerel	1,912	5,230	8,895	390	1,539	50,732
Mullet	90					90
"Perches," surf			50	670	4,230	5,240
Pilchard						3,185
Pompano, California						231
Rockfishes	1,745	885	1,733	9,009	190	97,661
Sea basses or "rock bass"		485	75	1,090	815	3,305
Sea bass, black	1,858	2,018	6,923	4,397	12,792	58,168
Sea bass, white, or squeteague	90,245	41,414	20,360	9,174	2,206	252,462
Sharks						12,628
Sheepshead		165				165
"Smelt"	500	171	966	6,396	5,640	13,712
Stingarees or stingrays						24,885
Swordfish						273
Tuna		200,415	16,278		9,625	724,281
Whitefish				435		4,852
Yellowtail	3,952	26,870	48,535	43,140	5,260	218,400
Other fish						630
Sea crawfish or spiny lobster		22,443	90,590	105,330	85,958	942,020
Abalones	11,287	7,367	19,317	6,651	2,387	95,110
Clams						25,557
Turtles		2,300				76,918
Total	489,501	792,500	1,196,123	856,122	639,299	8,121,225

FISHERIES OF THE SOUTH ATLANTIC STATES IN 1918.

The statistics of the fisheries contained in this report apply to the commercial coast fisheries of North Carolina, South Carolina, Georgia, and the eastern coast of Florida for the calendar year, 1918.[9] The results of a similar canvass of the fisheries of the Gulf States in 1918, including the western coast of Florida, are included in "Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1919," pages 129 to 191.

[9] The data were collected by Winthrop A. Roberts and Rob Leon Greer, assisted in North Carolina by Arthur Orr, E. M. Haynes, and G. W. Hoofnagle.

EARLIER PUBLICATIONS.

Some of the earlier publications relating to the fisheries of the South Atlantic States and published in Washington, D. C., follow:

1887. North Carolina and Its Fisheries. By R. Edward Earll. *In* The Fisheries and Fishery Industries of the United States, by G. Brown Goode et al., Sec. II, Pt. XII, p. 475–497.

The Fisheries of South Carolina and Georgia. By R. Edward Earll. Ibid., Sec. II, Pt. XIII, p. 499–518.

Eastern Florida and Its Fisheries. By R. Edward Earll. Ibid., Sec. II, Pt. XIV, p. 519–531.

History and Methods of the Fisheries. Ibid., Sec. V, Vol. I (xi+808 p.), Vol. II (xx+881 p.), and atlas of 275 pls.

1892. V. The Fisheries of the South Atlantic States [1887 and 1888]. *In* Statistical Review of the Coast Fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 351–361.

1893. Report on the Fisheries of the South Atlantic States. By Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. XI, 1891 (1893), p. 269–356, Pl. XLIII–LXXIV.

1897. Report on the Fisheries of Indian River, Florida. By John J. Brice et al. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 223–262, pl. 23–59.

1898. Report on the Fish and Fisheries of the Coastal Waters of Florida. By John J. Brice. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 263–342.

1899. Notes on the Extent and Condition of the Alewife Fisheries of the United States in 1896. By Hugh M. Smith. Report, U. S. Commission of Fish and Fisheries, 1898 (1899), p. 31–43.

The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Ibid., p. 101–176.

1900. Statistics of the Fisheries of the South Atlantic States [1897]. Report, U. S. Commission of Fish and Fisheries, 1899 (1900), p. 171–227.

1905. Statistics of the South Atlantic States, 1902. Report, U. S. Commission of Fish and Fisheries, 1903 (1905), p. 343–410.

1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

COMMON AND SCIENTIFIC NAMES OF FISHES.

In the appended list are given the common and scientific names of the species of fishes of the South Atlantic States listed in the statistical tables, as accurately as it has been practicable to determine them, for the guidance of the reader.

Alewives	*Pomolobus æstivalis.* *Pomolobus pseudoharengus.*
Amberfish	Seriola (species).
Angelfish	*Chætodipterus faber.*
Barracuda	Sphyræna (species).
Black bass	*Micropterus dolomieu.* *Micropterus salmoides.*
Bluefish	*Pomatomus saltatrix.*
Blue runner or hardtail	*Caranx crysos.*
Bonito	*Sarda sarda.*
Bowfin	*Amiatus calvus.*
Butterfish	*Poronotus triacanthus.*
Carp	*Cyprinus carpio.*
Catfish	Siluridæ (species).
Cero and kingfish	*Scomberomorus cavalla.* *Scomberomorus regalis.*
Cowfish and "shellfish"	Ostraciidæ (species).
Crappie	*Pomoxis sparoides.*
Crevalle	Caranx (species).
Croaker	*Micropogon undulatus.*

Drum, red and black	*Sciænops ocellatus.* *Pogonias cromis.*
Eels	*Anguilla rostrata.* Other Apodes.
Flounders	Pleuronectidæ (species).
Gizzard shad	*Dorosoma cepedianum.*
Groupers	Epinephelus (species). Mycteroperca (species). *Garrupa nigrita.*
Grunts	Hæmulidæ (species).
Hickory shad	*Pomolobus mediocris.*
Hogfish	*Lachnolaimus maximus.*
Jewfish	*Promicrops guttatus.*
King whiting	Menticirrhus (species).
Ladyfish	*Albula vulpes.*
Leather jacket or "turbot"	*Balistes carolinensis.*
Menhaden	*Brevoortia tyrannus.*
Moonfish	*Vomer setipinnis.*
Mullet	*Mugil cephalus.* *Mugil curema.*
Parrotfish	Scaridæ (species).
Perch, white	*Morone americana.*
Perch, yellow	*Perca flavescens.*
Permit	*Trachinotus goodei.*
Pigfish	*Orthopristis chrysopterus.*
Pike or pickerel	Esox (species).
Pinfish or sailor's choice	*Lagodon rhomboides.* Other species.
Pompano	*Trachinotus carolinus.* Trachinotus (other species). (See also Permit.)
Porgies (Gulf)	Calamus (species). Pagrus (species).
Porkfish	*Anisotremus virginicus.*
Scup	Stenotomus (species).
Sea bass	*Centropristes striatus.*
Sea gar or needlefish	Tylosurus (species). Ablennes (species).
Sergeantfish or snook	*Centropomus undecimalis.*
Shad	*Alosa sapidissima.*
Sharks	All Selachii except Batoidei.
Sheepshead	*Archosargus probatocephalus.*
Skates	Batoidei (species).
Snapper, mangrove	*Lutianus griseus.*
Snapper, mutton	*Lutianus analis.*
Snapper, red	*Lutianus blackfordi.*
Spanish mackerel	*Scomberomorus maculatus.*
Spot	*Leiostomus xanthurus.*
Squeteagues or "sea trout"	*Cynoscion regalis.* *Cynoscion nothus.* *Cynoscion nebulosus.*
Striped bass	*Roccus lineatus.*
Sturgeon	*Acipenser sturio.*
Suckers	Castostomidæ (species).
Sunfish	Centrarchidæ (species).
Tautog	*Tautoga onitis.*
Tilefish	*Lopholatilus chamæleonticeps.*
Yellowtail or "silver perch"	*Bairdiella chrysura.*

GENERAL STATISTICS

The number of persons engaged in the fisheries of the South Atlantic States in 1918 was 15,046, of whom 1,964 were on vessels fishing, 91 on vessels transporting fishery products, 8,604 in shore fisheries, and 4,387 shoremen in the wholesale fishery trade, oyster canneries, fertilizer factories, and other industries connected with the fisheries. Of the total, 8,036 are credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to the east coast of Florida.

Compared with the returns for 1902, there has been a decrease in the number of persons employed in North Carolina of 6,719, or 45.54 per cent; in South Carolina, a decrease of 1,713, or 46.14 per cent; in Georgia, a decrease of 606, or 26.51 per cent, and in Florida, an increase of 632 persons, or 23.42 per cent. The total decrease for the entire region amounts to 8,406, or 35.84 per cent.

The capital invested in the fisheries of this region amounted to $7,423,971, distributed as follows: North Carolina, $4,222,043; South Carolina, $221,251; Georgia, $769,998; and the east coast of Florida, $2,210,679. The investment included 261 fishing and transporting vessels, valued at $1,855,588 and having a net tonnage of 5,597 tons and outfits valued at $565,858; 5,632 boats, valued at $910,218; fishing apparatus used by vessels and boats, valued at $957,239; shore and accessory property to the value of $2,731,918; and cash capital to the amount of $403,150.

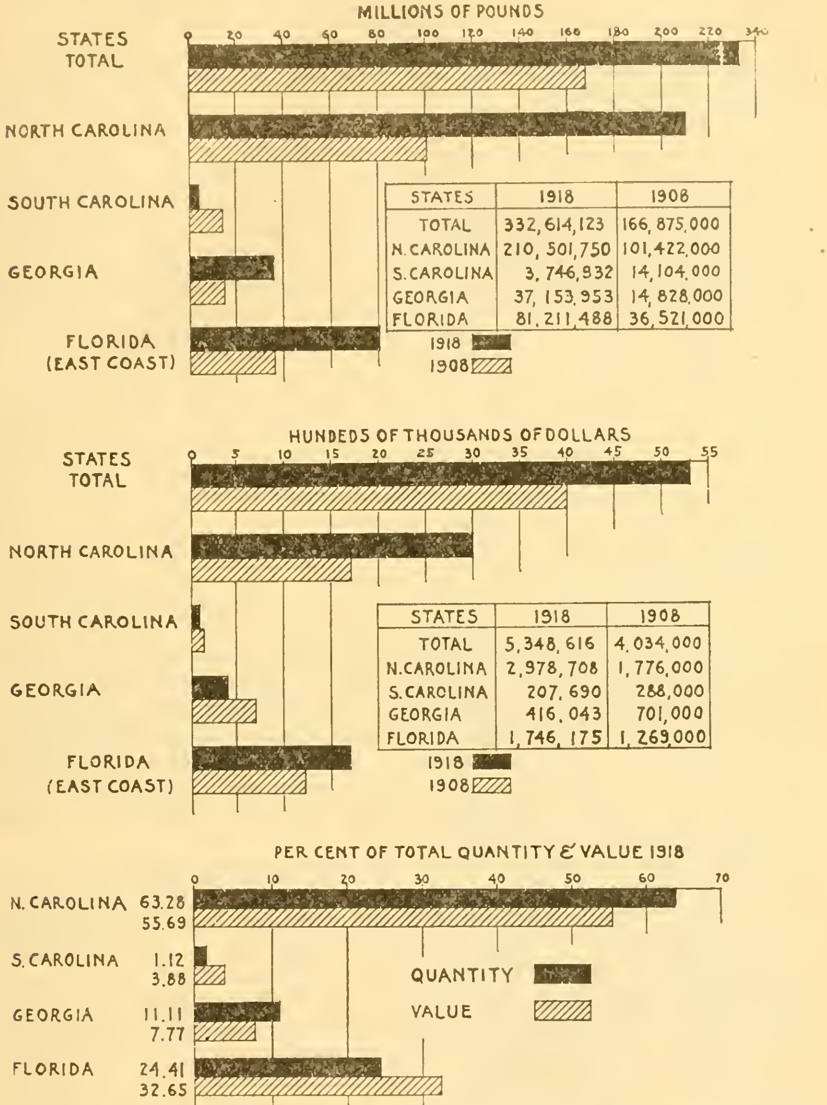
Compared with 1902, there has been an increase in the investment in North Carolina amounting to $2,248,602, or 113.94 per cent; in South Carolina, a decrease of $99,472, or 31.01 per cent; in Georgia, an increase of $427,848, or 125.04 per cent, and on the east coast of Florida, an increase of $1,855,844, or 523.01 per cent, representing a total increase for the region of $4,432,822, or 148.19 per cent.

The principal forms of fishing apparatus arranged in order of their value were: 3,779 pound nets, valued at $355,439; 15,399 gill nets, valued at $233,883; 91 purse seines, valued at $219,027; 582 haul seines, valued at $102,193; and 371 otter trawls, valued at $22,055. Other apparatus employed included fyke nets, dredges, lines, cast nets, stop nets, eel pots, tongs, grabs, rakes, spears, etc., to the value of $24,642. The use of the otter trawl introduced in the shrimp fishery at Fernandina, Fla., about 1915, represents the most important change in fishing apparatus since 1902.

The products of the fisheries amounted to 332,614,123 pounds, having a value to the fishermen of $5,348,616. The yield of the various States was as follows: North Carolina, 210,501,750 pounds, valued at $2,978,708; South Carolina, 3,746,932 pounds, valued at $207,690; Georgia, 37,153,953 pounds, valued at $416,043; and east coast of Florida, 81,211,488 pounds, valued at $1,746,175.

The more important species taken in these States were: Alewives, fresh and salted, taken mostly in North Carolina, 15,185,585 pounds, valued at $412,067; black bass, credited to North Carolina, 551,125 pounds, valued at $63,137; bluefish, 892,045 pounds, valued at $85,567; cero and kingfish, taken mostly in Florida, 2,483,647 pounds, valued at $161,562; menhaden, 257,757,799 pounds, valued at $1,605,117; mullet, fresh and salted, 11,757,318 pounds, valued at $508,044; sea bass, 577,596 pounds, valued at $50,592; shad, 2,888,644 pounds, valued at $568,585; Spanish mackerel, credited mostly to Florida, 3,211,405 pounds, valued at $232,355; spot, 1,692,775 pounds, valued at $72,795; squeteagues or "sea trout," 5,105,249 pounds, valued at $360,527; shrimp, 15,656,903 pounds, valued at $470,346; and oysters, 5,871,376 pounds, or 838,768 bushels, valued at $260,863.

Compared with the Bureau's returns for 1902, there has been an increase in the products of the fisheries of 226,168,051 pounds, or 212.47 per cent, in quantity and of $2,508,983, or 88.35 per cent, in value. Compared with the census returns for 1908, the increase



STATES	1918	1908
TOTAL	332,614,123	166,875,000
N. CAROLINA	210,501,750	101,422,000
S. CAROLINA	3,746,932	14,104,000
GEORGIA	37,153,953	14,828,000
FLORIDA	81,211,488	36,521,000

STATES	1918	1908
TOTAL	5,348,616	4,034,000
N. CAROLINA	2,978,708	1,776,000
S. CAROLINA	207,690	288,000
GEORGIA	416,043	701,000
FLORIDA	1,746,175	1,269,000

FIG. 7.—Top: Quantities of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the South Atlantic States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the South Atlantic States in 1918.

amounts to 165,739,123 pounds, or 99.31 per cent, in quantity and $1,314,616, or 32.58 per cent, in value. The large increase in the catch for 1918 over that of previous years is due to the increase in the catch of menhaden, the 1902 catch amounting to 18,862,000 pounds, valued at $31,420. The catch of other species in 1902 amounted to 87,584,072 pounds, valued at $2,808,213, and in 1918 to 74,856,324 pounds, valued at $3,743,499, a decrease of 14.53 per cent in quantity and an increase of 33.30 per cent in value. Compared with 1902 the increase in North Carolina amounted to 142,917,016 pounds, or 211.46 per cent, in quantity and $1,239,047, or 71.22 per cent, in value; in Georgia, to 26,051,343 pounds, or 234.64 per cent, in quantity and $56,962, or 15.86 per cent, in value; and on the east coast of Florida, to 61,627.223 pounds, or 314.67 per cent, in quantity and $1,268,307, or 265.41 per cent, in value. In South Carolina there was a decrease in the quantity amounting to 4,427,531 pounds, or 54.16 per cent, and in value of $55,333, or 21.03 per cent.

As an index of the trend of the fisheries of the South Atlantic States it is of interest to compare for various years from 1890 to 1918 the catch of certain staple species with the take of forms which have increased greatly in importance in recent years, species of which in the past there has been a comparative abundance but a lack of demand. For this purpose alewives, mullet, shad, squeteagues, and oysters have been selected as representative of staple varieties and cero (including kingfish), red and black drum, menhaden, Spanish mackerel, and shrimp, representing species for which the demand has greatly increased in recent years, resulting in much more intensive fishing operations. Lacking accurate data, for comparative purposes, as to the intensiveness with which these fisheries were prosecuted, it is difficult to draw definite conclusions regarding the present status of these fisheries, but the figures are nevertheless of interest. A study of the appended table reveals comparatively small fluctuations in the catch of alewives over the entire period. The fishery for mullet has more than doubled since 1890 but shows a reduction in the catch in 1918 as compared with 1902 and 1908. That the supply of shad is being depleted is indicated by the striking reduction in the catch in 1918 in comparison with that for other years. In comparison with 1908, the decrease amounts to 5,683,356 pounds, or 66.30 per cent. The fluctuation in the catch of squeteagues is not so marked, and in the absence of accurate information as to the intensiveness of fishing operations for the various years, the status of this fishery is largely conjectural. As on other parts of the coast, there has been a striking decline in the take of oysters.

With greater development of the fisheries and inability to supply the demand for staple varieties, the growth of other fisheries has been quite striking as indicated by the statistics for cero and kingfish, red and black drum, Spanish mackerel, and shrimp. On the Atlantic seaboard, the demand for red drum or "channel bass," as it is often called, has never been as great as on the Gulf and difficulty has been experienced in marketing it, particularly in the more northern part of its range. The increased catch of menhaden for conversion into oil and scrap is also of interest.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES, VARIOUS YEARS, 1890 TO 1918.

Year.	Alewives.	Mullet.	Shad.	Squeteague or sea trout.	Oysters.
1890	16, 543, 783	5, 573, 623	9, 385, 354	2, 368, 067	8, 344, 805
1897	15, 856, 350	5, 934, 942	11, 268, 343	3, 741, 274	11, 285, 268
1902	11, 601, 172	14, 310, 808	9, 849, 338	4, 848, 269	22, 719, 074
1908	12, 180, 000	14, 501, 800	8, 572, 000	8, 615, 000	30, 549, 000
1918	15, 185, 585	11, 757, 318	2, 888, 644	5, 105, 249	5, 871, 376

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC STATES, VARIOUS YEARS, 1890 TO 1918—Continued.

Year.	Cero and kingfish.	Drum, red and black.	Menhaden.	Spanish mackerel.	Shrimp.
1890		692,003	12,410,400		744,025
1897	358,070	772,032	11,310,000	362,390	627,221
1902	77,170	583,394	18,862,000	1,013,172	3,810,641
1908		1,421,000	57,412,000	1,685,000	5,697,000
1918	2,483,647	1,007,311	257,757,799	3,211,405	15,656,903

As indicative of the trend of important fisheries common to the South Atlantic and Gulf coasts the following table is of interest. In view of the present high degree of development of the fisheries in these sections, it is becoming increasingly important that frequent statistical inventories be made to supply information as to whether these fisheries are being endangered and as to the needs for restrictive measures to safeguard the harvests of the future.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE SOUTH ATLANTIC AND GULF STATES, VARIOUS YEARS, 1890 TO 1918.

Year.	Mullet.	Spanish mackerel.	Squeteague or sea trout.	Shrimp.	Oysters.
1890	20,758,740	700,459	5,327,500	8,195,375	28,931,903
1897	21,286,828	1,089,066	6,835,377	7,418,246	27,942,406
1902	41,544,130	2,597,063	9,637,316	16,177,551	56,835,009
1908	33,354,800	3,171,000	12,705,000	18,258,001	74,952,000
1918	40,398,682	6,706,250	10,065,987	42,799,902	29,625,841

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the South Atlantic States in 1918, and comparative statistics of persons, investment, and products for various years from 1880 to 1918.

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918.

Item.	North Carolina.		South Carolina.	
	Number.	*Value.*	*Number.*	*Value.*
PERSONS ENGAGED.				
On vessels fishing	1,295		103	
On vessels transporting	54		20	
In shore fisheries	4,903		1,121	
Shoresmen	1,784		756	
Total	8,036		2,000	
INVESTMENT.				
Vessels fishing:				
Steam	15	$807,315		
Tonnage	1,791			
Outfit		246,685		
Gasoline	55	413,710	3	$7,005
Tonnage	1,258		74	
Outfit		166,360		2,075
Sail	48	28,700	33	20,995
Tonnage	388		357	
Outfit		9,745		4,415
Vessels transporting:				
Gasoline	25	24,600	7	11,000
Tonnage	197		74	
Outfit		13,775		1,350
Sail	12	9,700		
Tonnage	92			
Outfit		4,450		

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

Item.	North Carolina.		South Carolina.	
INVESTMENT—continued.				
Boats:	*Number.*	*Value.*	*Number.*	*Value.*
Sail, row, etc	1,727	$38,053	639	$15,810
Power	1,357	269,720	51	20,600
Apparatus, vessel fisheries:				
Purse seines	57	156,727		
Gill nets	13	800		
Lines		50		100
Otter trawls	2	100		
Dredges	86	2,655		
Tongs and grabs	22	100	165	527
Apparatus, shore fisheries:				
Purse seines	3	1,600		
Haul seines	440	41,533	25	2,550
Gill nets	14,299	108,878	233	16,525
Pound nets	3,779	355,439		
Fyke nets	591	6,230		
Cast nets			71	155
Stop nets	6	90	2	130
Lines		333		515
Otter trawls	27	960	2	90
Eel pots	1,585	1,329		
Dredges	550	2,648		
Tongs, grabs, and rakes	1,008	2,046	549	1,482
Spears or gigs	80	78	36	27
Crab traps and drags	113	565		
Other apparatus		375		25
Shore and accessory property		1,347,644		95,775
Cash capital		159,050		20,100
Total		4,222,043		221,251
PRODUCTS.				
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	8,739,944	$238,624	9,500	$475
Salted	5,743,876	162,595		
Angelfish	8,975	340		
Black bass	551,125	63,137		
Bluefish	322,744	29,677	3,000	275
Bonito	3,015	107		
Bowfin	34,372	319		
Butterfish	731,257	24,785	600	45
Carp	153,169	5,619		
Catfish	304,509	9,783	2,900	108
Cero and Kingfish	211,781	13,947		
Crappie	5,340	568		
Crevalle	204	11	300	65
Croaker	386,807	11,912	16,000	1,062
Drum, red and black	99,546	3,246	6,000	285
Eels	174,541	13,333		
Flounders	91,121	7,022	16,200	1,061
Gizzard shad	44,525	1,154		
Grunts	15,000	1,150	100	6
Hickory shad	158,443	13,388	20,500	2,000
King whiting			40,125	4,707
Menhaden	179,910,599	1,306,489		
Mullet:				
Fresh	812,679	52,734	58,050	4,223
Salted	315,350	38,341	142,700	14,906
Perch:				
White	617,088	31,150		
Yellow	223,813	10,147		
Pigfish:				
Fresh	264,272	12,675		
Salted	3,125	63		
Pike	20,552	1,898		
Pinfish or sailor's choice	50,179	1,225	2,300	148
Pompano	8,685	994		
Porgies			2,000	130
Sea bass	111,650	10,928	132,000	13,200
Shad	1,657,036	376,696	167,462	29,085
Sharks			20,000	175
Sheepshead	26,223	1,839	2,100	210
Skates			2,000	15
Spanish mackerel	149,440	14,270		
Spot:				
Fresh	1,193,270	52,531	37,000	2,354
Salted	42,825	3,768	25,550	2,085
Squeteagues or "sea trout":				
Fresh	3,361,246	209,483	59,150	4,846
Salted	80	10		
Striped bass	286,528	46,030		
Sturgeon	6,916	974	117,225	21,136
Sturgeon caviar	671	1,497	665	889

FISHERIES OF THE SOUTH ATLANTIC STATES, 1918—Continued.

Item.	North Carolina.		South Carolina.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Suckers	16,464	$680		
Sunfish	123,980	1,202	3,000	$180
Tautog	150	9		
Yellowtail or "silver perch"	31,278	1,379	900	37
Shrimp	940,120	23,485	55,400	6,220
Crabs:				
Hard	145,605	1,983	18,000	400
Soft	233,705	23,821	300	75
Clams, hard	197,576	46,598	800	200
Oysters, market:				
Public	1,500,534	67,380	2,631,755	83,892
Private	18,200	2,900	152,075	12,650
Scallops	422,832	31,618		
Terrapin	210	92	1,275	545
Turtles	8,400	77		
Shark hides	19,125	2,868		
Other aquatic hides	1,050	157		
Total	210,501,750	2,978,708	3,746,932	207,690

Item.	Georgia.		Florida (east coast).		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	186		380		1,964	
On vessels transporting	2		15		91	
In shore fisheries	476		2,104		8,604	
Shoresmen	1,016		831		4,387	
Total	1,680		3,330		15,046	
INVESTMENT.						
Vessels fishing:						
Steam					15	$807,315
Tonnage					1,791	
Outfit						246,685
Gasoline	27	$119,848	23	$377,600	108	918,163
Tonnage	499		725		2,556	
Outfit		41,416		71,287		281,138
Sail	5	2,315			86	52,010
Tonnage	44				789	
Outfit		325				14,485
Vessels transporting:						
Gasoline	1	500	7	32,300	40	68,400
Tonnage	9		89		369	
Outfit		125		3,850		19,100
Sail					12	9,700
Tonnage					92	
Outfit						4,450
Boats:						
Sail, row, etc	313	8,805	607	20,180	3,286	82,848
Power	99	77,400	839	459,650	2,346	827,370
Apparatus, vessel fisheries:						
Purse seines	4	4,800	25	52,900	86	214,427
Gill nets					13	800
Lines		105				255
Otter trawls	12	705			14	805
Dredges	6	300			92	2,955
Tongs and grabs	42	160			229	787
Apparatus, shore fisheries:						
Purse seines			2	3,000	5	4,600
Haul seines	2	80	115	58,030	582	102,193
Gill nets	139	5,955	715	101,725	15,386	233,083
Pound nets					3,779	355,439
Fyke nets					591	6,230
Cast nets	1	3	16	80	88	238
Stop nets					8	220
Lines		13		2,965		3,826
Otter trawls	73	3,700	255	16,500	357	21,250
Eel pots					1,585	1,329
Dredges					550	2,648
Tongs, grabs, and rakes	400	1,264	37	224	1,994	5,016
Spears or gigs			12	12	128	117
Crab traps and drags			20	50	133	615
Other apparatus				6		406
Shore and accessory property		429,779		858,720		2,731,918
Cash capital		72,400		151,600		403,150
Total		769,998		2,210,679		7,423,971

FISHERIES OF THE SOUTH ATLANTIC STATES—Continued.

Item.	Georgia.		Florida (east coast).		Total.	
PRODUCTS.						
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value*
Fresh			692,265	$10,373	9,441,709	$249,472
Salted					5,743,876	162,595
Amberfish			11,686	390	11,686	390
Angelfish			2,915	91	11,890	431
Barracuda			2,915	97	2,915	97
Black bass					551,125	63,137
Bluefish	5,000	$900	561,301	54,715	892,045	85,567
Blue runner or hardtail			50,750	1,542	50,750	1,542
Bonito			8,141	258	11,156	365
Bowfin					34,372	319
Butterfish			4,200	170	736,057	25,000
Carp					153,169	5,619
Catfish	2,675	265	13,900	278	323,984	10,434
Cero and Kingfish	74	7	2,271,792	147,608	2,483,647	161,562
Cowfish and "shellfish"			50	2	50	2
Crappie					5,340	568
Crevalle			321,030	9,833	321,534	9,909
Croaker	5,900	255	124,278	3,447	532,985	16,676
Drum, red and black	1,674	112	900,091	24,638	1,007,311	28,281
Eels					174,541	13,333
Flounders	10,800	650	13,490	737	131,611	9,470
Gizzard shad					44,525	1,154
Groupers	27,758	1,019	74,783	3,622	102,541	4,641
Grunts	512	26	113,679	3,629	129,291	4,811
Hickory shad	13,007	2,035			191,950	17,423
Hogfish			250	11	250	11
Jewfish			12,487	365	12,487	365
King whiting	27,230	1,468	297,008	15,604	364,363	21,779
Ladyfish			1,280	13	1,280	13
Leatherjacket or "turbot"			370	13	370	13
Menhaden	29,484,600	88,453	48,362,600	210,175	257,757,799	1,605,117
Moonfish			7,970	245	7,970	245
Mullet:						
Fresh	10,650	693	10,417,889	397,147	11,299,268	454,797
Salted					458,050	53,247
Parrotfish			3,500	70	3,500	70
Perch:						
White					617,088	31,150
Yellow					223,813	10,147
Permit			7,290	244	7,290	244
Pigfish:						
Fresh			14,762	451	279,034	13,126
Salted					3,125	63
Pike					20,552	1,898
Pinfish or sailor's choice			442,535	13,033	495,014	14,406
Pompano			133,419	19,889	142,104	20,883
Porgies			5,950	328	7,950	458
Porkfish			1,710	57	1,710	57
Scup	12,000	900			12,000	900
Sea bass	292,615	23,765	41,331	2,699	577,396	50,592
Sea gar or needlefish			100	5	100	5
Sergeantfish or snook			314,774	8,629	314,774	8,629
Shad	100,540	26,960	963,606	135,844	2,888,644	568,585
Sharks	1,289	30	63,775	526	85,064	731
Sheepshead	400	25	104,303	4,115	133,026	6,189
Skates					2,000	15
Snapper:						
Mangrove			23,186	975	23,186	975
Mutton			241,078	7,399	241,078	7,399
Red	112,349	7,810	20,200	2,000	132,549	9,810
Spanish mackerel			3,061,965	218,085	3,211,405	232,355
Spot:						
Fresh	1,100	59	393,030	11,998	1,624,400	66,942
Salted					68,375	5,853
Squeteagues or "sea trout":						
Fresh	39,550	4,097	1,645,223	142,091	5,105,169	360,517
Salted					80	10
Striped bass	125	10			286,653	46,040
Sturgeon	39,150	4,700			163,291	26,810
Sturgeon caviar					1,336	2,386
Suckers					16,464	680
Sunfish					126,980	1,382
Tautog					150	9
Tilefish	35,000	2,400			35,000	2,400
Yellowtail or "silver perch"	2,000	100	43,970	1,279	78,148	2,795
Shrimp	5,793,465	173,990	8,867,918	266,651	15,656,903	470,346
Crabs:						
Hard	8,455	504	52,000	1,800	[1] 224,060	4,687
Soft					[2] 234,005	23,896
Sea crawfish or spiny lobster			23,503	1,174	23,503	1,174

[1] 672,180 in number. [2] 702,015 in number.

Fisheries of the South Atlantic States—Continued.

Item.	Georgia.		Florida (east coast).		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Clams, hard	120	$75	2,400	$600	[1] 200,896	$47,473
Conch meat			7,000	700	7,000	700
Oysters, market:						
Public	481,530	30,884	313,125	15,134	[2] 4,927,244	197,290
Private	628,292	43,029	145,565	4,994	[3] 944,132	63,573
Scallops					[4] 422,832	31,618
Octopus	2,731	268			2,731	268
Terrapin	2,112	454			3,597	1,091
Turtles	11,250	100	6,850	402	26,500	579
Shark hides					19,125	2,868
Other aquatic hides					1,050	157
Total	37,153,953	416,013	81,211,488	1,746,175	332,614,123	5,348,616

[1] 25,112 bushels. [2] 703,892 bushels. [3] 134,876 bushels. [4] 70,472 bushels.

Extent of Fisheries of South Atlantic States, Various Years, 1880 to 1918.[1]

State.	1880	1887	1888	1889
PERSONS ENGAGED.				
North Carolina	5,274	7,352	7,704	8,655
South Carolina	1,005	1,280	1,346	2,642
Georgia	899	627	638	1,497
Florida (east coast)	368	(2)	851	1,244
Total	7,546	(2)	10,539	14,038
INVESTMENT.				
North Carolina	$506,561	$766,881	$801,474	$968,600
South Carolina	66,275	92,930	97,189	107,205
Georgia	78,770	61,806	65,556	120,975
Florida (east coast)	43,554	(2)	109,670	128,434
Total	695,160	(2)	1,073,889	1,325,214
PRODUCTS.				
Pounds:				
North Carolina	32,249,488	45,121,956	43,022,855	45,545,643
South Carolina	6,143,250	4,075,537	4,180,847	4,879,125
Georgia	2,272,500	1,882,790	1,957,749	2,643,533
Florida (east coast)	2,286,750	(2)	(2)	5,982,375
Total	42,951,988	(2)	(2)	59,050,676
Value:				
North Carolina	$845,695	$772,957	$776,439	$950,427
South Carolina	212,482	157,688	163,657	200,381
Georgia	119,993	80,745	82,910	105,727
Florida (east coast)	78,408	(2)	173,886	199,043
Total	1,256,578	(2)	1,196,892	1,455,578

[1] Statistics for 1908 are from data published by the Bureau of the Census.
[2] Statistics not available.

EXTENT OF FISHERIES OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918—Continued.

State.	1890	1897	1902	1908	1918
PERSONS ENGAGED.					
North Carolina	10,274	12,045	14,755	9,681	8,036
South Carolina	2,701	2,139	3,713	2,559	2,000
Georgia	1,622	1,869	2,286	2,525	1,680
Florida (east coast)	1,404	1,132	2,698	3,196	3,330
Total	16,001	17,185	23,452	[1] 17,961	15,046
INVESTMENT.					
North Carolina	$1,243,988	$1,218,459	$1,973,441	$1,270,000	$4,222,043
South Carolina	127,762	174,354	320,723	114,000	221,251
Georgia	174,431	284,864	342,150	409,000	769,998
Florida (east coast)	142,105	151,155	354,835	531,000	2,210,679
Total	1,688,286	1,828,832	2,991,149	[1] 2,324,000	7,423,971
PRODUCTS.					
Pounds:					
North Carolina	51,799,142	64,234,257	67,584,734	101,422,000	210,501,750
South Carolina	4,944,840	5,280,446	8,174,463	14,104,000	3,746,932
Georgia	2,994,117	4,993,100	11,102,610	14,828,000	37,153,953
Florida (east coast)	7,463,531	5,882,662	19,584,265	36,521,000	81,211,488
Total	67,201,630	80,390,465	106,446,072	166,875,000	332,614,123
Value:					
North Carolina	$1,027,669	$1,316,017	$1,739,661	$1,776,000	$2,978,708
South Carolina	202,602	210,456	263,023	288,000	207,690
Georgia	123,563	170,605	359,081	701,000	416,043
Florida (east coast)	219,870	136,077	477,868	1,269,000	1,746,175
Total	1,573,704	1,833,155	2,839,633	4,034,000	5,348,616

[1] Exclusive of persons and investment in canneries, packing houses, and other establishments.

OYSTER INDUSTRY OF SOUTH ATLANTIC STATES, VARIOUS YEARS, 1880 TO 1918.[1]

Year.	North Carolina.		South Carolina.		Georgia.		Florida (east coast).		Total.	
	Bushels.	*Value.*	*Bushels.*	*Value.*	*Bushels.*	*Value.*	*Bushels.*	*Value.*	*Bushels.*	*Value.*
1880	170,000	$60,000	50,000	$20,000	70,000	$35,000	20,000	$5,000	310,000	$120,000
1887	212,980	48,353	37,725	18,581	110,085	26,950	(2)	(2)	(2)	(2)
1888	204,703	46,129	40,242	19,146	120,600	29,370	57,750	12,950	423,295	107,595
1889	1,001,620	194,272	43,620	19,890	163,200	26,684	62,356	11,123	1,270,796	251,969
1890	807,260	175,567	63,150	23,204	224,355	40,520	97,350	14,850	1,192,115	254,141
1895	(2)	(2)	(2)	(2)	(2)	(2)	99,434	15,415	(2)	(2)
1897	858,818	241,099	214,900	45,360	486,634	86,709	51,829	11,766	1,612,181	384,934
1902	1,022,813	268,363	689,700	118,460	1,224,000	220,467	309,069	37,188	3,245,582	644,478
1908	812,500	236,100	1,563,000	137,000	1,459,000	338,600	529,000	108,600	4,363,500	820,300
1910	332,257	63,405	710,124	94,677	505,157	170,812	153,460	35,290	1,700,998	364,184
1918	216,962	70,280	397,690	96,542	158,516	73,913	65,570	20,128	838,738	260,863

[1] Statistics for 1908 are from data published by the Bureau of the Census.
[2] Statistics not available.

FISHERIES OF NORTH CAROLINA.

The fisheries of North Carolina were more extensive than those of South Carolina, Georgia, and eastern coast of Florida combined in persons engaged, investment, and quantity and value of the products. In 1918 the number of persons employed in the coastal fisheries of this State was 8,036, of whom 1,295 were on vessels fishing, 54 on transporting vessels, 4,903 in the shore or boat fisheries, and 1,784 on shore in the wholesale establishments, canneries, and other fishery industries.

The investment in the fisheries of $4,222,043 includes 118 fishing vessels, valued at $1,249,725, with a net tonnage of 3,437 tons and outfits valued at $422,790; 37 transporting vessels, valued at $34,300, with a net tonnage of 289 tons and outfits valued at $18,225; 3,084 power, sail, row, and other boats valued at $307,773; fishing apparatus employed on vessels to the value of $160,432; fishing apparatus employed in shore or boat fisheries to the value of $522,104; shore and accessory property valued at $1,347,644; and cash capital amounting to $159,050.

The products amounted to 210,501,750 pounds, valued at $2,978,-708. The species of chief importance arranged in order of their value were: Menhaden, 179,910,599 pounds, valued at $1,306,489; alewives, 14,483,820 pounds, valued at $401,219, of which 5,743,876 pounds, valued at $162,595, were salted; shad, 1,657,036 pounds, valued at $376,696; squeteague or "sea trout," 3,361,326 pounds, valued at $209,493; mullet, 1,128,029 pounds, valued at $91,075, of which 315,350 pounds, valued at $38,341, were salted; oysters, 1,518,734 pounds, or 216,962 bushels, valued at $70,280; black bass, 551,125 pounds, valued at $63,137; spot, 1,236,095 pounds, valued at $56,299, of which 42,825 pounds, valued at $3,768, were salted; hard clams, 197,576 pounds, or 24,697 bushels, valued at $46,598; and striped bass, 286,528 pounds, valued at $46,030.

Menhaden represents 85.46 per cent of the total quantity and 43.86 per cent of the total value of the products of the State in 1918. The products of the fisheries exclusive of menhaden for various years follow: 39,388,742 pounds, valued at $1,011,498, in 1890; 52,924,257 pounds, valued at $1,296,317, in 1897; 48,722,734 pounds, valued at $1,708,241, in 1902; 44,010,000 pounds, valued at $1,706,000, in 1908, and 30,591,151 pounds, valued at $1,672,219, in 1918. From the foregoing it will be evident that the trend of production of food fishes is downward and should be a matter of some concern to the State. As indicative of the trend of certain of the important fisheries of the State, the following table gives the comparative production figures for various years:

PRODUCTS OF CERTAIN FISHERIES OF NORTH CAROLINA, VARIOUS YEARS, 1890 TO 1918.

Species.	1890	1897	1902	1908	1918
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Alewives	16,481,063	15,790,437	11,172,975	10,928,000	14,483,820
Bluefish	1,345,194	1,696,175	977,142	1,256,000	322,714
Mullet	3,585,981	3,409,585	6,705,492	5,070,800	1,128,029
Shad	5,768,413	8,963,488	6,566,724	3,912,000	1,657,036
Squeteagues or "sea trout"	1,885,677	3,090,254	3,781,456	4,635,000	3,361,326
Striped bass	568,341	845,123	1,175,400	510,000	286,528
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Clams	28,269	117,226	146,897	91,000	24,697
Oysters	807,260	858,818	1,022,813	812,500	216,962

An examination of this table reveals a very marked decline in the catch of bluefish, mullet, shad, striped bass, clams, and oysters, while the fisheries for alewives and squeteagues have fluctuated comparatively little. In 1918 the catch of bluefish amounted to only 25.69 per cent of that in 1908; of mullet, to only 22.25 per cent of the 1908 catch; of shad, to only 42.04 per cent of the catch in 1908, and 25.23 per cent of the catch in 1902; of striped bass, to only 56.18 per cent of the 1908 catch and 24.38 per cent of the 1902 catch; of clams, to only 27.14 per cent of the 1908 catch and 16.81 per cent of the 1902 catch; and of oysters, to only 26.70 per cent of the 1908 catch and 21.21 per cent of the 1902 catch.

The principal factors affecting the abundance of shad in our Atlantic coast waters appear to be unsatisfactory spawning areas, due to pollution and artificial barriers restricting the movements of the fish in the rivers, and interference with the fish in their migrations to the spawning areas and while on these areas. It is conceivable that, unless these conditions are rectified, the consumer may have to depend on the Pacific coast for these fish at some not far distant date. In North Carolina, while pollution is believed to have been a less significant factor than in some of the other States, interference with the free movement of a sufficient body of the fish to the spawning areas and during the spawning period is considered to be an important factor affecting the supply of fish in the waters, which fish-cultural operations have been unable to wholly counteract. A study of the production figures for striped bass would indicate that the supply of this fish is being depleted. Difficulties in propagation, such as inability to procure ripe fish of both sexes at same time, handicap operations in this field. The decline in the catch of oysters would indicate how important it is for the State to give more serious consideration to the encouragement of oyster farming. In this connection the results of former investigations of the Bureau should prove of interest, notably a document by Dr. Caswell Grave.[10]

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries of North Carolina in 1918 are given by counties in the appended table. It will be noted that of the catch of sea bass of 111,650 pounds, valued at $10,928, 59,650 pounds, valued at $5,763, are credited to Carteret County. The increase in the catch for this county is directly attributable in large part to the Bureau for its work in locating the small fishing grounds along this section of the coast and for encouragement given to the establishment of an important fishery. Difficulties in marketing the catch at satisfactory prices are reported to have retarded the fullest development of this fishery.

As a result of the Bureau's efforts to develop fisheries for sharks and other unutilized aquatic animals and to encourage the saving of the hides for tanning into leather and the extraction of the liver oil of sharks, etc., 20,175 pounds of the hides of sharks, porpoise, etc., valued at $3,025, and 720 gallons of shark oil, valued at $540, were saved in 1918.

[10] Grave, Caswell: Investigations for the Promotion of the Oyster Industry of North America. Report U. S. Commission of Fish and Fisheries, 1903 (1905), p. 247-341, X pl.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES.

Item.	Beaufort.		Bertie.		Bladen.		Brunswick.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	12						59	
On vessels transporting	18							
In shore fisheries	236		22		45		301	
Shoresmen	167		13				147	
Total	433		35		45		507	
INVESTMENT.								
Vessels fishing:								
Gasoline							5	$39,620
Tonnage							160	
Outfit								17,510
Sail	4	$2,750						
Tonnage	30							
Outfit		950						
Vessels transporting:								
Gasoline	2	7,500						
Tonnage	15							
Outfit		5,000						
Sail	7	7,000						
Tonnage	50							
Outfit		3,500						
Boats:								
Sail, row, etc	74	6,195	1	$5	23	$270	151	2,210
Power	25	6,400	7	1,600			17	8,150
Apparatus, vessel fisheries:								
Purse seines							3	9,000
Otter trawls							2	100
Dredges	8	160						
Apparatus, shore fisheries:								
Haul seines	15	6,700					21	1,800
Gill nets	490	903			22	350	100	2,475
Pound nets	137	10,210	73	9,585				
Lines								1
Otter trawls							14	570
Dredges	21	549						
Tongs and rakes	2	6					160	268
Eel pots	250	325						
Other apparatus					1	12	6	90
Shore and accessory property		39,975		1,950				65,685
Cash capital		34,000						5,800
Total		132,123		13,140		632		153,579
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:								
Fresh	326,865	$6,760	211,845	$4,209				
Salted			216,039	5,906				
Black bass	10,111	1,343						
Butterfish	70,009	4,128						
Catfish	44,008	1,113	982	20				
Cero and king fish							3,250	$178
Croaker							1,500	43
Drum, red and black							1,500	73
Eels	39,164	1,076						
Flounders	5,800	348					8,800	433
Hickory shad	16,760	1,515	628	31				
Menhaden							9,300,000	33,325
Mullet:								
Fresh							28,700	2,180
Salted							213,900	25,450
Perch:								
White	6,630	613	2,261	121				
Yellow	40,485	2,778						
Pigfish, fresh							150	9
Pike	11,013	1,032						
Pompano	750	60						
Sea bass							1,000	70
Shad	80,057	14,270	5,366	1,182	4,077	$1,165	2,050	425
Sheepshead							1,800	106
Spot:								
Fresh	5,148	255					11,250	587
Salted							36,700	3,370
Squeteagues, or "sea trout," fresh	314,892	10,734					8,600	604

Persons Engaged, Investment, and Products of the Fisheries of North Carolina in 1918, by Counties—Continued.

Item.	Beaufort.		Bertie.		Bladen.		Brunswick.	
PRODUCTS—continued.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Striped bass	24, 701	$3, 426	333	$50			1, 000	$100
Suckers	4, 890	124	131	8				
Tautog							150	9
Shrimp							370, 000	11, 100
Crabs:								
Hard							650	20
Soft							40	10
Turtles							500	13
Clams, hard							44, 000	8, 350
Oysters, market, public	65, 415	4, 565					4, 725	500
Total	1, 066, 698	54, 140	437, 585	11, 527	4, 077	$1, 165	10, 040, 265	86, 955

Item.	Camden.		Carteret.		Chowan.		Columbus.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing			656					
On vessels transporting			35					
In shore fisheries	8		1, 251		285		30	
Shoresmen			766		167			
Total	8		2, 708		452		30	
INVESTMENT.								
Vessels fishing:								
Gasoline			49	$356, 150				
Tonnage			1, 026					
Outfit				142, 350				
Sail			26	17, 500				
Tonnage			232					
Outfit				5, 145				
Vessels transporting:								
Gasoline			22	16, 600				
Tonnage			177					
Outfit				8, 025				
Sail			4	2, 450				
Tonnage			36					
Outfit				925				
Boats:								
Sail, row, etc	3	$45	414	9, 755	29	$1, 100	15	$160
Power	5	835	461	112, 875	101	26, 410		
Apparatus, vessel fisheries:								
Purse seines			38	102, 600				
Gill nets			13	800				
Lines				50				
Dredges			42	1, 530				
Tongs			16	82				
Apparatus, shore fisheries:								
Haul seines			123	3, 185				
Purse seines			1	1, 000				
Gill nets	82	972	1, 877	49, 305	234	6, 238	15	150
Pound nets			268	24, 750	967	103, 936		
Fyke nets	40	400						
Lines				230				
Otter trawls			13	390				
Dredges			492	1, 525				
Tongs and rakes			182	432				
Eel pots			25	35				
Other apparatus			370	659				
Shore and accessory property				543, 480		63, 405		
Cash capital				74, 000				
Total		2, 252		1, 475, 828		201, 089		310
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:								
Fresh			75, 636	$3, 774	4, 747, 518	$98, 415		
Salted					3, 230, 025	87, 768		
Angel fish			3, 800	155				
Bluefish			261, 055	23, 545				
Bonito			3, 015	107				
Butterfish			71, 999	4, 379				
Catfish	2, 400	$120			62, 727	2, 218		

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Camden.		Carteret.		Chowan.		Columbus.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cero and king fish			151,871	$10,615				
Crevalle			201	11				
Croaker			323,226	9,863				
Drum, red and black			32,165	1,332				
Eels			1,500	150	6,860	$549		
Flounders			8,175	543				
Gizzard shad					34,629	1,036		
Hickory shad			23,611	1,419	58,283	5,832		
Menhaden			90,232,799	480,212				
Mullet:								
Fresh			405,855	19,804				
Salted			22,500	4,000				
Perch, white	2,300	$230			72,890	6,333		
Pigfish, fresh			152,669	4,859				
Pike					294	28		
Pinfish, or sailor's choice			18,380	238				
Pompano			2,768	332				
Sea bass			59,650	5,763				
Shad	17,800	4,450	53,994	13,753	173,472	34,736	1,575	$450
Sheepshead			17,039	988				
Spanish mackerel			115,330	11,372				
Spot, fresh			792,565	30,603				
Squeteagues, or "sea trout," fresh			1,584,096	122,323				
Striped bass			995	133	17,878	3,577		
Sturgeon			540	27				
Suckers					8,693	383		
Yellowtail			8,108	229				
Shrimp			450,120	9,385				
Crabs:								
Hard			2,000	150				
Soft			233,665	23,811				
Terrapin			60	57				
Turtles			7,500	44				
Clams, hard			47,176	8,103				
Oysters, market, public			879,977	31,925				
Scallops			415,572	30,768				
Shark hides			19,125	2,868				
Other aquatic hides			1,050	157				
Total	22,500	4,800	96,479,790	857,827	8,413,269	240,875	1,575	450

Item.	Craven.		Currituck.		Dare.		Gates.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing					7			
In shore fisheries	66		427		762		30	
Shoresmen	4		20		13			
Total	70		447		782		30	
INVESTMENT.								
Vessels fishing:								
Sail					3	$1,300		
Tonnage					20			
Outfit						450		
Boats:								
Sail, row, etc	47	$585	57	$700	86	3,430	22	$265
Power	20	3,075	167	15,530	287	41,600	4	250
Apparatus, vessel fisheries:								
Dredges					6	30		
Tongs					6	18		
Apparatus, shore fisheries:								
Haul seines	8	850	183	16,353	34	4,525		
Purse seines					2	600		
Gill nets	463	1,705	296	1,879	7,814	16,131	74	248
Pound nets	25	750	56	10,035	1,581	143,891	10	390
Fyke nets			455	4,550			15	125
Lines						30		
Tongs and rakes					49	188		
Eel pots	20	25	1,240	879				
Shore and accessory property		6,265		4,040		31,488		
Cash capital				2,750		2,000		
Total		13,255		56,716		245,681		1,278

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Craven.		Currituck.		Dare.		Gates.	
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:								
Fresh	22,800	$725	142,668	$4,252	777,636	$36,700	73,688	$1,179
Salted			133,083	2,140	128,355	4,547		
Angel fish	50	2						
Black bass			504,164	57,372	36,850	4,422		
Bluefish	700	42			46,944	4,674		
Bowfin			34,372	319				
Butterfish	30,000	1,200			437,473	12,345		
Carp			150,741	5,449				
Catfish	1,200	24	116,012	2,379	33,981	1,645	312	25
Cero and king fish			10,960	548	17,815	720		
Crappie							340	68
Croaker	3,050	77	13,600	354	16,538	726		
Drum, red and black					35,566	795		
Eels	500	40	112,581	10,268	8,000	680		
Flounders	600	35	4,948	330	19,567	977		
Gizzard shad			9,371	97				
Hickory shad	16,940	990			7,467	684		
Mullet, fresh	17,400	1,395						
Perch:								
White	3,100	282	412,040	16,296	71,659	2,874		
Yellow			156,555	6,187	23,886	958	312	25
Pigfish:								
Fresh	200	5			37,428	1,661		
Salted					3,125	63		
Pike			9,245	838				
Pinfish, or sailor's choice	3,000	50			22,799	337		
Pompano	75	8			1,012	57		
Shad	14,013	3,633	51,096	9,339	881,270	219,272	600	120
Sheepshead					834	60		
Spanish mackerel	250	200			27,973	2,091		
Spot:								
Fresh	19,300	989			49,082	2,232		
Salted					3,125	63		
Squeteagues, or "sea trout," fresh	36,910	2,043	25,400	1,854	901,238	47,700		
Striped bass	6,375	565	51,367	7,149	148,740	23,136		
Sturgeon					2,876	527		
Sturgeon caviar					661	1,487		
Sunfish			123,980	1,202				
Crabs, hard					142,290	1,778		
Clams, hard					6,400	1,200		
Oysters, market, public					60,900	4,350		
Total	176,463	12,305	2,062,183	126,373	3,951,490	378,761	75,252	1,417

Item.	Halifax.		Hertford.		Hyde.		Martin.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing					2			
In shore fisheries	39		29		145		18	
Shoresmen			2					
Total	39		31		147		18	
INVESTMENT.								
Vessels fishing:								
Sail					1	$400		
Tonnage					7			
Outfit						150		
Boats:								
Sail, row, etc	4	$50	11	$114	26	1,245	3	$75
Power	19	1,170	4	975	55	11,295		
Apparatus, vessel fisheries, dredges					2	60		
Apparatus, shore fisheries:								
Haul seines			1	200	1	75	3	500
Gill nets			50	253	1,684	3,028		
Pound nets			37	2,450	233	22,425		
Dredges					2	40		
Tongs and rakes					78	310		
Other apparatus	47	275						
Shore and accessory property				125		1,665		
Total		1,495		4,117		40,693		575

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Halifax.		Hertford.		Hyde.		Martin.	
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:								
Fresh			216,875	$5,205	87,706	$3,054	30,000	$1,500
Salted							25,000	1,200
Angel fish					5,125	183		
Bluefish					7,495	848		
Butterfish					39,626	978		
Catfish					2,560	64	630	38
Cero and kingfish					3,335	119		
Croaker					1,993	43		
Drum, red and black					1,350	14		
Eels					333	10		
Flounders					10,781	394		
Hickory shad					15,112	730		
Mullet, salted					650	169		
Perch:								
White			1,584	96	3,078	277	1,000	80
Yellow					700	49		
Pigfish, fresh					3,125	95		
Pompano					1,280	92		
Shad			250	50	109,827	18,396		
Spanish mackerel					2,987	242		
Spot, fresh					3,325	150		
Squeteagues, or "sea trout," fresh					149,961	4,987		
Striped bass	6,635	$2,770			10,829	1,509		
Oysters, market, public					38,500	2,200		
Total	6,635	2,770	218,709	5,351	499,681	34,603	56,630	2,81[illegible]

Item.	New Hanover.		Onslow.		Pamlico.		Pasquotank and Perquimans.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	513				46			
On vessels transporting					1			
In shore fisheries	238		318		97		47	
Shoresmen	322		35		64		11	
Total	1,073		353		208		58	
INVESTMENT.								
Vessels fishing:								
Steam	15	$807,315						
Tonnage	1,791							
Outfit		246,685						
Gasoline	1	17,940						
Tonnage	72							
Outfit		6,500						
Sail					14	$6,750		
Tonnage					99			
Outfit						3,050		
Vessels transporting:								
Gasoline					1	500		
Tonnage					5			
Outfit						750		
Sail			1	$250				
Tonnage			6					
Outfit				25				
Boats:								
Sail, row, etc	157	2,600	298	4,935	55	1,665	13	$23[illegible]
Power	15	3,900	40	13,775	39	7,200	15	3,220
Apparatus, vessel fisheries:								
Purse seines	16	45,127						
Dredges					28	875		
Apparatus, shore fisheries:								
Haul seines	22	1,180	18	1,780				
Gill nets	77	3,045	411	9,850	35	1,100	206	4,060
Pound nets					70	3,375	81	3,610
Fyke nets							3	20
Lines		50		2				
Dredges			14	84	18	450		
Tongs and rakes	175	100	117	411	35	205		
Eel pots			50	65				
Other apparatus	25	23	14	14				
Shore and accessory property		560,336		6,505		6,410		13,000
Cash capital		25,000		2,000		2,500		11,000
Total		1,719,801		39,696		34,830		35,145

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	New Hanover.		Onslow.		Pamlico.		Pasquotank and Perquimans.	
PRODUCTS.								
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	15,000	$1,200	177,507	$6,250	3,750	$125	150,000	$3,000
Salted							39,000	390
Bluefish	500	62	5,400	455				
Butterfish			1,000	100	81,150	1,655		
Catfish	18,000	990						
Cero and king fish	2,000	249	22,250	1,495				
Crappie							300	30
Croaker			13,350	352	6,250	150		
Drum, red and black	8,000	480	3,000	22	11,665	110		
Eels			3,293	329				
Flounders	10,300	1,545	4,300	335				
Grunts	15,000	1,150						
Hickory shad	5,000	400						
Menhaden	80,377,800	792,952						
Mullet:								
Fresh	32,000	2,750	193,024	14,955	4,000	400		
Salted			47,000	5,232	5,800	800		
Perch, yellow							1,875	150
Pigfish, fresh	48,000	4,800	12,000	425				
Pinfish, or sailor's choice	6,000	600						
Pompano	2,300	345	500	100				
Sea bass	50,000	5,000	200	25				
Shad	38,600	11,275			20,250	3,750	134,600	26,920
Sheepshead	5,000	600	700	35	850	50		
Spanish mackerel	1,500	225	300	30	1,100	110		
Spot, fresh	31,000	2,350	77,050	3,865	1,250	50		
Squeteagues, or "sea trout":								
Fresh	13,500	1,765	103,896	9,258	198,950	5,445		
Salted					80	10		
Striped bass							9,250	1,870
Sturgeon	3,500	420						
Sturgeon caviar	10	10						
Yellowtail	3,000	180			170	5		
Shrimp	120,000	3,000						
Crabs, hard	665	35						
Terrapin			150	35				
Turtles	400	20						
Clams, hard	48,000	14,500	16,800	4,645				
Oysters, market:								
Public	10,500	600	24,150	3,750	402,367	18,490		
Private			14,700	2,500	3,500	400		
Scallops			7,260	850				
Total	80,865,575	847,503	727,830	55,043	741,132	31,550	335,025	32,340

Item.	Pender.		Tyrrell.		Washington.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing							1,295	
On vessels transporting							54	
In shore fisheries	264		89		156		4,903	
Shoresmen			26		27		1,784	
Total	264		115		183		8,036	
INVESTMENT.								
Vessels fishing:								
Steam							15	$807,315
Tonnage							1,791	
Outfit								246,685
Gasoline							55	413,710
Tonnage							1,258	
Outfit								166,360
Sail							48	28,700
Tonnage							388	
Outfit								9,745
Vessels transporting:								
Gasoline							25	24,600
Tonnage							197	
Outfit								13,775
Sail							12	9,700
Tonnage							92	
Outfit								4,450

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Pender.		Tyrrell.		Washington.		Total.	
INVESTMENT—continued.								
Boats:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Sail, row, etc	182	$1,350	14	$237	42	$827	1,727	38,053
Power	3	600	37	4,915	36	5,645	1,357	269,720
Apparatus, vessel fisheries:								
Purse seines							57	156,727
Gill nets							13	800
Lines								50
Otter trawls							2	100
Dredges							86	2,655
Tongs							22	100
Apparatus, shore fisheries:								
Haul seines	8	985			3	3,400	440	41,533
Purse seines							3	1,600
Gill nets	34	830	164	1,680	174	4,676	14,299	108,878
Pound nets			116	9,527	125	10,505	3,779	355,439
Fyke nets			70	1,005	8	130	591	6,230
Lines		20						333
Otter trawls							27	960
Dredges							550	2,648
Tongs and rakes	210	126					1,008	2,046
Eel pots							1,585	1,329
Other apparatus	30	30			3	5	496	1,108
Shore and accessory property		2,100		1,215				1,347,644
Cash capital								159,050
Total		6,041		18,579		25,188		4,222,043
PRODUCTS.								
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh			762,350	$10,417	918,100	$51,859	8,739,944	$238,624
Salted			1,151,383	27,623	820,991	33,021	5,743,876	162,595
Angel fish							8,975	340
Black bass							551,125	63,137
Bluefish	650	$51					322,744	29,677
Bonito							3,015	107
Bowfin							34,372	319
Butterfish							731,257	24,785
Carp					2,428	170	153,169	5,619
Catfish	1,000	30	6,350	381	14,347	736	304,509	9,783
Cero and king fish	300	23					211,781	13,947
Crappie			4,700	470			5,340	568
Crevalle							204	11
Croaker	7,300	304					386,807	11,912
Drum, red and black	6,300	420					99,546	3,246
Eels					2,310	231	174,541	13,333
Flounders	17,200	2,030			650	52	91,121	7,022
Gizzard shad					525	21	44,525	1,154
Grunts							15,000	1,150
Hickory shad					14,642	1,757	158,443	13,388
Menhaden							179,910,599	1,306,489
Mullet:								
Fresh	131,700	11,250					812,679	52,734
Salted	25,500	2,690					315,350	38,341
Perch:								
White			8,896	838	31,650	3,110	617,088	31,150
Yellow							223,813	10,147
Pigfish:								
Fresh	10,700	821					264,272	12,675
Salted							3,125	63
Pike							20,552	1,898
Pinfish, or sailor's choice							50,179	1,225
Pompano							8,685	994
Sea bass	800	70					111,650	10,928
Shad	1,000	275	1,750	350	65,389	12,885	1,657,036	376,696
Sheepshead							26,223	1,839
Spanish mackerel							149,440	14,270
Spot:								
Fresh	203,300	11,450					1,193,270	52,531
Salted	3,000	335					42,825	3,768
Squeteagues, or "sea trout":								
Fresh	23,800	2,770					3,361,246	209,483
Salted							80	10
Striped bass			1,975	475	6,450	1,290	286,528	46,030
Sturgeon							6,916	974
Sturgeon caviar							671	1,497
Suckers					2,750	165	16,464	680
Sunfish							123,980	1,202

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Pender.		Tyrrell.		Washington.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
PRODUCTS—continued.								
Tautog							150	$9
Yellowtail	20,000	$965					31,278	1,379
Shrimp							940,120	23,485
Crabs:								
Hard							[1] 145,605	1,983
Soft							[2] 233,705	23,821
Terrapin							210	92
Turtles							8,400	77
Clams, hard	35,200	9,800					[3] 197,576	46,598
Oysters, market:								
Public	14,000	1,000					[4] 1,500,534	67,380
Private							[5] 18,200	2,900
Scallops							[6] 422,832	31,618
Shark hides							19,125	2,868
Other aquatic hides							1,050	157
Total	501,750	44,284	1,937,404	$40,554	1,880,232	$105,297	210,501,750	2,978,708

[1] 436,815 in number.
[2] 701,115 in number.
[3] 24,697 bushels.
[4] 214,362 bushels.
[5] 2,600 bushels.
[6] 70,472 bushels.

FISHERIES BY APPARATUS.

In the vessel fisheries of North Carolina, in which seven counties are represented, the forms of apparatus in use included purse seines, gill nets, lines, otter trawls, oyster dredges, and oyster tongs. The total yield from all forms of apparatus used on vessels was 179,072,191 pounds, valued at $1,355,684. The catch with purse seines amounted to 178,101,814 pounds, valued at $1,305,057, of which 177,868,599 pounds, valued at $1,297,582, were menhaden. Other of the more important species taken in purse seines included mullet, 71,165 pounds, valued at $2,630; croakers, 57,000 pounds, valued at $1,765; and spots, 69,300 pounds, valued at $1,385. Gill-net fishing yielded 83,300 pounds of fish, chiefly squeteague, croaker, kingfish, and bluefish, valued at $6,265, and was prosecuted only from vessels operating in Carteret County. The catch of sea bass with lines was 47,500 pounds, valued at $4,725. Shrimp were taken with otter trawls to the amount of 10,000 pounds, valued at $300; oysters with dredges, 725,218 pounds, or 103,603 bushels, valued at $34,912; and oysters with tongs, 104,359 pounds, or 14,908 bushels, valued at $4,425.

In the shore or boat fisheries pound nets were the most productive form of apparatus, the catch amounting to 16,233,529 pounds, valued at $683,292. The catch of alewives in pound nets amounted to 12,254,728 pounds, valued at $301,577, or 75 per cent in quantity and 44 per cent in value of the total take by this form of gear. Other species of importance were squeteagues, shad, and butterfish. The catch with seines in the shore fisheries amounted to 6,028,340 pounds, valued at $340,795, of which 5,605,300 pounds, valued at $332,938, were taken in haul seines, the remainder being credited to purse seines. Among the more important species taken in haul seines were alewives, 1,589,037 pounds, valued at $66,825; black bass, 533,364 pounds, valued at $60,977; and mullet, 667,065 pounds, valued at $53,559. The yield by gill nets, which was slightly less in quantity and exceeded in value that of seines, amounted to 5,995,917 pounds, valued at $386,224. The principal varieties in the order of their value were shad, squeteague, mullet, and spot. The take with tongs, rakes, and hands totaled 767,262 pounds, valued at $72,455, and with the exception of an incidental catch of scallops and terrapin was made up of oysters and clams. Various species were taken with scoop, dip, and bow nets, amounting to 364,383 pounds, valued at $34,046; with lines, amounting to 386,010 pounds, valued at $23,258; with fyke nets, amounting to 283,629 pounds, valued at $11,375; and by stop nets, amounting to 10,840 pounds, valued at $605. The catch with otter trawls, confined almost entirely to shrimp, was 592,580 pounds, valued at $15,149; of scallops and oysters with dredges, 542,363 pounds, valued at $36,761; of eels with pots, 161,046 pounds, valued at $12,309; of soft crabs with drags, 38,660 pounds, valued at $3,725, and of flounders with gigs, 25,000 pounds, valued at $3,030. The total yield from all forms of apparatus used in the shore or boat fisheries was 31,429,559 pounds, valued at $1,623,024. The products of the vessel and shore fisheries are shown separately by counties in the appended tables.

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Dare.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:								
Bluefish					4,100	$240		
Butterfish					1,750	70		
Croaker					57,000	1,765		
Drum					650	25		
Kingfish					250	10		
Menhaden			9,300,000	$33,325	88,190,799	471,305		
Mullet					71,165	2,630		
Spanish mackerel					500	50		
Spots					69,300	1,385		
Squeteague					28,500	1,300		
Total			9,300,000	33,325	88,424,014	478,780		
Gill nets:								
Bluefish					4,800	415		
Butterfish					1,200	60		
Croaker					13,000	420		
Kingfish					8,700	502		
Pigfish					2,600	83		
Spots					1,000	30		
Squeteague					52,000	4,755		
Total					83,300	6,265		
Lines: Sea bass					47,500	4,725		
Otter trawls: Shrimp			10,000	300				
Dredges: Oysters, market, public	43,610	$3,300			420,175	18,702	10,000	$750
Tongs: Oysters, market, public					93,359	3,675	11,000	750
Grand total	43,610	3,300	9,310,000	33,625	89,068,348	512,147	21,000	1,500

YIELD OF VESSEL FISHERIES OF NORTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Hyde.		New Hanover.		Pamlico.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:								
Bluefish							4,100	$240
Butterfish							1,750	70
Croaker							57,000	1,765
Drum							650	25
Kingfish							250	10
Menhaden			80,377,800	$792,952			177,868,599	1,297,582
Mullet							71,165	2,630
Spanish mackerel							500	50
Spots							69,300	1,385
Squeteague							28,500	1,300
Total			80,377,800	792,952			178,101,814	1,305,057
Gill nets:								
Bluefish							4,800	415
Butterfish							1,200	60
Croaker							13,000	420
Kingfish							8,700	502
Pigfish							2,600	83
Spots							1,000	30
Squeteague							52,000	4,755
Total							83,300	6,265
Lines: Sea bass							47,500	4,725
Otter trawls: Shrimp							10,000	300
Dredges: Oysters, market, public	7,000	$500			244,433	$11,660	725,218	34,912
Tongs: Oysters, market, public							104,359	4,425
Grand total	7,000	500	80,377,800	792,952	244,433	11,660	179,072,191	1,355,684

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Currituck.		Craven.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value*
Purse seines:										
Menhaden					300,000	$1,500				
Shrimp					105,040	1,857				
Total					405,040	3,357				
Haul seines:										
Alewives—										
Fresh	137,365	$2,970					86,653	$1,835	22,600	$715
Salted							121,000	1,694		
Black bass	10,111	1,343					490,089	55,654		
Bluefish					7,400	$632			700	42
Bowfin							25,979	242		
Butterfish					2,850	117				
Carp							123,472	4,631		
Catfish	37,608	953					72,661	1,476		
Croaker					36,325	1,093	13,600	354	2,700	60
Drum					19,265	950				
Eels	1,512	45								
Flounders					825	57	1,600	80	250	16
Gizzard shad							9,371	97		
Hickory shad	14,060	1,272							5,000	250
Kingfish					38,700	2,767	10,960	548		
Mullet—										
Fresh			21,200	$1,700	267,465	13,009				
Salted			163,900	19,450						
Perch, white	3,845	356					303,514	11,927	1,400	112
Perch, yellow	38,728	2,655					101,753	3,986		
Pigfish					13,419	333			200	5
Pike	11,013	1,032					4,467	409		
Pinfish					5,000	88			3,000	50
Pompano					790	95			50	6
Shad	26,600	4,787					24,000	4,000	2,060	535
Sheepshead					6,325	355				

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Currituck.		Craven.	
Haul seines—Con.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Spanish mackerel					4,405	$445				
Spot—										
Fresh	5,148	$255	4,600	$360	181,870	6,835			14,500	$780
Salted			21,700	2,170						
Squeteague	164,283	5,822	100	10	52,250	3,427	25,400	$1,854	16,000	1,160
Striped bass	5,894	793					15,111	1,533	5,500	440
Suckers	4,890	124								
Sunfish							104,422	1,026		
Yellowtail					1,500	42				
Crabs, soft					90,009	9,020				
Shrimp					117,000	3,254				
Turtles					2,000	11				
Total	461,057	22,407	211,500	23,690	847,398	42,530	1,534,052	91,346	73,960	4,171
Total, by seines	461,057	22,407	211,500	23,690	1,252,438	45,887	1,534,052	91,346	73,960	4,171

Apparatus and species.	Dare.		Hertford.		Hyde.		Martin.		Onslow.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines: Striped bass	18,000	$4,500								
Haul seines:										
Alewives—										
Fresh			54,219	$1,301			30,000	$1,500		
Salted							25,000	1,200		
Black bass	33,164	$3,980								
Bluefish	31,914	3,474			835	$100			2,000	$175
Butterfish									1,000	100
Catfish	900	14					630	38		
Croaker	11,151	540							4,300	122
Drum	19,066	585							3,000	22
Flounders									300	25
Kingfish	6,000	300							4,000	275
Mullet—										
Fresh									36,000	2,490
Salted									35,500	3,970
Perch, white	41,958	1,679	792	48			1,000	80		
Perch, yellow	13,986	559								
Pigfish	22,428	1,061			375	15			3,000	75
Pinfish	22,049	322								
Pompano	808	45							500	100
Shad			125	25						
Sheepshead	120	10							400	20
Spanish mackerel	5,100	280							300	30
Spot—Fresh	33,453	1,620			375	15			21,800	605
Squeteague	315,620	26,645			2,300	225			9,400	660
Striped bass	5,168	469								
Total	562,915	41,583	55,136	1,374	3,885	355	56,630	2,818	121,500	8,669
Total, by seines	580,915	46,083	55,136	1,374	3,885	355	56,630	2,818	121,500	8,669

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

Apparatus and species.	New Hanover.		Pender.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:								
Menhaden							300,000	$1,500
Striped bass							18,000	4,500
Shrimp							105,040	1,857
Total							423,040	7,857
Haul seines:								
Alewives—								
Fresh					600,000	$30,000	930,837	38,321
Salted					512,200	25,610	658,200	28,504
Black bass							533,364	60,977
Bluefish	500	$62	150	$13			43,529	4,498
Bowfin							25,979	242
Butterfish							3,850	217
Carp							123,472	4,631
Catfish	500	15	1,000	30	1,267	76	114,566	2,602
Croaker			6,100	244			74,176	2,413
Drum			5,500	380			46,831	1,937
Eels							1,512	45
Flounders	200	30	4,200	290			7,375	498
Gizzard shad							9,371	97
Hickory shad							19,060	1,522
Kingfish	1,500	187					61,160	4,077
Mullet—								
Fresh	20,000	1,750	102,500	9,000			447,165	27,949
Salted			20,500	2,190			219,900	25,610
Perch, white					2,000	160	354,509	14,362
Perch, yellow							154,467	7,200
Pigfish			8,150	633			47,572	2,122
Pike							15,480	1,441
Pinfish							30,049	460
Pompano	2,300	345					4,448	591
Shad					20,800	4,160	73,585	13,507
Sheepshead							6,845	385
Spanish mackerel							9,805	755
Spot—								
Fresh	19,000	1,450	178,200	9,940			458,946	21,860
Salted			3,000	335			24,700	2,505
Squeteague	3,500	465	21,200	2,485			610,053	42,753
Striped bass							31,673	3,235
Suckers							4,890	124
Sunfish							104,422	1,026
Yellowtail	3,000	180	20,000	965			24,500	1,187
Crabs, soft							90,009	9,020
Shrimp	120,000	3,000					237,000	6,254
Turtles							2,000	11
Total	170,500	7,484	370,500	26,505	1,136,267	60,006	5,605,300	332,938
Total, by seines	170,500	7,484	370,500	26,505	1,136,267	60,006	6,028,340	340,795

BY GILL NETS.

Species.	Beaufort.		Bladen.		Brunswick.		Camden.		Carteret.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives: Fresh									45,000	$2,380
Bluefish									242,455	22,068
Bonito									1,015	27
Butterfish									8,975	452
Cero									1,758	95
Croaker					300	$9			167,201	5,120
Drum									10,250	320
Flounders					2,300	108			1,475	83
Hickory shad									16,908	1,169
Kingfish					1,100	110			100,213	7,106
Menhaden									1,740,000	7,395
Mullet:										
Fresh					6.000	400			67,225	4,165
Salted					50,000	6,000			22,500	4,000
Pigfish: Fresh									128,550	4,250
Pinfish									13,380	150
Pompano									1,353	147
Shad	10,440	$1,740	3,990	$1,140	2,050	425	17,800	$4,450	16,124	4,792
Sheepshead					300	18			9,264	538
Spanish mackerel									98,575	9,757
Spot:										
Fresh					3,500	130			538,395	22,293
Salted					15,000	1,200				
Squeteague: Fresh					6,000	500			1,121,527	95,152
Striped bass					1,000	100			25	3
Yellowtail									6,608	187
Shark hides									19,125	2,868
Other aquatic hides									11,050	2,157
Shrimp									5,500	220
Turtles					500	13			2,000	13
Total	10,440	1,740	3,990	1,140	88,050	9,013	17,800	4,450	4,386,451	194,907

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY GILL NETS—Continued.

Species.	Chowan.		Columbus.		Craven.		Currituck.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:								
Fresh	4,750	$120						
Salted	1,900	48						
Catfish					1,100	$22		
Croaker					350	17		
Flounders					250	15		
Hickory shad	15,010	1,900			10,940	690		
Mullet: Fresh					17,400	1,395		
Perch: White					1,400	140		
Shad	79,792	17,404	1,575	$450	9,288	2,433	13,284	$2,214
Spot: Fresh					4,500	194		
Squeteague: Fresh					910	83		
Striped bass	7,980	1,596			500	50	250	50
Total	109,432	21,068	1,575	450	46,638	5,039	13,534	2,264

Species.	Dare.		Gates.		Hertford.		Hyde.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives: Fresh			21,688	$347				
Bluefish	15,000	$1,200					6,600	$748
Drum	16,500	210					250	3
Flounders							225	11
Kingfish							835	50
Mullet: Salted							650	169
Pigfish:								
Fresh	15,000	600					500	25
Salted	3,125	63						
Pinfish	750	15						
Shad	151,634	43,512			125	$25	38,961	6,202
Sheepshead	714	50						
Spanish mackerel	1,000	50					85	10
Spot:								
Fresh	15,000	600					2,500	125
Salted	3,125	63						
Squeteague: Fresh	6,667	500					14,500	1,114
Sturgeon	1,337	328						
Sturgeon caviar	311	697						
Total	230,163	47,888	21,688	347	125	25	65,166	8,457

Species.	New Hanover.		Onslow.		Pamlico.		Pender.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives: Fresh	15,000	$1,200	177,507	$6,250				
Bluefish			3,400	280				
Butterfish					250	$10		
Croaker			9,050	230	1,250	50	400	$30
Drum					5,000	60		
Eels			1,645	164				
Flounders	100	15						
Hickory shad	5,000	400						
Kingfish	200	25	18,250	1,220			300	23
Mullet:								
Fresh	12,000	1,000	157,024	12,465	4,000	400	29,200	2,250
Salted			11,500	1,262	5,800	800	5,000	500
Pigfish: Fresh	3,000	300	9,000	350			50	3
Shad	38,600	11,275					1,000	275
Sheepshead			300	15	850	50		
Spanish mackerel	1,500	225			100	10		
Spot: Fresh	12,000	900	55,250	3,260	1,250	50	25,100	1,510
Squeteague:								
Fresh			94,451	8,593	21,850	1,315	600	45
Salted					80	10		
Sturgeon	3,500	420						
Sturgeon caviar	10	10						
Yellowtail					170	5		
Terrapin			150	35				
Total	90,910	15,770	537,527	34,124	40,600	2,760	61,650	4,636

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY GILL NETS—Continued.

Species.	Perquimans.		Tyrrell.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:								
Fresh	68,000	$1,360			36,500	$815	368,445	$12,472
Salted	13,000	130					14,900	178
Bluefish							267,515	24,296
Bonito							1,015	27
Butterfish							9,225	462
Carp					71	5	71	5
Catfish					300	15	1,400	37
Cero							1,758	95
Croaker							178,551	5,456
Drum							32,000	593
Eels							1,645	164
Flounders							4,350	232
Hickory shad					6,125	735	53,983	4,894
Kingfish							120,898	8,534
Menhaden							1,740,000	7,395
Mullet:								
Fresh							292,849	22,075
Salted							95,450	12,731
Perch:								
White							1,400	140
Yellow	625	50					625	50
Pigfish:								
Fresh							156,100	5,528
Salted							3,125	63
Pinfish							14,130	165
Pompano							1,353	147
Shad	109,600	21,920	875	$175	26,844	5,253	521,982	123,685
Sheepshead							11,428	671
Spanish mackerel							101,260	10,052
Spot:								
Fresh							657,495	29,062
Salted							18,125	1,263
Squeteague:								
Fresh							1,266,505	107,302
Salted							80	10
Striped bass	7,250	1,450	988	238			17,993	3,487
Sturgeon							4,837	748
Sturgeon caviar							321	707
Yellowtail							6,778	192
Shark hides							19,125	2,868
Other aquatic hides							1,050	157
Shrimp							5,500	220
Terrapin							150	35
Turtles							2,500	26
Total	198,475	24,910	1,863	413	69,840	6,823	5,995,917	386,224

BY POUND NETS.

Species.	Beaufort.		Bertie.		Carteret.		Chowan.		Currituck.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:										
Fresh	189,500	$3,790	211,845	$4,209	30,636	$1,394	4,742,768	$98,295	49,305	$2,250
Salted			216,939	5,906			3,228,125	87,720	12,083	446
Angelfish					3,800	155				
Bluefish					1,000	90				
Bonito					2,000	80				
Butterfish	70,009	4,128			57,224	3,680				
Catfish	6,400	160	982	20			62,727	2,218	8,125	375
Cero					500	50				
Crevalle					204	11				
Croaker					45,500	1,355				
Drum					2,000	37				
Eels	835	25					6,860	549		
Flounders	5,800	348			2,550	148			3,348	250
Gizzard shad							34,629	1,036		
Hickory shad	2,700	243	628	31	6,703	280	43,273	3,932		
Kingfish					1,750	85				
Menhaden					2,000	12				
Perch:										
White	2,785	257	2,261	121			72,890	6,333	7,249	319
Yellow	1,757	123							2,416	106
Pigfish					600	18				
Pike							294	28		
Pompano	750	60			625	90				
Shad	43,017	7,743	5,366	1,182	37,870	8,961	93,680	17,332	13,812	3,125
Sheepshead					1,000	60				
Spanish mackerel					6,850	620				
Spot					2,000	60				
Squeteague	150,609	4,912			288,019	14,314				
Striped bass	18,807	2,633	333	50	970	130	9,898	1,981	34,063	5,313
Sturgeon					540	27				
Suckers			131	8			8,693	383		
Turtles					3,500	20				
Total	492,969	24,422	437,585	11,527	497,841	31,677	8,303,837	219,807	130,401	12,184

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS—Continued.

Species.	Craven.		Dare.		Gates.		Hertford.		Hyde.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:										
Fresh	200	$10	777,636	$36,700	52,000	$832	162,656	$3,904	87,706	$3,054
Salted			128,355	4,547						
Angelfish	50	2							5,125	183
Black bass			3,686	442						
Butterfish	30,000	1,200	437,473	12,345					39,626	978
Catfish	100	2	33,081	1,631					2,560	64
Caviar			350	790						
Croaker			5,387	186					1,993	43
Drum									1,100	11
Eels									333	10
Flounders	100	4	19,567	977					10,556	383
Hickory shad	1,000	50	7,467	684					15,112	730
Kingfish			11,815	420					2,500	69
Perch:										
White	300	30	29,701	1,195			792	48	3,078	277
Yellow			9,900	399					700	49
Pigfish									2,250	55
Pompano	25	2	204	12					1,280	92
Shad	2,665	665	729,636	175,760	600	120			70,866	12,194
Spanish mackerel	250	200	21,873	1,761					2,902	232
Spot	300	15	629	12					450	10
Squeteague	20,000	800	578,951	20,555					133,164	3,648
Striped bass	375	75	125,572	18,167					10,829	1,509
Sturgeon			1,539	199						
Total	55,365	3,055	2,922,822	276,782	52,600	952	163,448	3,952	392,130	23,591

Species.	Pamlico.		Perquimans.		Tyrrell.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:										
Fresh	3,750	$125	82,000	$1,640	762,350	$10,417	31,600	$1,044	7,183,952	$167,664
Salted			26,000	260	1,151,383	27,623	308,791	7,411	5,070,776	133,913
Angelfish									8,975	340
Black bass									3,686	442
Bluefish									1,000	90
Bonito									2,000	80
Butterfish	80,900	1,645							715,232	23,976
Carp							2,357	165	2,357	165
Catfish					6,350	381	12,180	609	132,505	5,460
Caviar									350	790
Cero									500	50
Crevalle									204	11
Croaker	5,000	100							57,880	1,684
Drum	6,665	50							9,765	98
Eels							2,310	231	10,338	815
Flounders							650	52	42,571	2,162
Gizzard shad							525	21	35,154	1,057
Hickory shad							8,517	1,022	85,400	6,972
Kingfish									16,065	574
Menhaden									2,000	12
Perch:										
White					8,896	838	28,900	2,890	156,852	12,308
Yellow			1,250	100					16,023	777
Pigfish									2,850	73
Pike									294	28
Pompano									2,884	256
Shad	20,250	3,750	25,000	5,000	875	175	17,745	3,472	1,061,382	239,479
Sheepshead									1,000	60
Spanish mackerel	1,000	100							32,875	2,913
Spot									3,379	97
Squeteague	177,100	4,130							1,347,843	48,359
Striped bass			2,000	400	987	237	6,450	1,290	210,284	31,785
Sturgeon									2,079	226
Suckers							2,750	165	11,574	556
Turtles									3,500	20
Total	294,665	9,900	136,250	7,400	1,930,841	39,671	422,775	18,372	16,233,529	683,292

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY FYKE NETS.

Species.	Camden.		Currituck.		Gates.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives			6,710	$167		
Black bass			14,075	1,718		
Bowfin			8,393	77		
Carp			27,269	818		
Catfish	2,400	$120	35,226	528	312	$25
Crappie					340	68
Perch:						
White	2,300	230	101,277	4,050		
Yellow			52,386	2,095	312	25
Pike			4,778	429		
Striped bass			1,943	253		
Sunfish			19,558	176		
Total	4,700	350	271,615	10,311	964	118

Species.	Perquimans.		Tyrrell.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives							6,710	$167
Black bass							14,075	1,718
Bowfin							8,393	77
Carp							27,269	818
Catfish					600	$36	38,538	709
Crappie	300	$30	4,700	$470			5,340	568
Perch:								
White					750	60	104,327	4,340
Yellow							52,698	2,120
Pike							4,778	429
Striped bass							1,943	253
Sunfish							19,558	176
Total	300	30	4,700	470	1,350	96	283,629	11,375

BY STOP NETS.

Species.	Brunswick.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*
Croaker	200	$9	200	$9
Drum	1,500	73	1,500	73
Flounders	4,500	265	4,500	265
Kingfish	150	8	150	8
Mullet	1,500	80	1,500	80
Pigfish	150	9	150	9
Sheepshead	1,500	88	1,500	88
Squeteague	500	$34	500	$34
Tautog	150	9	150	9
Crabs:				
Hard	650	20	650	20
Soft	40	10	40	10
Total	10,840	605	10,840	605

BY LINES.

Apparatus and species.	Brunswick.		Carteret.		Dare.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Hand lines:						
Bluefish			1,300	$100		
Croaker			4,200	110		
Flounders			325	25		
Pigfish			7,500	175		
Sea bass	1,000	$70	12,150	1,038		
Sheepshead			450	35		
Spanish mackerel			5,000	500		
Spot	150	7				
Squeteague			41,800	3,375		
Total	1,150	77	72,725	5,358		
Trot lines: Crabs, hard					142,290	$1,778
Total, by lines	1,150	77	72,725	5,358	142,290	1,778

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES—Continued.

Apparatus and species.	New Hanover.		Onslow.		Pender.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Hand lines:								
Bluefish					500	$38	1,800	$138
Croaker					800	30	5,000	140
Drum	8,000	$480			800	40	8,800	520
Flounders	5,900	750					5,325	775
Grunt	15,000	1,150					15,000	1,150
Kingfish	300	37					300	37
Pigfish	45,000	4,500			2,500	185	55,000	4,860
Sailor's choice	6,000	600					6,000	600
Sea bass	50,000	5,000	200	$25	800	70	64,150	6,203
Sheepshead	5,000	600					5,450	635
Spanish mackerel							5,000	500
Spot							150	7
Squeteague	10,000	1,300	45	5	2,000	240	53,845	4,920
Turtles	400	20					400	20
Total	144,700	14,437	245	30	7,400	603	226,220	20,565
Set lines: Catfish	17,500	975					17,500	975
Trot lines: Crabs, hard							142,290	1,778
Total, by lines	162,200	15,412	245	30	7,400	603	386,010	23,258

BY OTTER TRAWLS.

Species.	Brunswick.		Carteret.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Croaker	1,000	$25			1,000	$25
Flounders	2,000	60			2,000	60
Kingfish	2,000	60			2,000	60
Spots	3,000	90			3,000	90
Squeteague	2,000	60			2,000	60
Shrimp	360,000	10,800	222,580	$4,054	582,580	14,854
Total	370,000	11,095	222,580	4,054	592,580	15,149

BY DREDGES AND CRAB DRAGS.

Apparatus and species.	Beaufort.		Carteret.		Hyde.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Oyster dredges: Oysters, market, public	20,405	$1,165			7,000	$400
Scallop dredges: Scallops			404,448	$29,726		
Total	20,405	1,165	404,448	29,726	7,000	400
Crab drags: Crabs, soft			38,660	3,725		

Apparatus and species.	Onslow.		Pamlico.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Oyster dredges: Oysters, market, public			103,250	$4,620	130,655	$6,185
Scallop dredges: Scallops	7,260	$850			411,708	30,576
Total	7,260	850	103,250	4,620	542,363	36,761
Crab drags: Crabs, soft					38,660	3,725

YIELD OF SHORE FISHERIES OF NORTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS, RAKES, AND HAND.

Apparatus and species.	Beaufort.		Brunswick.		Carteret.		Dare.		Hyde.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Tongs:										
Clams, hard	....	......	4,000	$750	3,000	$845	....	......	....	......
Oysters, market, public	1,400	$100	....	......	275,884	7,368	39,900	$2,850	24,500	$1,300
Total	1,400	100	4,000	750	278,884	8,213	39,900	2,850	24,500	1,300
Rakes:										
Clams, hard	....	......	40,000	7,600	43,576	7,127	6,400	1,200	....	......
Scallops	....	......	....	......	900	105	....	......	....	......
Total	....	......	40,000	7,600	44,476	7,232	6,400	1,200	....	......
Hand:										
Clams, hard	....	......	....	......	600	131	....	......	....	......
Oysters, market, public	....	......	4,725	500	90,559	2,180	....	......	....	......
Scallops	....	......	....	......	10,224	937	....	......	....	......
Terrapin	....	......	....	......	60	57	....	......	....	......
Total	....	......	4,725	500	101,443	3,305	....	......	....	......

Apparatus and species.	New Hanover.		Onslow.		Pamlico.		Pender.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Tongs:										
Clams, hard	....	......	2,000	$485	....	......	....	......	9,000	$2,080
Oysters, market—										
Public	....	......	18,025	3,050	54,684	$2,210	....	......	414,393	16,878
Private	....	......	14,700	2,500	3,500	400	....	......	18,200	2,900
Total	....	......	34,725	6,035	58,184	2,610	....	......	441,593	21,858
Rakes:										
Clams, hard	48,000	$14,500	3,600	1,010	....	......	35,200	$9,800	176,776	41,237
Oysters, market, public	....	......	....	......	....	......	7,000	500	7,000	500
Scallops	....	......	....	......	....	......	....	......	900	105
Total	48,000	14,500	3,600	1,010	....	......	42,200	10,300	184,676	41,842
Hand:										
Clams, hard	....	......	11,200	3,150	....	......	....	......	11,800	3,281
Oysters, market, public	10,500	600	6,125	700	....	......	7,000	500	118,909	4,480
Scallops	....	......	....	......	....	......	....	......	10,224	937
Terrapin	....	......	....	......	....	......	....	......	60	57
Total	10,500	600	17,325	3,850	....	......	7,000	500	140,993	8,755

BY POTS AND GIGS.

Apparatus and species.	Beaufort.		Carteret.		Craven.		Currituck.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Pots: Eels	36,817	$1,006	1,500	$150	500	$40	112,581	$10,268
Gigs: Flounders	....	....	3,000	230	....	....	....	....

Apparatus and species.	Dare.		New Hanover.		Onslow.		Pender.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value*	*Pounds.*	*Value.*
Pots: Eels	8,000	$680	....	......	1,648	$165	....	......	161,046	$12,309
Gigs: Flounders	....	......	5,000	$750	4,000	310	13,000	$1,740	25,000	3,030

Yield of Shore Fisheries of North Carolina in 1918, by Apparatus, Counties, and Species—Continued.

BY SCOOP, DIP, AND BOW NETS.

Apparatus and species.	Bladen.		Carteret.		Halifax.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Scoop and dip nets:						
Shad	87	$25				
Crabs—						
Hard			2,000	$150		
Soft			101,996	11,066		
Total	87	25	106,996	11,216		
Bow nets: Striped bass					6,635	$2,770

Apparatus and species.	New Hanover.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Scoop and dip nets:						
Alewives			250,000	$20,000	250,000	$20,000
Shad					87	25
Crabs—						
Hard	665	$35			2,665	185
Soft					101,996	11,066
Total	665	35	250,000	20,000	357,718	31,276
Bow nets: Striped bass					6,635	2,770

INDUSTRIES.

Menhaden industry.—In 1918 there were 21 factories in operation as compared with 9 in 1902 and 6 in 1897. These 21 factories were valued at $905,436, employing cash capital to the amount of $66,800, and gave employment to 599 persons, to whom $260,037 were paid in wages. These plants handled 179,910,599 pounds of menhaden, valued at $1,306,489. Manufactured products included 979,068 gallons of oil, valued at $761,588, of which 720 gallons, valued at $540, was shark oil; and 23,088 tons of dried and acidulated scrap, valued at $1,290,614. Other by-products of the fisheries of the State included 3,100 tons of ground oyster shells, valued at $18,600, and 20,175 pounds of shark and other aquatic hides, valued at $3,025, the total value of by-products being $2,073,827.

Wholesale trade.—In 1918 there were 46 wholesale fishery establishments in the coastal region of North Carolina handling fresh and salt fish, oysters, clams, and other fishery products, valued at $158,950, with a cash capital amounting to $61,750, and engaging 208 persons to whom $85,475 were paid in wages.

Canning industry.—There were 8 establishments, valued at $130,715, engaged in canning fishery products and the crushing of oyster shells, employing working capital to the amount of $30,500, and engaging 500 persons to whom $49,100 were paid in wages. The products included canned oysters to the value of $112,334; canned shrimp to the value of $39,576; canned alewife or river herring roe to the value of $4,070; canned redfish or red drum to the value of $450; 392,667 pounds of salted alewives or river herring to the value of $7,068; and 3,100 tons of crushed oyster shells to the value of $18,600. The important features of each of the above shore industries are shown in the appended tables.

INDUSTRIES OF NORTH CAROLINA IN 1918.

MENHADEN INDUSTRY.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments	21	$905,436	PRODUCTS.		
Cash capital		66,800			
Persons engaged	599		Oil .... gallons	[1] 979,068	$761,588
Wages paid		260,037	Dry scrap .... tons	9,488	674,850
			Acidulated scrap .... do	13,600	615,764

WHOLESALE TRADE IN FRESH AND SALTED FISH, OYSTERS, CLAMS, SCALLOPS, AND CRABS.

Establishments	46	$158,950	Persons engaged	208	
Cash capital		61,750	Wages paid		$85,475

PREPARED FISHERY PRODUCTS AND CERTAIN BY-PRODUCTS.

Establishments	8	$130,715	Shrimp, canned:		
Cash capital		30,500	No. 1 cans .... cases	[3] 9,200	$38,256
Persons engaged	500		No. 1½ cans .... do	[1] 550	1,320
Wages paid		49,100	Total		39,576
PRODUCTS.					
Oysters, canned:			Alewife roe, canned: No. 2 cans .... cases	[2] 1,100	4,070
4-ounce cans .... cases	[2] 724	1,665			
Do .... do	[3] 1,700	8,500	Redfish, canned: No. 2 cans .... cases	[2] 200	450
5-ounce cans .... do	[2] 23,389	45,034	Alewives, salted .... pounds	392,667	7,068
Do .... do	[3] 5,000	26,500	Oyster shells, crushed (agricultural lime) .... pounds	6,200,000	18,600
8-ounce cans .... do	[2] 526	2,420			
10-ounce cans .... do	[2] 5,643	28,215			
Total		112,334			

[1] Includes 720 gallons of shark oil, valued at $540.
[2] Two dozen cans per case.
[3] Four dozen cans per case.

FISHERIES OF SOUTH CAROLINA.

The coastal fisheries of South Carolina are less extensive than those of the other South Atlantic States, the products representing only 1.13 per cent of the total quantity and 3.88 per cent of the total value for the region. In 1918 the number of persons employed in the fisheries of this State was 2,000, of whom 103 were on fishing vessels, 20 on vessels transporting fishery products, 1,121 in the shore and boat fisheries, and 756 shoresmen in the wholesale fish establishments and other fishery industries. Compared with 1902, there has been a decrease of 1,713 persons, or 46.14 per cent.

The total investment of the fisheries of the State was $221,251. This included 43 fishing and transporting vessels, valued at $39,000, of a net tonnage of 505 tons, and with outfits valued at $7,840; 690 boats, valued at $36,410; fishing apparatus used on vessels and boats to the value of $22,126; shore and accessory property worth $95,775, and working cash capital to the value of $20,100.

The total yield of the fisheries in 1918 was 3,746,932 pounds, valued at $207,690, representing a decrease as compared with 1902 of 4,427,531 pounds, or 54.16 per cent in quantity, and $55,333, or 21.03 per cent in value. The five most important species arranged in order of value were as follows: Oysters, 2,783,830 pounds, or 397,690 bushels, valued at $96,542; shad, 167,462 pounds, valued at $29,085;

sturgeon, including sturgeon caviar, 117,890 pounds, valued at $22,025; mullet, fresh and salted, 200,750 pounds, valued at $19,129; and sea bass, 132,000 pounds, valued at $13,200. Compared with 1902, there has been a decrease in the take of oysters of 292,010 bushels; of shad, of 266,671 pounds; an increase in the catch of sturgeon of 33,275 pounds, but a decrease of 9,535 pounds in the production of caviar; an increase in the catch of mullet of 62,150 pounds; and a decrease in the catch of sea bass amounting to 577,545 pounds. For years there has been a small fishery for sharks for food, the catch in 1918 amounting to 20,000 pounds, a decrease of 70,000 pounds as compared with 1902.

FISHERIES BY COUNTIES.

The following table gives, by counties, the number of persons employed, investment, and products of the fisheries of South Carolina in 1918.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES.

Item.	Beaufort.		Charleston.		Colleton.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	81		6			
On vessels transporting			20			
In shore fisheries	277		358		80	
Shoresmen	444		299			
Total	802		683		80	
INVESTMENT.						
Vessels fishing:						
Gasoline			2	$3,005		
Tonnage			24			
Outfit				275		
Sail	33	$20,995				
Tonnage	357					
Outfit		4,415				
Vessels transporting: Gasoline			7	11,000		
Tonnage			74			
Outfit				1,350		
Boats:						
Sail and row	286	8,760	238	4,025	40	$1,000
Power			24	10,900	2	800
Apparatus, vessel fisheries:						
Tongs	81	443				
Grabs	78	78	6	6		
Apparatus, shore fisheries:						
Haul seines			4	60		
Gill nets	14	800	25	2,800	41	1,570
Cast nets			71	155		
Lines		10		505		
Otter trawls			1	50		
Tongs and rakes	196	1,095	8	36		
Grabs	243	242	102	109		
Shore and accessory property		55,915		33,045		1,200
Cash capital		8,100		10,500		
Total		100,853		77,821		4,570
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Black drum			5,000	$225		
Bluefish			1,500	140		
Catfish			2,500	100		
Crevalle			300	65		
Croaker	3,500	$275	8,800	585		
Flounders			1,000	130		
Grunts			100	6		
King whiting	2,525	300	35,650	4,250		
Mullet, fresh			3,300	125		
Pinfish or sailor's choice			2,000	130		
Porgies			2,000	130		

Persons Engaged, Investment, and Products of the Fisheries of South Carolina in 1918, by Counties—Continued.

Item.	Beaufort.		Charleston.		Colleton.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Redfish or red drum			1,000	$60		
Sea bass			72,000	7,200		
Shad	8,762	$1,400	20,700	3,260	32,600	$5,110
Sharks			20,000	175		
Sheepshead			1,500	150		
Skates			2,000	15		
Spot, fresh	1,000	75	1,200	75		
Squeteague or "sea trout"	5,000	600	46,500	3,640		
Sturgeon	4,101	735	324	97	2,800	504
Sturgeon caviar	75	56			70	50
Shrimp			55,400	6,220		
Crabs:						
Hard			18,000	400		
Soft			300	75		
Clams, hard			800	200		
Terrapin			1,275	545		
Oysters, market:						
Public	1,562,085	49,023	1,069,670	34,869		
Private	133,000	9,300	19,075	3,350		
Total	1,720,018	61,764	1,391,894	66,217	35,470	5,664

Item.	Georgetown.		Horry.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	16				103	
On vessels transporting					20	
In shore fisheries	192		214		1,121	
Shoresmen	8		5		756	
Total	216		219		2,000	
INVESTMENT.						
Vessels fishing:						
Gasoline	1	$4,000			3	$7,005
Tonnage	50				74	
Outfit		1,800				2,075
Sail					33	20,995
Tonnage					357	
Outfit						4,415
Vessels transporting: Gasoline					7	11,000
Tonnage					74	
Outfit						1,350
Boats:						
Sail and row	46	1,030	29	$995	639	15,810
Power	24	8,750	1	150	51	20,600
Apparatus, vessel fisheries:						
Lines		100				100
Tongs					81	443
Grabs					84	84
Apparatus, shore fisheries:						
Haul seines	5	390	16	2,100	25	2,550
Gill nets	153	11,355			233	16,525
Stop nets			2	130	2	130
Bow nets	5	25			5	25
Cast nets					71	155
Gigs or spears	26	20	10	7	36	27
Lines						515
Otter trawls	1	40			2	90
Tongs and rakes					204	1,131
Grabs					345	351
Shore and accessory property		4,165		1,450		95,775
Cash capital		1,500				20,100
Total		33,175		4,832		221,251

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES—Continued.

Item.	Georgetown.		Horry.		Total.	
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives	9,500	$175			9,500	$175
Black drum					5,000	225
Bluefish			1,500	$135	3,000	275
Butterfish			600	45	600	45
Catfish	400	8			2,900	108
Crevalle					300	65
Croaker	1,300	88	2,400	114	16,000	1,062
Flounders	14,500	875	700	56	16,200	1,061
Grunts					100	6
Hickory shad	20,500	2,000			20,500	2,000
King whiting	250	17	1,700	110	40,125	4,707
Mullet:						
Fresh	35,600	2,495	19,150	1,603	58,050	4,223
Salted	3,400	370	139,300	14,536	142,700	14,906
Pinfish or sailor's choice			300	18	2,300	148
Porgies					2,000	130
Redfish or red drum					1,000	60
Sea bass	60,000	6,000			132,000	13,200
Shad	105,400	19,315			167,462	29,085
Sharks					20,000	175
Sheepshead			600	60	2,100	210
Skates					2,000	15
Spot:						
Fresh	20,000	1,060	14,800	1,141	37,000	2,354
Salted			25,550	2,085	25,550	2,085
Squeteague or "sea trout"	3,550	246	4,100	360	59,150	4,846
Sturgeon	110,000	19,800			117,225	21,136
Sturgeon caviar	520	783			665	889
Sunfish			3,000	180	3,000	180
Yellowtail or "silver perch"	400	12	500	25	900	37
Shrimp					55,400	6,220
Crabs:						
Hard					[1] 18,000	400
Soft					[2] 300	75
Clams, hard					[3] 800	200
Terrapin					1,275	545
Oysters, market:						
Public					[4] 2,631,755	83,892
Private					[5] 152,075	12,650
Total	385,320	53,541	214,200	20,501	3,746,932	207,690

[1] 54,000 in number. [2] 900 in number. [3] 100 bushels. [4] 375,965 bushels. [5] 21,725 bushels.

FISHERIES BY APPARATUS.

The combined yield of the vessel and shore fisheries of South Carolina in 1918 with all forms of apparatus amounted to 3,746,932 pounds, valued at $207,690. Grabs were the most productive form of gear used, taking 283,288 bushels of oysters, valued at $67,139. The catch with gill nets, consisting chiefly of shad and sturgeon, amounted to 350,902 pounds, valued at $55,827. The catch of oysters with tongs amounted to 114,402 bushels, valued at $29,403. Sea bass, king whiting, and squeteague were the principal species taken with lines, the total catch with this form of apparatus being 291,575 pounds, valued at $24,751. The catch with seines was 237,375 pounds, valued at $22,439, of which 176,350 pounds, valued at $17,531, were mullet.

The two leading forms of a paratus used in the shore fisheries were gill nets and grabs. Other kinds of gear used in the shore fisheries were seines, cast nets, otter trawls, gigs, stop nets, bow nets, and rakes.

Only three forms of fishing apparatus were employed in the vessel fisheries, namely, grabs, tongs, and lines.

The products of the vessel and shore or boat fisheries are shown in the following tables:

YIELD OF VESSEL FISHERIES OF SOUTH CAROLINA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lines: Sea bass					60,000	$6,000	60,000	$6,000
Tongs: Oysters, market, public	440,048	$12,216					440,048	12,216
Grabs: Oysters, market, public	435,148	12,076	66,500	$13,976			501,648	26,052
Total	875,196	24,292	66,500	13,976	60,000	6,000	1,001,696	44,268

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

Species.	Beaufort.		Charleston.		Georgetown.		Colleton.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives					9,500	$475			9,500	$475
Catfish					400	8			400	8
Croaker					700	47			700	47
Flounders					500	25			500	25
Hickory shad					19,250	1,900			19,250	1,900
King whiting					200	14			200	14
Mullet:										
Fresh					19,500	1,300			19,500	1,300
Salted					1,000	125			1,000	125
Shad	8,762	$1,400	20,700	$3,260	105,400	19,315	32,600	$5,110	167,462	29,085
Spots					13,000	720			13,000	720
Squeteague					1,500	103			1,500	103
Sturgeon	4,101	735	324	97	110,000	19,800	2,800	504	117,225	21,136
Sturgeon caviar	75	56			520	783	70	50	665	889
Total	12,938	2,191	21,024	3,357	281,470	44,615	35,470	5,664	350,902	55,827

BY ALL OTHER APPARATUS.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Horry.		Total.	
Seines:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Bluefish							1,500	$135	1,500	$135
Butterfish							600	45	600	45
Croaker					600	$41	2,400	114	3,000	155
Flounders					2,000	100	600	48	2,600	148
King whiting					50	3	1,700	140	1,750	143
Mullet—										
Fresh					16,100	1,195	18,550	1,555	34,650	2,750
Salted					2,400	245	139,300	14,536	141,700	14,781
Sailor's choice							300	18	300	18
Sheepshead							600	60	600	60
Spots—										
Fresh					7,000	340	13,800	1,064	20,800	1,404
Salted							18,550	1,535	18,550	1,535
Squeteague					2,050	143	4,100	360	6,150	503
Sunfish							3,000	180	3,000	180
Yellowtail					400	12	500	25	900	37
Terrapin			1,275	$545					1,275	545
Total			1,275	545	30,600	2,079	205,500	19,815	237,375	22,439
Otter trawls: Shrimp			30,000	1,200					30,000	1,200
Bow nets: hickory shad					1,250	100			1,250	100

YIELD OF SHORE FISHERIES OF SOUTH CAROLINA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY ALL OTHER APPARATUS—Continued.

Apparatus and species.	Beaufort.		Charleston.		Georgetown.		Horry.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cast nets:										
Catfish			1,000	$25					1,000	$25
Croaker			800	25					800	25
Mullet			3,300	125					3,300	125
Shrimp			25,400	5,020					25,400	5,020
Total			30,500	5,195					30,500	5,195
Stop nets:										
Flounders							100	$8	100	8
Mullet							600	48	600	48
Spots—										
Fresh							1,000	80	1,000	80
Salted							7,000	550	7,000	550
Total							8,700	686	8,700	686
Gigs or spears: Flounders					12,000	$750			12,000	750
Lines:										
Black drum			5,000	225					5,000	225
Bluefish			1,500	140					1,500	140
Catfish			1,500	75					1,500	75
Channel bass			1,000	60					1,000	60
Crevalle			300	65					300	65
Croaker	3,500	$275	8,000	560					11,500	835
Flounders			1,000	130					1,000	130
Grunt			100	6					100	6
King whiting	2,525	300	35,650	4,250					38,175	4,550
Porgy			2,000	130					2,000	130
Sailor's choice			2,000	130					2,000	130
Sea bass			72,000	7,200					72,000	7,200
Sheepshead			1,500	150					1,500	150
Spots	1,000	75	1,200	75					2,200	150
Squeteague	5,000	600	46,500	3,640					51,500	4,240
Sharks			20,000	175					20,000	175
Skates			2,000	15					2,000	15
Crabs—										
Hard			18,000	400					18,000	400
Soft [1]			300	75					300	75
Total	12,025	1,250	219,550	17,501					231,575	18,751
Tongs: Oysters, market—										
Public	304,941	11,987	1,750	250					306,691	12,237
Private	45,500	3,450	8,575	1,500					54,075	4,950
Total	350,441	15,437	10,325	1,750					360,766	17,187
Grabs: Oysters, market—										
Public	381,948	12,744	1,001,420	20,643					1,383,368	33,387
Private	87,500	5,850	10,500	1,850					98,000	7,700
Total	469,448	18,594	1,011,920	22,493					1,481,368	41,087
Rakes: Clams, hard			800	200					800	200

[1] Taken with the hands.

INDUSTRIES.

Wholesale trade.—In 1918 there were 6 wholesale establishments, valued at $51,820, with cash capital amounting to $8,100, employing 59 persons, to whom $40,678 were paid in wages.

Oyster-canning industry.—In addition to those given above, there were 9 establishments engaged in the canning of oysters and utilization of shells, valued at $121,925, using cash capital to the amount of

$12,000, employing 592 persons, to whom $60,985 were paid in wages during the year. The pack amounted to 2,769,168 cans of various sizes, valued at $338,843.

The following table contains statistics of the canning industry for South Carolina in 1918:

OYSTER-CANNING INDUSTRY IN SOUTH CAROLINA IN 1918.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments	9	$121,925	PRODUCTS—continued.		
Cash capital		12,000			
Persons engaged	592		Oysters canned—Continued.		
Wages paid		60,985	5-ounce cans......cases..	[2] 50,495	$154,028
			Do......do....	[3] 23,705	117,235
PRODUCTS.[1]			6-ounce cans......do....	[3] 100	800
			8-ounce cans......do....	[2] 1,826	7,690
Oysters canned:			10-ounce cans......do....	[2] 9,190	45,700
3-ounce cans......cases..	[3] 401	1,746			
4-ounce cans......do....	[2] 880	1,822	Total		338,843
Do......do....	[3] 2,289	9,822			

[1] The by-products are included with the statistics for Georgia.
[2] Two dozen cans per case.
[3] Four dozen cans per case.

FISHERIES OF GEORGIA.

In 1918 the fisheries of Georgia gave employment to 1,680 persons, of whom 188 were on fishing and transporting vessels, 476 in the shore fisheries, and 1,016 shoresmen in the wholesale fishery trade and oyster and shrimp canning industry.

The investment amounted to $769,998, which includes 33 fishing and transporting vessels, valued at $122,663, with a net tonnage of 552 tons and outfits valued at $41,866; 412 power and other boats, valued at $86,205; fishing apparatus employed on vessels and boats, valued at $17,085; shore and accessory property, valued at $429,779; and cash capital amounting to $72,400.

The products amounted to 37,153,953 pounds, valued at $416,043, and represent an increase of 26,051,343 pounds in quantity and $56,962 in value as compared with 1902. The 5 most important products, arranged in the order of their value, are as follows: Shrimp, 5,793,465 pounds, valued at $173,990; menhaden, 29,484,600 pounds, valued at $88,453; oysters, 1,109,822 pounds, or 158,546 bushels, valued at $73,913; shad, 100,540 pounds, valued at $26,960; and sea bass, 292,615 pounds, valued at $23,765. Compared with 1902, there has been an increase in the catch of shrimp of 5,449,338 pounds in quantity and $165,582 in value, and an increase in the catch of sea bass amounting to 216,115 pounds in quantity and $17,683 in value; a decrease in the take of oysters amounting to 7,458,178 pounds, or 1,065,454 bushels, in quantity, and $146,554 in value; a decrease of 928,510 pounds in quantity of shad and $48,229 in value; a decrease in the catch of mullet amounting to 115,150 pounds in quantity and $1,883 in the value; and a decrease in the catch of terrapin amounting to 31,196 pounds in quantity and $10,682 in value. In 1902 there was no fishery for menhaden in the State.

FISHERIES BY COUNTIES.

The following table shows, by counties, the number of persons employed, number and value of vessels, boats and apparatus used, amount of capital invested, and the quantity and value of the products of the fisheries in 1918.

Persons Engaged, Investment, and Products of the Fisheries of Georgia in 1918, by Counties.

Item.	Bryan.		Camden.		Chatham.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing			102		54	
In shore fisheries	21		68		183	
Shoresmen			191		316	
Total	21		361		553	
INVESTMENT.						
Vessels fishing:						
Gasoline			7	$56,900	7	$37,040
Tonnage			215		176	
Outfit				28,233		9,308
Sail					5	2,315
Tonnage					44	
Outfit						325
Boats:						
Sail, row, etc	21	$315	22	1,115	186	5,850
Power			25	24,400	10	2,225
Apparatus, vessel fisheries:						
Purse seines			4	4,800		
Lines						105
Otter trawls			3	160		
Dredges					6	360
Tongs					13	76
Grabs					13	12
Apparatus, shore fisheries:						
Gill nets	21	735	16	1,050	38	1,260
Lines				2		
Otter trawls			23	1,200		
Tongs					160	835
Grabs					160	162
Shore and accessory property		25		77,145		194,130
Cash capital				14,000		36,600
Total		1,075		209,605		290,543
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Bluefish					5,000	$900
Cero, or kingfish					74	7
Flounders					500	55
Groupers					27,758	1,019
Grunts					512	26
King whiting					100	12
Menhaden			29,484,600	$88,453		
Mullet					3,000	240
Redfish, or red drum					24	4
Red snapper					111,749	7,740
Scup					12,000	900
Sea bass			125	10	291,490	23,655
Shad	13,500	$3,262	61,250	18,000	14,502	3,505
Sharks					1,289	30
Sheepshead			175	10		
Squeteague, or "sea trout"			850	50	3,700	385
Striped bass			125	10		
Tilefish					35,000	2,400
Shrimp			1,290,818	39,046		
Oysters, market:						
Public			37,800	1,400	412,930	28,364
Private					261,079	21,288
Octopus					2,731	268
Terrapin					2,030	419
Total	13,500	5,262	30,875,743	146,979	1,185,468	94,217

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA IN 1918, BY COUNTIES—Continued.

Item.	Effingham.		Glynn.		Liberty.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing			30			
On vessels transporting			2			
In shore fisheries	3		116		16	
Shoresmen			382		37	
Total	3		530		53	
INVESTMENT.						
Vessels fishing:						
Gasoline			13	$25,908		
Tonnage			108			
Outfit				3,875		
Vessels transporting, gasoline			1	500		
Tonnage			9			
Outfit				125		
Boats:						
Sail, row, etc	3	$45	23	320	14	$195
Power			52	46,725	1	600
Apparatus, vessel fisheries:						
Otter trawls			9	545		
Tongs			8	60		
Grabs			8	12		
Apparatus, shore fisheries:						
Haul seines			2	80		
Gill nets	3	100	6	15	4	45
Lines				6		
Otter trawls			48	2,400		
Tongs			10	75	12	70
Grabs			10	15	12	12
Shore and accessory property		5		127,764		13,500
Cash capital				18,000		800
Total		150		226,425		15,222
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Croaker			5,600	$235		
Flounders			10,000	575		
Hickory shad					195	$25
King whiting			26,200	1,397		
Mullet			2,500	100		
Redfish, or red drum			100	6		
Red snapper			600	70		
Sea bass			1,000	100		
Shad	1,998	$483			605	111
Spot			1,100	59		
Squeteague, or "sea trout"			27,700	2,962		
Yellowtail, or "silver perch"			2,000	100		
Crabs, hard			8,455	504		
Shrimp			4,412,647	132,350		
Clams, hard			120	75		
Oysters, market:						
Public			5,600	400		
Private			115,332	2,141	154,021	6,600
Terrapin			82	35		
Turtles			11,250	100		
Total	1,998	483	4,630,286	141,209	154,821	6,736

Item.	McIntosh.		Wayne.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing					186	
On vessels transporting					2	
In shore fisheries	49		20		476	
Shoresmen	90				1,016	
Total	139		20		1,680	

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF GEORGIA IN 1918, BY COUNTIES—Continued.

Item.	McIntosh.		Wayne.		Total.	
INVESTMENT.						
Vessels fishing:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Gasoline					27	$119,848
Tonnage					499	
Outfit						41,416
Sail					5	2,315
Tonnage					44	
Outfit						325
Vessels transporting, gasoline					1	500
Tonnage					9	
Outfit						125
Boats:						
Sail, row, etc	34	$860	10	$105	313	8,805
Power	11	3,450			99	77,400
Apparatus, vessel fisheries:						
Purse seines					4	4,800
Lines						105
Otter trawls					12	705
Dredges					6	300
Tongs					21	136
Grabs					21	24
Apparatus, shore fisheries:						
Haul seines					2	80
Gill nets	18	2,425	33	325	139	5,955
Cast nets	1	3			1	3
Lines		5				13
Otter trawls	2	100			73	3,700
Tongs	8	60			190	1,040
Grabs	28	35			210	224
Shore and accessory property		17,200		10		429,779
Cash capital		3,000				72,400
Total		27,138		440		769,998
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Bluefish					5,660	$900
Catfish	2,675	$265			2,675	265
Cero, or kingfish					74	7
Croaker	300	20			5,900	255
Flounders	300	20			10,800	650
Groupers					27,758	1,019
Grunts					512	26
Hickory shad	7,887	1,350	4,925	$660	13,007	2,035
King whiting	930	59			27,230	1,468
Menhaden					29,484,600	88,453
Mullet	5,150	353			10,650	693
Redfish, or red drum	1,550	102			1,674	112
Red snapper					112,349	7,810
Scup					12,000	900
Sea bass					292,615	23,765
Shad	2,485	519	6,200	1,080	100,540	26,960
Sharks					1,289	30
Sheepshead	225	15			400	25
Spot					1,100	59
Squeteague, or "sea trout"	7,300	700			39,550	4,097
Striped bass					125	10
Sturgeon	39,150	4,700			39,150	4,700
Tilefish					35,000	2,400
Yellowtail, or "silver perch"					2,000	100
Crabs, hard					[1] 8,455	504
Shrimp	90,000	2,594			5,793,465	173,990
Clams, hard					[2] 120	75
Oysters, market:						
Public	25,200	720			[3] 481,530	30,884
Private	97,860	10,000			[4] 628,292	43,029
Octopus					2,731	268
Terrapin					2,112	454
Turtles					11,250	100
Total	281,012	21,417	11,125	1,740	37,153,953	416,043

[1] 25,365 in number. [2] 15 bushels. [3] 68,790 bushels. [4] 89,726 bushels.

FISHERIES BY APPARATUS.

The yield of all forms of apparatus in Georgia in 1918 amounted to 37,153,953 pounds, valued at $416,043. In the value of their product, otter trawls, employed chiefly in the taking of shrimp, ranked first, with a catch of 5,838,115 pounds, valued at $175,705. Exceeding all other forms of apparatus in quantity, but ranking second in the value of their catch, purse seines took 29,484,600 pounds of menhaden, valued at $88,453. The yield of the gill-net fishery amounted to 203,332 pounds, valued at $38,705, of which 100,540 pounds, valued at $26,960, were shad. The catch with lines was 505,712 pounds, valued at $38,224, the principal species taken by this apparatus in the order of their value being: Sea bass, red snapper, tilefish, and groupers. Oysters were taken with tongs to the amount of 486,444 pounds, or 69,492 bushels, valued at $32,029, and with grabs to the amount of 468,678 pounds, or 66,954 bushels, valued at $31,384. The combined take of oysters with these two forms of gear amounted to 136,446 bushels, valued at $63,413.

Aside from purse seines, lines, and otter trawls used in the vessel fisheries, the only other forms of apparatus employed were dredges, tongs, and grabs, all of which were engaged in taking oysters.

The bulk of the catch in the shore fisheries was made with otter trawls, gill nets, tongs, and grabs, the remainder being taken by hand and with lines, seines, and cast nets.

The products of the vessel and shore or boat fisheries are shown in the appended tables.

YIELD OF VESSEL FISHERIES OF GEORGIA IN 1918, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Camden.		Chatham.		Glynn.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines: Menhaden	29,484,600	$88,453					29,484,600	$88,453
Lines:								
Bluefish			5,000	$900			5,000	900
Cero, or kingfish			74	7			74	7
Flounders			500	55			500	55
Groupers			27,758	1,019			27,758	1,019
Grunts			512	26			512	26
Redfish, or red drum			24	4			24	4
Red snapper			111,749	7,740			111,749	7,740
Scup			12,000	900			12,000	900
Sea bass			291,490	23,655			291,490	23,655
Sharks			1,289	30			1,289	30
Squeteague, or "sea trout"			2,500	185			2,500	185
Tilefish			35,000	2,400			35,000	2,400
Octopus			2,731	268			2,731	268
Total			490,627	37,189			490,627	37,189
Otter trawls: Shrimp	155,655	4,600			410,665	$11,800	566,320	16,400
Dredges: Oysters, market, private			116,900	9,100			116,900	9,100
Tongs: Oysters, market—								
Public			39,900	2,100			39,900	2,100
Private			3,500	300	43,120	800	46,620	1,100
Total			43,400	2, 00	43,120	800	86,520	3,200
Grabs: Oysters, market—								
Public			37,275	1,875			37,275	1,875
Private			3,500	300	43,078	800	46,578	1,100
Total			40,775	2,175	43,078	800	83,853	2,975
Grand total	29,640,255	93,053	691,702	50,864	496,863	13,400	30,828,820	157,317

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY GILL NETS.

Species.	Bryan.		Camden.		Chatham.		Effingham.		Glynn.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Flounders									5,000	$325
King whiting					100	$12			5,000	325
Mullet					3,000	240				
Red snapper									600	70
Sea bass									1,000	100
Shad	13,500	$3,262	61,250	$18,000	14,502	3,505	1,998	$483		
Spot									500	24
Squeteague, or "sea trout"					1,200	200			25,000	2,800
Terrapin					2,030	419				
Total	13,500	3,262	61,250	18,000	20,832	4,376	1,998	483	37,100	3,644

Species.	Liberty.		McIntosh.		Wayne.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Flounders			150	$10			5,150	$335
Hickory shad	195	$25	7,887	1,350	4,925	$660	13,007	2,035
King whiting			30	2			5,130	339
Mullet			4,100	303			7,100	543
Redfish, or red drum			650	45			650	45
Red snapper							600	70
Sea bass							1,000	100
Shad	605	111	2,485	519	6,200	1,080	100,540	26,960
Sheepshead			75	5			75	5
Spot							500	24
Squeteague, or "sea trout"			1,900	130			28,100	3,130
Sturgeon			39,150	4,700			39,150	4,700
Terrapin							2,030	419
Total	800	136	56,727	7,061	11,125	1,740	203,332	38,705

BY SEINES, OTTER TRAWLS, CAST NETS, LINES, AND HAND.

Apparatus and species.	Camden.		Glynn.		McIntosh.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Seines:								
Croakers			600	$35			600	$35
King whiting			1,200	72	300	$17	1,500	89
Mullet			2,500	100			2,500	100
Redfish, or red drum			100	6	300	17	400	23
Spot			600	35			600	35
Squeteague, or "sea trout"			1,200	72	4,400	500	5,600	572
Crabs, hard			120	4			120	4
Shrimp			100	25			100	25
Total			6,420	349	5,000	534	11,420	883
Otter trawls:								
Croakers			5,000	200			5,000	200
Flounders			5,000	250			5,000	250
King whiting			20,000	1,000			20,000	1,000
Squeteague, or "sea trout"			1,500	90			1,500	90
Yellowtail, or "silver perch"			2,000	100			2,000	100
Shrimp	1,135,163	$34,446	4,001,882	120,525	90,000	2,594	5,227,045	157,565
Turtles			11,250	100			11,250	100
Total	1,135,163	34,446	4,046,632	122,265	90,000	2,594	5,271,795	159,305
Cast nets: Mullet					750	50	750	50
Lines:								
Hand lines—								
Croakers					300	20	300	20
Flounders					150	10	150	10
King whiting					600	40	600	40
Redfish, or red drum					600	40	600	40
Sea bass	125	10					125	10
Sheepshead	175	10			150	10	325	20
Squeteague, or "sea trout"	850	50			1,000	70	1,850	120
Striped bass	125	10					125	10
Total	1,275	80			2,800	190	4,075	270
Set lines—catfish					2,675	265	2,675	265
Trot lines—crabs, hard			8,335	500			8,335	500
Total, by lines	1,275	80	8,335	500	5,475	455	15,085	1,035
Hand:								
Terrapin			82	35			82	35
Clams, hard			120	75			120	75
Oyster, market, public	37,800	1,400					37,800	1,400
Total	37,800	1,400	202	110			38,002	1,510

YIELD OF SHORE FISHERIES OF GEORGIA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY TONGS AND GRABS.

Apparatus and species.	Chatham.		Glynn.		Liberty.		McIntosh.		Total.	
Tongs: Oysters, market:	*Pounds*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Public	167,881	$12,195	2,800	$200			12,600	$360	183,281	$12,755
Private	67,536	7,174	16,156	300	84,021	$3,600	48,930	5,000	216,643	16,074
Total	235,417	19,369	18,956	500	84,021	3,600	61,530	5,360	399,924	28,829
Grabs: Oysters, market:										
Public	167,874	12,194	2,800	200			12,600	360	183,274	12,754
Private	69,643	7,414	12,978	241	70,000	3,000	48,930	5,000	201,551	15,655
Total	237,517	19,608	15,778	441	70,000	3,000	61,530	5,360	384,825	28,409

INDUSTRIES.

Wholesale trade.—In 1918 there were 18 establishments, valued at $237,575, in operation. These used working cash capital to the amount of $33,000 and gave employment to 223 persons, to whom $66,900 were paid in wages.

Canning industry.—There were 10 establishments, valued at $265,444, engaged in canning oysters, shrimp, etc., in preparing cooked shrimp for market, and in crushing oyster shells. These used cash capital to the amount of $30,300 and gave employment to 634 persons, to whom $129,075 were paid in wages. The products included canned oysters to the value of $93,208; canned shrimp to the value of $355,548; 40 cases of canned flounders, valued at $200; 464,983 pounds of cooked shrimp, valued at $103,889; poultry grit from ground oyster shells, 127 tons, valued at $1,525; and lime from oyster shells, 18 tons, valued at $99.

PREPARED FISHERY PRODUCTS AND BY-PRODUCTS OF GEORGIA IN 1918.

Item.	Number.	Value.
Establishments	10	$265,444
Cash capital		30,300
Persons engaged	634	
Wages paid		129,075
PRODUCTS.		
Oysters, canned:		
4-ounce cans........cases	[1] 500	1,300
5-ounce cans........do	[1] 14,799	41,837
Do........do	[2] 6,329	35,576
6-ounce cans........do	[2] 50	400
10-ounce cans........do	[1] 2,364	13,645
12-ounce cans........do	[1] 50	400
Total		93,208
PRODUCTS—continued.		
Shrimp, canned:		
No. 1 cans........cases	[2] 55,706	$295,567
No. 1½ cans........do	[1] 10,740	59,981
Total		355,548
Flounders, canned: 10-ounce cans........cases	[2] 40	200
Shrimp, cooked:		
Meat........pounds	214,684	64,865
Headless, cooked...do	198,945	33,582
Whole, cooked.....do	51,354	5,442
Oyster shells:		
Crushed, poultry grit, pounds	[3] 254,000	1,525
Lime........tons	18	99

[1] Two dozen cans per case. [2] Four dozen cans per case.
[3] Includes oyster shells crushed in South Carolina.

FISHERIES OF EAST COAST OF FLORIDA.

The statistics here presented are for the eastern coast of Florida and, among the South Atlantic States, were surpassed only by North Carolina. The number of persons employed was 3,330, of whom 395 were on fishing and transporting vessels, 2,104 in the shore or boat fisheries, and 831 in the wholesale fishery trade, the menhaden industry, and the oyster and shrimp canning industry. Compared with 1902, there has been an increase in the persons employed of 632.

The investment amounted to $2,210,679, which includes 30 fishing and transporting vessels, valued at $409,900, with a net tonnage of 814 tons and outfits valued at $75,137; 839 power boats, valued at $459,650; 607 sail, row, and other boats, valued at $20,180; fishing apparatus employed on vessels and boats, valued at $235,492; shore and accessory property to the value of $858,720; and working cash capital amounting to $151,600. Compared with 1902, the increase in the investment amounts to $1,855,844.

The products of eastern Florida amounted to 81,211,488 pounds, valued at $1,746,175, an increase of 61,627,223 pounds, or 314.67 per cent, in the quantity and $1,268,307, or 265.41 per cent, in the value as compared with 1902.

The 10 leading products arranged in order of value follow: Mullet, 10,417,889 pounds, valued at $397,147; shrimp, 8,867,918 pounds, valued at $266,651; Spanish mackerel, 3,061,965 pounds, valued at $218,085; menhaden, 48,362,600 pounds, valued at $210,175; cero and kingfish, 2,271,792 pounds, valued at $147,608; squeteague or "sea trout," 1,645,223 pounds, valued at $142,091; shad, 963,606 pounds, valued at $135,844; bluefish, 561,301 pounds, valued at $54,715; red and black drum, 900,091 pounds, valued at $24,638; and oysters, 458,990 pounds, or 65,570 bushels, valued at $20,128.

Compared with 1902, the increase in the catch of bluefish amounts to 481,801 pounds, or 606.03 per cent; of red and black drum, to 765,206, or 567.30 per cent; of mullet, to 3,076,973 pounds, or 41.91 per cent; of Spanish mackerel, to 2,402,877 pounds, or 364.57 per cent; of squeteague, to 746,660 pounds, or 83.09 per cent; and of shrimp, to 5,855,064 pounds, or 194.33 per cent. There has been a decrease in the catch of shad as compared with 1902, amounting to 855,825 pounds, or 47.04 per cent; and of oysters, of 1,704,493 pounds, or 243,499 bushels, or 78.78 per cent. No cero, kingfish (not king whiting), or menhaden were included in the returns for 1902.

A comparison of the fisheries of the east and west coast of Florida in 1918 is given on pages 116, 117.

FISHERIES BY COUNTIES.

The statistics of the number of persons engaged, investment, and products of the fisheries of the eastern coast of Florida in 1918, by counties, are given in the table following.

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES.

Item.	Brevard.		Broward.		Dade		Duval.		Lake.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing					114		214			
On vessels transporting					9					
In shore fisheries	228		2		229		167		5	
Shoresmen					48		163			
Total	228		2		400		544		5	
INVESTMENT.										
Vessels fishing: Gasoline					12	$89,100	9	$258,500		
Tonnage					202		467			
Outfit						4,143		48,997		
Vessels transporting: Gasoline					5	2,300				
Tonnage					36					
Outfit						2,250				
Boats:										
Sail, row etc.	216	$5,820	1	$40			20	550	2	$60
Power	98	29,100	1	250	124	59,300	73	20,250	1	250
Apparatus, vessel fisheries: Purse seines					12	22,400	9	22,500		
Apparatus, shore fisheries:										
Haul seines			1	175			8	280	1	200
Gill nets	182	26,800			43	6,450	92	12,800		
Cast nets							6	30		
Dip nets					3	3				
Lines		40		5		920		190		
Traps							20	50		
Gaffs					3	3				
Tongs							10	70		
Shore and accessory property		19,000		50		104,806		583,835		500
Cash capital						18,000		55,000		
Total		80,760		520		329,675		1,003,052		1,010
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives									30,000	$450
Amberfish			150	$12	200	$8				
Angelfish					175	7				
Barracuda			150	12	200	8				
Black drum	36,500	$1,095	160	8			32,400	$1,020		
Bluefish			300	60	23,864	1,866	1,600	155		
Blue runner or hardtail					2,500	82				
Bonito			100	10	50	3				
Butterfish					4,200	170				
Cero and kingfish			300	45	973,331	68,133				
Cowfish and "shellfish"					50	2				
Crevalle	3,300	132	800	80	800	26				
Flounders	1,210	48					400	40		
Groupers			200	20	41,978	2,518				
Grunts			400	40	10,650	426				
Hogfish					150	6				
King whiting	13,900	1,132					32,000	2,240		
Leather jacket or "turbot"					200	8				
Menhaden							42,635,400	181,201		
Moonfish			100	8	540	16				
Mullet	4,292,600	171,704	500	50	2,651,085	90,395	78,000	4,740		
Permit			50	5						
Pigfish	2,000	64			100	4				
Pinfish or sailor's choice	43,150	1,386	200	20	200	10				
Pompano	100	15	30	6	446	68	240	36		
Porgies					5,000	300				
Porkfish					350	17				
Redfish or red drum	31,400	1,256	100	12			26,400	1,680		
Sea bass					100	8	20,000	1,600		
Sergeantfish or snook	430	15	350	28						
Shad							265,608	36,855	4,850	678

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

Item.	Brevard.		Broward.		Dade.		Duval.		Lake.	
PRODUCTS—con.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Sharks							50,000	$250		
Sheepshead	11,945	$478	50	$5	100	$6	14,000	840		
Snapper:										
Mangrove	200	8	600	60	2,700	135				
Mutton	1,400	54	700	70	7,500	300				
Red							19,200	1,920		
Spanish mackerel					870,415	59,806				
Spot	20,500	675					1,200	96		
Squeteague or "sea trout"	591,482	50,291			1,000	80	88,000	7,200		
Yellowtail or "silver perch"					450	18				
Crabs, hard							52,000	1,800		
Sea crawfish or spiny lobster					21,408	1,070				
Oysters, market, public							31,500	1,800		
Turtles					6,000	360				
Total	5,050,117	228,353	5,240	551	4,625,742	225,856	3,347,948	243,483	31,850	$1,128

Item.	Nassau.		Palm Beach.		Putnam.		Seminole.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	52							
In shore fisheries	319		551		142		59	
Shoresmen	541		42					
Total	912		593		142		59	
INVESTMENT.								
Vessels fishing: Gasoline	2	$30,000						
Tonnage	56							
Outfit		8,147						
Boats:								
Sail, row, etc	43	2,380	55	$3,505	88	$2,200	49	$1,225
Power	132	154,700	229	130,500	18	5,450	12	2,450
Apparatus, vessel fisheries: Purse seines	4	8,000						
Apparatus, shore fisheries:								
Purse seines			2	3,000				
Haul seines			23	18,900	15	3,200	28	1,575
Gill nets	16	1,050	181	25,975	36	4,000		
Lines				1,570				
Otter trawls	250	16,250						
Tongs			1	7				
Shore and accessory property		500		92,095		3,900		3,000
Cash capital		41,000		18,100				
Total		262,927		293,652		18,750		8,250
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives					334,526	$5,018		
Amberfish			11,336	$370				
Angelfish			1,170	37				
Barracuda			2,515	76				
Black drum			23,950	503				
Bluefish			362,339	36,532				
Blue runner or hardtail			47,600	1,447				
Bonito			7,841	236				
Catfish			1,600	32				
Cero and kingfish			1,298,161	79,430				
Crevalle			61,910	2,021				
Croaker			34,388	1,031				
Flounders			430	17				
Groupers			32,605	1,084				
Grunts			18,400	595				
Hogfish			100	5				
Jewfish			7,117	222				
King whiting	100,000	$2,000	13,211	530				
Ladyfish			1,280	13				
Leather jacket or "turbot"			170	5				
Menhaden	5,660,000	28,300	57,000	570				
Moonfish			7,230	218				

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

Item.	Nassau.		Palm Beach.		Putnam.		Seminole.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Mullet			1,016,734	$37,466				
Parrotfish			3,500	70				
Permit			6,465	213				
Pigfish			4,932	148				
Pinfish or sailor's choice			34,135	1,034				
Pompano			60,029	9,568				
Porgies			950	28				
Porkfish			1,360	40				
Redfish or red drum			32,355	1,167				
Sea bass			19,821	1,021				
Sea gar or needlefish			100	5				
Sergeantfish or snook			81,074	2,604				
Shad	61,250	$18,000			456,471	$56,786	102,161	$13,277
Sharks			13,350	272				
Sheepshead			16,686	608				
Snapper:								
Mangrove			16,195	666				
Mutton			93,385	2,994				
Red			1,000	80				
Spanish mackerel			1,493,319	102,290				
Spot			31,040	939				
Squeteague or "sea trout"			135,835	12,567				
Yellowtail or "silver perch"			20,230	607				
Shrimp	8,806,568	264,197						
Sea crawfish or spiny lobster			2,095	104				
Oysters, market:								
Public	90,293	3,315	2,100	195				
Private	135,065	3,994	10,500	1,000				
Turtles			250	12				
Conch meat			7,000	700				
Total	14,853,176	319,806	5,094,853	301,372	790,997	61,804	102,161	13,277

Item.	St. John.		St. Lucie.		Volusia.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing							380	
On vessels transporting			6				15	
In shore fisheries	34		280		88		2,104	
Shoresmen			37				831	
Total	34		323		88		3,330	
INVESTMENT.								
Vessels fishing: Gasoline							23	$377,600
Tonnage							725	
Outfit								71,287
Vessels transporting: Gasoline			2	$20,000			7	32,300
Tonnage			53				89	
Outfit				1,600				3,850
Boats:								
Sail, row, etc	15	$375	52	2,185	66	$1,840	607	20,180
Power	9	2,550	120	49,250	22	5,600	839	459,650
Apparatus, vessel fisheries:								
Purse seines							25	52,900
Apparatus, shore fisheries:								
Purse seines							2	3,000
Haul seines	5	750	26	32,100	8	850	115	58,030
Gill nets	5	500	115	17,400	45	6,750	715	101,725
Cast nets	10	50					16	80
Dip nets							3	3
Lines		140				100		2,965
Otter trawls	5	250					255	16,500
Traps							20	50
Spears	12	12					12	12
Gaffs							3	3
Tongs	5	30	2	14	14	98	32	219
Rakes	5	5					5	5
Shore and accessory property		500		45,034		5,500		858,720
Cash capital				19,500				151,600
Total		5,062		187,083		20,738		2,210,679

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY COUNTIES—Continued.

Item.	St. John.		St. Lucie.		Volusia.		Total.	
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives					327,739	$4,905	692,265	$10,373
Amberfish							11,686	390
Angelfish			1,570	$47			2,915	91
Barracuda			50	1			2,915	97
Black drum	16,939	$526	407,192	8,408	14,200	618	531,332	12,178
Bluefish	900	92	171,648	15,935	650	65	561,301	51,715
Blue runner or hardtail			650	13			50,750	1,542
Bonito	150	9					8,141	258
Butterfish							4,200	170
Catfish			12,300	246			13,900	278
Cero and kingfish							2,271,792	117,608
Cowfish and "shellfish"							50	2
Crevalle			254,220	7,574			321,030	9,833
Croaker	2,150	84	87,740	2,332			121,278	3,447
Flounders	7,670	460	2,980	140	800	32	13,490	737
Groupers							74,783	3,622
Grunts	150	9	84,019	2,559			113,679	3,629
Hogfish							250	11
Jewfish	220	9	5,150	134			12,487	365
King whiting	3,150	176	82,797	4,855	51,950	4,671	297,008	15,604
Ladyfish							1,280	13
Leather jacket or "turbot"							370	13
Menhaden			10,200	104			48,362,600	210,175
Moonfish			100	3			7,970	245
Mullet	12,140	529	1,423,870	54,535	942,960	37,728	10,417,889	397,117
Parrotfish							3,500	70
Permit	155	5	460	11	200	10	7,290	244
Pigfish	300	12	6,630	199	800	21	14,762	451
Pinfish or sailor's choice	1,180	47	359,270	10,404	4,400	132	442,535	13,033
Pompano	825	124	67,749	9,672	4,000	400	133,419	19,889
Porgies							5,950	328
Porkfish							1,710	57
Redfish or red drum	9,230	431	259,874	7,482	9,400	432	368,759	12,460
Sea bass	1,410	70					41,331	2,699
Sea gar or needlefish							100	5
Sergeantfish or snook			232,920	5,982			314,774	8,629
Shad					73,266	10,248	963,606	135,844
Sharks			425	4			63,775	526
Sheepshead	465	29	60,557	2,125	500	24	101,303	4,115
Snapper:								
Mangrove			3,491	106			23,186	975
Mutton			138,093	3,981			241,078	7,399
Red							20,200	2,000
Spanish mackerel	1,510	151	696,721	55,838			3,061,965	218,085
Spot	3,590	144	331,140	9,938	5,560	206	393,030	11,998
Squeteague or "sea trout"	25,372	1,947	667,534	57,746	136,000	12,260	1,615,223	142,091
Yellowtail or "silver perch"			23,290	654			43,970	1,279
Shrimp	61,350	2,454					8,867,918	266,651
Crabs, hard							[1] 52,000	1,800
Sea crawfish or spiny lobster							23,503	1,174
Clams, hard	2,400	600					[2] 2,400	600
Oysters, market:								
Public	31,500	2,250	4,900	455	153,132	7,119	[3] 313,425	15,134
Private							[4] 145,565	4,994
Turtles			600	30			6,850	402
Conch meat							7,000	700
Total	182,707	10,158	5,398,140	261,513	1,725,557	78,874	81,211,488	1,746,175

[1] 156,000 in number. [2] 300 bushels. [3] 44,775 bushels. [4] 20,795 bushels.

FISHERIES BY APPARATUS.

Gill nets were the most productive form of apparatus employed in the fisheries of the east coast of Florida in 1918, the catch amounting to 11,636,930 pounds, valued at $671,599. The principal species taken with this form of apparatus were: Mullet, 6,882,403 pounds, valued at $275,395; Spanish mackerel, 2,301,590 pounds, valued at $166,592; shad, 591,719 pounds, valued at $87,789; squeteague or "sea trout," 1,030,347 pounds, valued at $86,549; and bluefish, 374,340 pounds, valued at $36,156. Purse seines, taking mostly menhaden, mullet, and Spanish mackerel, yielded 51,446,435 pounds, valued at $332,812. Other leading forms of apparatus, in the order of their importance, based on the value of their catch, were: Otter trawls with 8,967,918 pounds, principally shrimp, valued at $268,651; haul seines with 5,699,060 pounds, valued at $254,635; and lines with 2,914,917 pounds, valued at $192,880.

The total yield of all forms of apparatus employed in the fisheries of the east coast of Florida amounted to 81,211,488 pounds, valued at $1,746,175, of which 63.04 per cent of the quantity and 18.63 per cent of the value are credited to purse seines operated in the vessel fisheries, the remainder being credited to the various forms of apparatus employed in the shore fisheries.

The products of the vessel and shore fisheries of the east coast of Florida in 1918 are shown in the following tables, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF EAST COAST OF FLORIDA IN 1918, BY PURSE SEINES, COUNTIES, AND SPECIES.

Species.	Dade.		Duval.		Nassau.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Bluefish	23,564	$1,836					23,564	$1,836
Bluerunner or hardtail	900	34					900	34
Butterfish	4,200	170					4,200	170
Menhaden			42,635,400	$181,201	5,660,000	$28,300	48,295,400	209,501
Mullet	2,242,485	74,051					2,242,485	74,051
Pompano	86	14					86	14
Sharks			50,000	250			50,000	250
Spanish mackerel	579,800	39,456					579,800	39,456
Total	2,851,035	115,561	42,685,400	181,451	5,660,000	28,300	51,196,435	325,312

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES.

Species.	Broward.		Duval.		Lake.		Palm Beach.		Putnam.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives					30,000	$450			334,526	$5,018
Angelfish							400	$12		
Barracuda							100	3		
Black drum	160	$8	2,400	$120			21,500	430		
Bluefish	300	60	100	15			64,340	6,834		
Blue runner or hardtail							25,175	775		
Bonito							2,190	66		
Catfish							1,600	32		
Cero or kingfish							18,000	1,080		
Crevalle	800	80					43,830	1,465		
Croaker							21,850	655		
Flounders			400	40			230	7		
Grunts	200	20					7,390	261		
Hogfish							100	5		
Jewfish							1,450	43		
King whiting			8,000	800			7,936	291		
Ladyfish							1,280	13		
Menhaden							57,000	570		
Moonfish	100	8					1,475	46		
Mullet	500	50	16,000	1,280			[1] 727,891	26,368		
Parrotfish							3,500	70		
Permit	50	5					4,130	142		
Pigfish							3,800	114		
Pinfish or "sailor's choice"	200	20					31,310	949		
Pompano	30	6	240	36			41,427	6,604		
Porkfish							100	3		
Redfish or red drum			2,400	240			21,285	682		

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY SEINES—Continued.

Species.	Broward.		Duval.		Lake.		Palm Beach.		Putnam.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Sea gar or needlefish							100	$5		
Sergeantfish or snook	150	$12					59,376	1,871		
Shad					4,850	$678			191,610	$23,852
Sharks							5,100	102		
Sheepshead							9,715	298		
Snapper:										
Mangrove	300	30					1,920	59		
Mutton	600	60					47,680	1,430		
Spanish mackerel							166,122	10,683		
Spot			1,200	$96			22,800	692		
Squeteague or "sea trout"			8,000	800			29,761	2,530		
Yellowtail or "silver perch"							19,020	571		
Sea crawfish or spiny lobster							652	33		
Turtles							250	12		
Total	3,390	359	38,710	3,427	34,850	1,128	1,471,785	65,806	526,136	28,870

Species.	Seminole.		St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives							327,739	$4,905	692,265	$10,373
Angelfish			1,470	$44					1,870	56
Barracuda			50	1					150	4
Black drum			406,292	8,388	7,120	$214	9,600	480	447,072	9,640
Bluefish			46,610	4,629	150	15	650	65	112,150	11,618
Blue runner or hardtail			650	13					25,825	788
Bonito									2,190	66
Catfish			12,300	246					13,900	278
Cero or kingfish									18,000	1,080
Crevalle			250,300	7,457					294,930	9,002
Croaker			87,710	2,332	1,250	50			110,840	3,037
Flounders			2,980	140					3,610	187
Grunts			78,889	2,355					86,479	2,646
Hogfish									100	5
Jewfish			5,150	134					6,600	177
King whiting			78,360	4,480	1,850	111	51,300	4,617	117,446	10,299
Ladyfish									1,280	13
Menhaden			10,200	104					67,200	674
Moonfish			100	3					1,675	57
Mullet			527,400	18,785			960	48	1,272,751	46,531
Parrotfish									3,500	70
Permit			460	11	115	5	200	10	4,955	173
Pigfish			5,400	162	150	6			9,350	282
Pinfish or "sailor's choice"			349,610	10,095	580	23			381,709	11,087
Pompano			57,435	8,615	625	94	4,000	400	103,757	15,755
Porkfish									100	3
Redfish or red drum			247,824	7,052	6,200	310	4,000	240	281,709	8,524
Sea gar or needlefish									100	5
Sergeantfish or snook			221,065	5,637					280,591	7,520
Shad	102,161	$13,277					73,266	10,248	371,887	48,055
Sharks			425	4					5,525	106
Sheepshead			58,475	2,059	210	13	200	12	68,600	2,382
Snapper:										
Mangrove			825	26					3,045	115
Mutton			137,293	3,953					185,573	5,443
Spanish mackerel			6,973	627					173,095	11,310
Spot			325,920	9,776	1,340	54	1,960	98	353,220	10,716
Squeteague or "sea trout"			314,105	27,563	8,342	665	12,000	1,200	372,208	32,758
Yellowtail or "silver perch"			23,290	654					42,310	1,225
Sea crawfish or spiny lobster									652	33
Turtles			600	30					850	42
Total	102,161	13,277	3,258,191	125,385	27,932	1,560	485,875	22,323	5,949,060	262,135

[1] Includes 250,000 pounds of mullet, valued at $7,500, caught with purse seines.

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY GILL NETS.

Species.	Brevard.		Dade.		Duval.		Nassau.		Palm Beach.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Angelfish									770	$25
Barracuda									2,235	67
Black drum	36,500	$1,095							2,450	73
Bluefish									249,202	24,838
Blue runner or hardtail			1,200	$36					22,175	665
Bonito									4,191	126
Crevalle	3,300	132	600	18					11,975	359
Croaker									12,538	376
Flounders	1,210	48							100	5
Grunts									5,230	159
King whiting	13,900	1,132							5,275	239
Moonfish			500	15					5,755	172
Mullet	1,292,600	171,704	408,600	16,344	50,000	$2,620			288,843	11,098
Permit									2,335	71
Pigfish	2,000	64							1,132	34
Pinfish or sailor's choice	43,150	1,386							2,825	85
Pompano	100	15							18,522	2,948
Porgies									100	3
Porkfish									1,260	37
Red drum	31,400	1,256							10,270	453
Sea bass									700	35
Sergeantfish or snook	430	15							7,341	221
Shad					265,608	36,855	61,250	$18,000		
Sharks									7,750	155
Sheepshead	11,945	478							3,890	162
Snapper:										
Mangrove	200	8							10,485	419
Mutton	1,400	54							33,420	1,027
Spanish mackerel			289,835	20,288					1,322,007	91,093
Spot	20,500	675							8,240	247
Squeteague or "sea trout"	518,400	42,252							67,193	6,149
Yellowtail or "silver perch"									1,210	36
Sea crawfish or spiny lobster									1,443	71
Total	1,977,035	220,314	700,735	36,701	315,608	39,475	61,250	18,000	2,110,867	141,448

Species.	Putnam.		St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Angelfish			100	$3					1,870	$28
Barracuda									2,235	67
Black drum			900	20	8,000	$240	4,600	$138	52,150	1,566
Bluefish			125,038	11,306	100	12			374,340	36,156
Blue runner or hardtail									23,375	701
Bonito									4,191	126
Crevalle			3,920	117					19,795	626
Croaker					200	6			12,738	382
Flounders							800	32	2,110	85
Grunts			5,130	194					10,360	353
King whiting			4,437	375	1,300	65	650	51	25,562	1,865
Moonfish									6,255	187
Mullet			896,470	35,750	3,890	199	942,000	37,680	6,882,403	275,395
Permit									2,335	71
Pigfish			1,230	37	150	6	800	24	5,312	165
Pinfish or sailor's choice			9,660	309	210	8	4,400	132	60,245	1,920
Pompano			10,314	1,057	200	30			29,136	4,050
Porgies									100	3
Porkfish									1,260	37
Red drum			12,050	430	1,830	73	5,400	192	60,950	2,404
Sea bass									700	35
Sergeantfish or snook			11,855	345					19,626	581
Shad	264,861	$32,934							591,719	87,789
Shark									7,750	155
Sheepshead			2,082	66	175	11	300	12	18,392	729
Snapper:										
Mangrove			2,666	80					13,351	507
Mutton			800	28					35,620	1,109
Spanish mackerel			689,748	55,211					2,301,590	166,592
Spot			5,220	162	1,600	64	3,600	108	39,160	1,256
Squeteague or "sea trout"			353,429	30,183	7,320	505	84,000	7,460	1,030,347	86,549
Yellowtail or "silver perch"									1,210	36
Sea crawfish or spiny lobster									1,443	71
Total	264,861	32,934	2,135,049	135,673	24,975	1,219	1,046,550	45,832	11,636,930	671,596

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY LINES.

Species.	Brevard.		Broward.		Dade.		Duval.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Amberfish			150	$12	200	$8		
Angelfish					175	7		
Barracuda			150	12	200	8		
Black drum							30,000	$900
Bluefish					300	30	1,500	150
Blue runner or hardtail					400	12		
Bonito			100	10	50	3		
Cero or kingfish			300	45	973,331	68,133		
Cowfish and "shellfish"					50	2		
Crevalle					200	8		
Grouper			200	20	41,978	2,518		
Grunts			200	20	10,650	426		
Hogfish					150	6		
King whiting							24,000	1,440
Leather jacket or "turbot"					200	8		
Moonfish					40	1		
Pigfish					100	4		
Pinfish or sailor's choice					200	10		
Pompano					360	54		
Porgies					5,000	300		
Porkfish					350	17		
Red drum			100	12			24,000	1,440
Sea bass					100	8	20,000	1,600
Sergeantfish or snook			200	16				
Sheepshead			50	5	100	6	14,000	840
Snapper:								
Mangrove			300	30	2,700	135		
Mutton			100	10	7,500	300		
Red							19,200	1,920
Spanish mackerel					780	62		
Squeteague or "sea trout"	73,082	$8,039			1,000	80	80,000	6,400
Yellowtail or "silver perch"					450	18		
Crabs, hard							32,000	800
Total	73,082	8,039	1,850	192	1,046,564	72,164	244,700	15,490

Species.	Palm Beach.		St. John.		Volusia.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Amberfish	11,336	$370					11,686	$390
Angelfish							175	7
Barracuda	180	6					530	26
Black drum			1,300	$52			31,300	952
Bluefish	48,797	4,860	650	65			51,247	5,105
Blue runner or hardtail	250	7					650	19
Bonito	1,460	44	150	9			1,760	66
Cero or kingfish	1,280,161	78,350					2,253,792	146,528
Cowfish and "shellfish"							50	2
Crevalle	6,105	197					6,305	205
Flounders	100	5	170	10			270	15
Grouper	32,605	1,084					74,783	3,622
Grunts	5,840	175	150	9			16,840	630
Hogfish							150	6
Jewfish	5,667	179	220	9			5,887	188
King whiting							24,000	1,440
Leather jacket or "turbot"	170	5					370	13
Moonfish							40	1
Pigfish							100	4
Pinfish or sailor's choice							200	10
Pompano	80	16					440	70
Porgies	850	25					5,850	325
Porkfish							350	17
Red drum	800	32	1,200	48			26,100	1,532
Sea bass	19,121	986	1,410	70			40,631	2,664
Sergeantfish or snook	14,357	512					14,557	528
Sharks	500	15					500	15
Sheepshead	3,081	148					17,231	999
Snapper:								
Mangrove	3,790	188					6,790	353
Mutton	12,285	537					19,885	847
Red	1,000	80					20,200	2,000
Spanish mackerel	5,190	514	1,510	151			7,480	727
Squeteague or "sea trout"	38,876	3,888	9,360	749	40,000	$3,600	242,318	22,756
Yellowtail or "silver perch"							450	18
Crabs, hard							32,000	800
Total	1,492,601	92,223	16,120	1,172	40,000	3,600	2,914,917	192,880

YIELD OF SHORE FISHERIES OF THE EAST COAST OF FLORIDA IN 1918, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, CAST NETS, DIP NETS, TRAPS, AND SPEARS.

Apparatus and species.	Dade.		Duval.		Nassau.		St. John.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls:										
Shrimp					8,806,568	$264,197	61,350	$2,454	8,867,918	$266,651
King whiting					100,000	2,000			100,000	2,000
Total					8,906,568	266,197	61,350	2,454	8,967,918	268,651
Cast nets:										
Croaker							700	28	700	28
Black drum							510	20	510	20
Mullet			12,000	$840			8,250	330	20,250	1,170
Pinfish, or sailor's choice							390	16	390	16
Sheepshead							80	5	80	5
Spot							650	26	650	26
Squeteague or "sea trout"							350	28	350	28
Total			12,000	840			10,930	453	22,930	1,293
Dip nets: Sea crawfish or spiny lobster	21,408	$1,070							21,408	1,070
Traps: Crabs, hard			20,000	1,000					20,000	1,000
Spears: Flounders							7,500	450	7,500	450

BY RAKES, TONGS, AND HAND.

Apparatus and species.	Dade.		Duval.		Nassau.		Palm Beach.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Tongs: Oysters, market, public			31,500	$1,800			2,100	$195
By hand:								
Oysters, market, public					90,293	$3,315		
Oysters, market, private					135,065	3,994	10,500	1,000
Conch meat							7,000	700
Turtles [1]	6,000	$360						
Total	6,000	360			225,358	7,309	17,500	1,700

Apparatus and species.	St. Lucie.		St. John.		Volusia.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Rakes: Clams, hard			2,400	$600			2,400	$600
Tongs: Oysters, market, public	4,900	$455	31,500	2,250	153,132	$7,119	223,132	11,819
By hand:								
Oysters, market, public							90,293	3,315
Oysters, market, private							145,565	4,994
Conch meat							7,000	700
Turtles [1]							6,000	360
Total							248,858	9,369

[1] Part of these were taken by gaffs.

INDUSTRIES.

Menhaden industry.—In 1918 there were 4 factories, valued at $413,098, operated on the east coast of Florida, using $40,000 in cash capital and employing 177 persons, to whom $103,256 were paid in wages. The manufactured products, including the products of a factory in Georgia, follow: Oil, 125,478 gallons, valued at $48,189; dried scrap, 444 tons, valued at $37,296; acidulated scrap, 6,886 tons, valued at $296,174; and crude or green scrap, 5,000 tons, valued at $185,000.

Wholesale trade.—There were 50 firms engaged in the wholesale trade in fishery products, valued at $534,644. These used $101,600 in cash capital and gave employment to 416 persons, to whom $189,421 were paid in wages.

Canning industry.—In 1918 there were 3 canneries, valued at $92,023, using cash capital to the amount of $15,000 and employing 275 persons, to whom $34,306 were paid in wages. The products prepared consisted of canned oysters to the value of $17,210, and canned shrimp to the value of $118,660.

The following tables contain detailed statistics of these industries in 1918:

INDUSTRIES ON THE EAST COAST OF FLORIDA, 1918.

MENHADEN INDUSTRY.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments	4	$413,098	PRODUCTS.		
Cash capital		40,000			
Persons engaged	177		Oil.....gallons..	[1] 125,478	$48,189
Wages paid		103,256	Dry scrap.....tons..	444	37,296
			Acidulated scrap.....do....	6,886	296,174
			Crude or green scrap...do....	[1] 5,000	185,000

OYSTER AND SHRIMP CANNING INDUSTRY.

Item.	Number.	Value.	Item.	Number.	Value.
Establishments	3	$92,023	PRODUCTS—continued.		
Cash capital		15,000			
Persons engaged	275		Shrimp, canned:		
Wages paid		34,306	No. 1 cans.....cases..	[2] 15,317	$75,920
			No. 1½ cans.....do....	[3] 8,503	12,740
PRODUCTS.			Total		118,660
Oysters, canned:					
4-ounce cans.....cases..	[2] 500	2,700			
5-ounce cans.....do....	[2] 1,434	8,030			
8-ounce cans.....do....	[3] 1,200	6,480			
Total		17,210			

[1] Includes one factory in Georgia. [2] Four dozen cans per case. [3] Two dozen cans per case.

SUMMARY OF THE FISHERIES OF FLORIDA IN 1918.

In the following table the fisheries of both coasts of Florida are combined for purposes of comparison and study of the State as a whole with other States of the region. In 1918 the fisheries of the State gave employment to 8,491 persons, the total investment amounted to $4,614,924, and the products amounted to 135,965,127 pounds, valued at $5,166,538. Of the South Atlantic and Gulf States, Florida ranks first in the number of persons engaged, investment, and quantity and value of products, and North Carolina second. Louisiana ranks third, excepting in quantity of products, Georgia and Texas having larger quantities accredited to them.

FISHERIES OF FLORIDA IN 1918.

Item.	East coast.		West coast.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	380		623		1,003	
On vessels transporting	15		70		85	
In shore fisheries	2,104		3,600		5,704	
Shoresmen	831		868		1,699	
Total	3,330		5,161		8,491	
INVESTMENT.						
Vessels fishing:						
Gasoline	23	$377,600	33	$92,630	56	$470,230
Tonnage	725		360		1,085	
Outfit		71,287		27,043		98,330
Sail			62	309,800	62	309,800
Tonnage			2,069		2,069	
Outfit				71,520		71,520
Vessels transporting:						
Gasoline	7	32,300	34	105,800	41	138,100
Tonnage	89		455		544	
Outfit		3,850		22,444		26,294
Sail			50	80,650	50	80,650
Tonnage			1,025		1,025	
Boats:						
Sail, row, etc	607	20,180	2,019	128,900	2,626	149,080
Power	839	459,650	1,018	438,962	1,857	898,612
Apparatus, vessel fisheries:						
Seines	25	52,900	1	1,600	26	54,500
Gill nets			6	120	6	120
Lines				5,379		5,379
Otter trawls			16	720	16	720
Tongs			12	120	12	120
Sponge apparatus				219		210
Other apparatus				2		2
Apparatus, shore fisheries:						
Seines	117	61,030	163	61,175	280	122,205
Trammel nets			146	11,990	146	11,990
Gill nets	715	101,725	1,795	106,070	2,510	207,795
Stop nets			136	6,810	136	6,810
Cast nets	16	80			16	80
Lines		2,965		2,046		5,011
Otter trawls	255	16,500	107	4,770	362	21,270
Tongs, grabs, and rakes	37	224	284	2,616	321	2,840
Spears or gigs	12	12			12	12
Crab traps and drags	20	50			20	50
Sponge apparatus				70,935		70,935
Other apparatus		6		12,596		12,602
Shore and accessory property		858,720		619,987		1,478,707
Cash capital		151,600		219,350		370,950
Total		2,210,679		2,404,245		4,614,924
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives	692,265	$10,373			692,265	$10,373
Amberfish	11,686	390	11,100	$413	22,786	803
Angelfish	2,915	91	20,825	798	23,740	889
Barracuda	2,915	97	4,860	232	7,775	329
Bluefish:						
Fresh	561,301	54,715	246,168	17,411	807,469	72,126
Salted			12,240	915	12,240	915
Blue runner or hardtail:						
Fresh	50,750	1,542	324,648	6,935	375,398	8,477
Salted			65,430	2,734	65,430	2,734
Bonito	8,141	258	50,955	2,045	59,096	2,303
Butterfish	4,200	170			4,200	170
Catfish	13,900	278	51,427	3,126	65,327	3,404
Cero and king fish	2,271,792	147,608	465,860	31,903	2,737,652	179,511
Cowfish and "shellfish"	50	2	300	12	350	14
Crevalle	321,030	9,833	105,927	3,800	426,957	13,633
Croaker	124,278	3,447			124,278	3,447
Drum, red and black	900,091	24,638	994,910	39,803	1,895,001	64,441
Elops or ten-pounder:						
Fresh			267,940	5,402	267,940	5,402
Salted			9,883	334	9,883	334
Flounders	13,490	737	37,381	2,089	50,871	2,826
Groupers	74,783	3,622	5,626,329	222,215	5,701,112	225,837
Grunts	113,679	3,629	87,349	3,618	201,028	7,247
Hogfish	250	11	7,344	336	7,594	347
Jewfish	12,487	365	69,844	2,704	82,331	3,069
King whiting	297,008	15,604	35,188	2,126	332,196	17,730

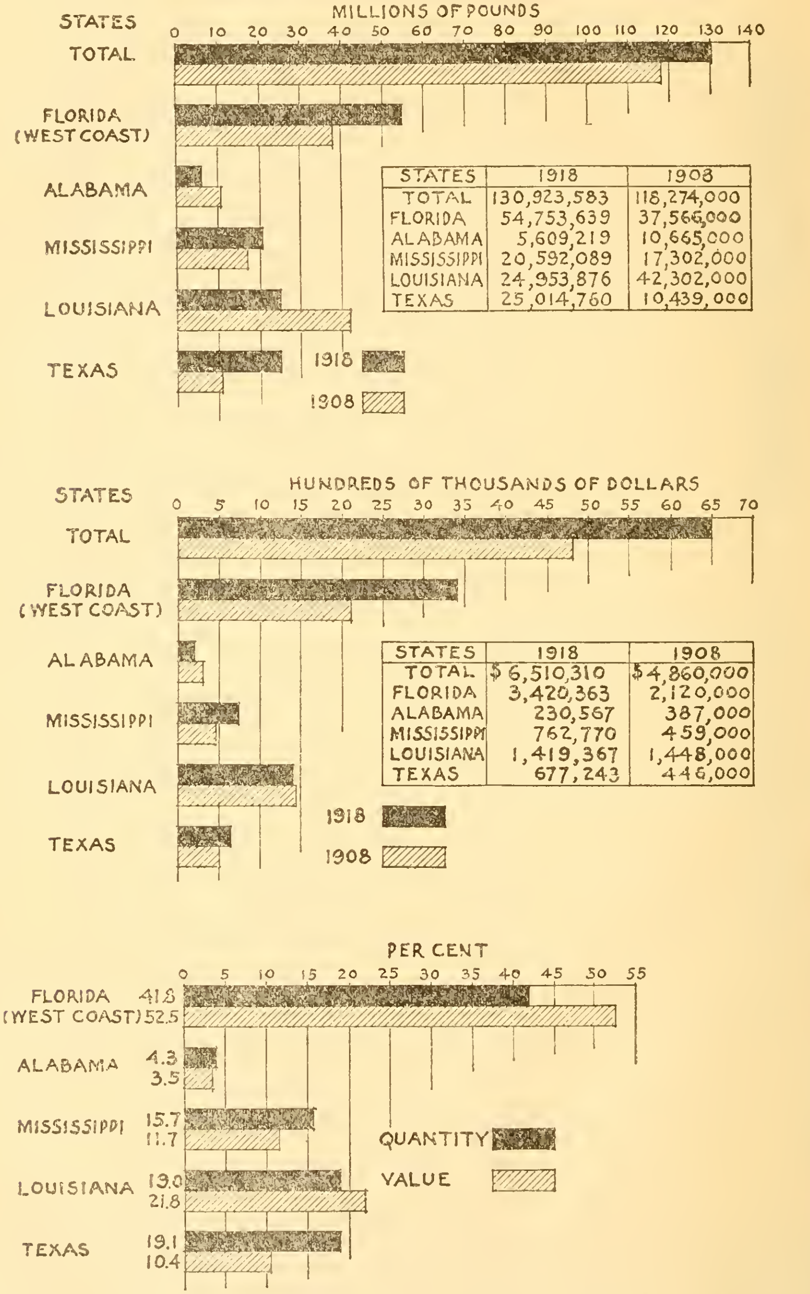
Fisheries of Florida in 1919—Continued.

Item.	East coast.		West coast.		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Ladyfish	1,280	$13			1,280	[illegible]
Leather jacket or "turbot"	370	13	7,756	$357	8,126	[illegible]
Menhaden:						
Fresh	48,362,600	210,175	263,530	6,779	48,626,130	[illegible]
Salted			21,022	669	21,022	[illegible]
Moonfish	7,970	245	650	23	8,620	[illegible]
Mullet:						
Fresh	10,417,889	397,147	22,569,736	973,129	32,987,625	1,370,276
Salted			2,453,930	177,974	2,453,930	177,974
Mullet roe, salted			85,285	17,593	85,285	17,593
Parrotfish	3,500	70			3,500	70
Permit	7,290	244	7,865	294	15,155	538
Pigfish	14,762	451	6,596	250	21,358	701
Pinfish or sailor's choice	442,535	13,033	21,132	809	463,667	13,842
Pompano:						
Fresh	133,419	19,889	235,992	27,262	369,411	47,151
Salted			3,075	520	3,075	520
Porgies	5,950	328	56,742	2,442	62,692	2,770
Porkfish	1,710	57	2,400	144	4,110	201
Redfish or red drum, salted			7,321	366	7,321	366
Scamp			300	10	300	10
Sea bass	41,331	2,699	31,641	2,180	72,972	4,879
Sea gar or needlefish	100	5			100	5
Sergeantfish or snook	314,774	8,629	73,745	2,568	388,519	11,197
Shad	963,606	135,844			963,606	135,844
Sharks	63,775	526			63,775	526
Sheepshead	104,303	4,115	988,662	32,627	1,092,965	36,742
Snapper:						
Mangrove	23,186	975	103,999	4,359	127,185	5,334
Mutton	241,078	7,399	14,100	564	255,178	7,963
Red	20,200	2,000	7,230,168	455,640	7,250,368	457,640
Spanish mackerel:						
Fresh	3,061,965	218,085	3,408,701	244,026	6,470,666	462,111
Salted			27,200	1,505	27,200	1,505
Spot	393,030	11,998	37,977	1,519	431,007	13,517
Squeteague or "sea trout":						
Fresh	1,645,223	142,091	1,630,686	145,534	3,275,909	287,625
Salted			31,625	3,772	31,625	3,772
Sturgeon			4,915	620	4,915	620
Sturgeon caviar and roe			12	12	12	12
Tang			600	30	600	30
Tarpon			1,800	180	1,800	180
Yellowtail			31,735	1,537	31,735	1,537
Yellowtail or "silver perch"	43,970	1,279			43,970	1,279
Shrimp	8,867,918	266,651	3,250,468	81,408	12,118,386	348,059
Sea crawfish	23,503	1,174	322,015	16,064	345,518	17,238
Crabs:						
Hard	52,000	1,800			[1] 52,000	1,800
Stone			24,500	2,600	24,500	2,600
Terrapin			2,475	206	2,475	206
Turtles	6,850	402	65,370	4,429	72,220	4,831
Clams, hard	2,400	600	160,872	14,336	[2] 163,272	14,936
Conch meat	7,000	700	2,000	100	9,000	800
Oysters, market:						
Public	313,425	15,134	2,602,446	121,049	[3] 2,915,871	136,183
Private	145,565	4,994	13,496	771	[4] 159,061	5,765
Sponges:						
Glove			2,022	245	2,022	245
Grass			73,033	12,125	73,033	12,125
Sheepswool			276,168	675,781	276,168	675,781
Wire			9,324	2,817	9,324	2,817
Yellow			91,641	34,187	91,641	34,187
Total	84,201,488	1,746,175	51,753,639	3,420,363	135,955,127	5,166,538

[1] 156,000 in number. [2] 20,409 bushels. [3] 416,553 bushels. [4] 22,723 bushels.

SPONGE FISHERY OF FLORIDA.

The sponge fishery of Florida is prosecuted on the west coast of the State, and the catch is sold by bunches chiefly through the sponge exchange at Tarpon Springs. The large wool and grass sponges are estimated at 2½ pounds per bunch, small wool sponges at 1 pound, and yellow and wire sponges at 1½ pounds. In 1919 the quantity sold at the exchange amounted to 424,075 pounds, valued at $707,964, and in 1920 to 409,746 pounds, valued at $678,209. A considerable quantity is also sold at Key West.



STATES	1918	1908
TOTAL	130,923,583	118,274,000
FLORIDA	54,753,639	37,566,000
ALABAMA	5,609,219	10,665,000
MISSISSIPPI	20,592,089	17,302,000
LOUISIANA	24,953,876	42,302,000
TEXAS	25,014,760	10,439,000

STATES	1918	1908
TOTAL	$6,510,310	$4,860,000
FLORIDA	3,420,363	2,120,000
ALABAMA	230,567	387,000
MISSISSIPPI	762,770	459,000
LOUISIANA	1,419,367	1,448,000
TEXAS	677,243	446,000

FIG. 8.—Top: Quantities of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Center: Values of fish taken in the commercial fisheries of the Gulf States in 1918 compared with 1908. Bottom: Percentages of total quantity and value of fishery products for each of the Gulf States in 1918.

Following are statistics of the quantity in pounds based on the above conversion figures of the different kinds of sponges sold at the exchange at Tarpon Springs in 1919 and 1920:

SPONGES SOLD AT THE EXCHANGE, TARPON SPRINGS, FLA., 1919 AND 1920.

Kind.	1919		1920	
	Pounds.	*Value.*	*Pounds.*	*Value.*
Large wool	205,462	$514,222	176,722	$522,399
Small wool	76,309	95,386	60,902	79,172
Yellow	73,051	39,161	72,648	43,199
Grass	62,547	25,171	92,880	29,722
Wire	6,706	4,024	6,594	3,417
Total	424,075	707,964	409,746	678,209

SUMMARIES OF THE FISHERIES OF THE GULF STATES FOR VARIOUS YEARS.

In the appended table are given comparative statistics showing the number of persons engaged, investment, and quantities and values of the products of the fisheries of the Gulf States for various years from 1880 to 1918. A similar summary of the fisheries of the South Atlantic States for the same years appears on page 65 of this report. In view of the increasing attention which the fisheries of these regions are receiving, these will serve to indicate the relative rate of growth and development of these fisheries.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918.[1]

Item.	1880	1887	1888	1889
PERSONS ENGAGED.				
Florida (west coast)	2,112	(2)	3,066	3,739
Alabama	635	(2)	318	594
Mississippi	186	1,153	1,380	1,809
Louisiana	1,597	3,607	3,758	3,966
Texas	601	1,027	1,021	1,211
Total	5,131	(2)	9,543	11,319
INVESTMENT.				
Florida (west coast)	$362,563	(2)	$613,736	$1,281,190
Alabama	38,200	(2)	61,904	126,925
Mississippi	8,800	$284,760	329,632	455,300
Louisiana	93,621	633,007	664,927	706,557
Texas	42,400	206,591	214,511	256,431
Total	545,584	(2)	1,884,710	2,826,403
PRODUCTS.[3]				
Pounds:				
Florida (west coast)	8,376,335	(2)	(2)	23,597,240
Alabama	3,541,500	(2)	1,633,589	4,560,269
Mississippi	788,500	6,548,175	7,833,010	8,933,339
Louisiana	6,996,000	18,455,489	19,121,056	20,947,239
Texas	3,858,875	6,282,489	6,609,161	7,357,800
Total	23,561,210	(2)	(2)	65,395,887
Value:				
Florida (west coast)	$564,819	(2)	$628,396	$948,845
Alabama	119,275	(2)	75,560	146,841
Mississippi	22,540	$189,716	231,712	250,884
Louisiana	392,610	579,504	612,820	621,048
Texas	128,300	256,250	271,257	297,258
Total	1,227,544	(2)	1,819,745	2,264,876

[1] Statistics for 1908 are from data published by the Bureau of the Census.
[2] Statistics not available.
[3] The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 137, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

EXTENT OF FISHERIES OF THE GULF STATES, VARIOUS YEARS, 1880 TO 1918—Contd.

Item.	1890	1897	1902	1908	1918
PERSONS ENGAGED.					
Florida (west coast)	4,068	5,011	6,416	6,016	5,161
Alabama	618	789	1,098	895	783
Mississippi	1,721	2,565	4,344	1,561	2,867
Louisiana	4,068	4,403	5,027	5,152	4,191
Texas	1,277	1,199	1,144	1,780	1,886
Total	11,752	13,967	18,029	[1] 15,404	14,888
INVESTMENT.					
Florida (west coast)	$1,369,294	$1,149,262	$1,945,320	$1,884,000	$2,404,245
Alabama	135,290	165,189	328,285	262,000	334,741
Mississippi	434,710	518,301	1,270,408	461,000	1,453,585
Louisiana	719,876	513,813	789,723	841,000	1,475,188
Texas	319,122	237,496	373,724	454,000	890,100
Total	2,978,292	2,584,061	4,707,460	[1] 3,902,000	6,537,859
PRODUCTS.[2]					
Pounds:					
Florida (west coast)	27,418,562	28,255,219	48,120,019	37,566,000	54,753,639
Alabama	4,776,968	4,699,381	9,351,447	9,918,450	5,609,219
Mississippi	8,131,401	7,829,685	23,426,965	17,302,000	20,592,089
Louisiana	20,789,203	17,401,788	24,754,135	42,302,000	24,953,876
Texas	7,959,400	7,174,550	8,044,404	10,439,000	25,014,760
Total	69,075,534	65,360,623	113,696,970	117,527,450	130,923,583
Value:					
Florida (west coast)	$1,064,139	$944,793	$1,462,166	$2,120,000	$3,420,363
Alabama	154,871	134,438	266,682	358,000	230,567
Mississippi	245,699	192,298	553,220	459,000	762,770
Louisiana	660,134	713,587	858,314	1,448,000	1,419,367
Texas	313,832	286,610	353,814	446,000	677,243
Total	2,438,675	2,271,726	3,494,196	4,831,000	6,510,310

[1] Exclusive of persons and investment in canneries, packing houses, and other establishments.
[2] The quantity and value of products given for Florida for 1888 in the report of the Division of Statistics and Methods of the Fisheries for 1919, page 137, include both coasts of the State, and those for Alabama for 1908 include the Tennessee River district.

FISHERIES OF THE NEW ENGLAND STATES IN 1919.

The statistics of the coast fisheries of the New England States presented in this report are for the calendar year 1919 and have been published in summarized form in Statistical Bulletin No. 497.[11] Included in this report are statistics of the sardine industry of Maine for 1919 and 1920 and the salmon fishery of the Penobscot River and Bay for 1918, 1919, and 1920.

EARLIER PUBLICATIONS.

Some of the previous publications containing statistical information on the fisheries of the New England States and published in Washington, D. C., follow:

1873. Report on the Conditions of the Sea Fisheries of the South Coast of New England in 1871 and 1872. By Spencer F. Baird. Report, U. S. Commission of Fish and Fisheries, 1871 and 1872 (1873), p. i–xli.

1887. The Coast of Maine and Its Fisheries. By R. Edward Earll. *In* The Fisheries and Fishery Industries of the United States, by G. Brown Goode et al., Sec. II, Pt. I, p. 5–102.

The Fisheries of New Hampshire. By W. A. Wilcox. Ibid., Sec. II, Pt. II, p. 103–112.

[11] The statistical data were collected by Winthrop A. Roberts, Rob Leon Greer, Andrew J. Messner Walter H. Rich, Lawrence T. Hopkinson, and Fred F. Johnson, statistical agents of the Bureau.

1887. The Fisheries of Massachusetts. By A. Howard Clark. Ibid., Sec. II, Pt. III, p. 113-280.

The Fisheries of Rhode Island. By A. Howard Clark. Ibid., Sec. II, Pt. IV, p. 281-310.

The Coast of Connecticut and Its Fisheries. By A. Howard Clark. Ibid., Sec. V, p. 311-340.

History and Methods of the Fisheries. Ibid., Sec. V, Vol. I (xi+808 p.), Vol. II (xx+881 p.), and atlas of 275 pls.

1889. The Sea Fisheries of Eastern North America. By Spencer F. Baird. Appendix A, Report, U. S. Commission of Fish and Fisheries, 1886 (1889), 224 p.

1891. Notes on the Oyster Fishery of Connecticut. By J. W. Collins. Bulletin, U. S. Fish Commission, Vol. IX, 1889 (1891), p. 461–497, Pl. CLIX-CLXVI.

1892. III. Fisheries of the New England States [1887 and 1888]. *In* Statistical Review of the Coast Fisheries of the United States, prepared under the direction of J. W. Collins. Report, U. S. Commission of Fish and Fisheries, 1888 (1892), p. 286–322.

Report on the Fisheries of the New England States. By J. W. Collins and Hugh M. Smith. Bulletin, U. S. Fish Commission, Vol. X, 1890 (1892), p. 73-176.

1898. The Herring Industry of the Passamaquoddy Region, Maine. By Ansley Hall. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), p. 443–487.

1899. The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Report, U. S. Commission of Fish and Fisheries, 1898 (1899), p. 101-269.

1901. The Lobster Fishery of Maine. By John N. Cobb. Bulletin, U. S. Fish Commission, Vol. XIX, 1899 (1901), p. 241-265, illus., pl. 28-32.

Statistics of the Fisheries of the New England States. Report, U. S. Commission of Fish and Fisheries, 1900 (1901), p. 311–386.

1905. Statistics of the Fisheries of the New England States, 1902. Report, U. S. Bureau of Fisheries, 1904 (1905), p. 245–325.

1908. Statistics of the Fisheries of the New England States for 1905. Report and Special Papers, U. S. Bureau of Fisheries, 1906 (1908), 93 p.

1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

COMMON AND SCIENTIFIC NAMES OF FISHES.

Following is a list of the common and scientific names of the fishes of New England States to which reference is made in the present report. If the trade will adopt the common names employed herein, it is believed that much of the confusion now encountered will be avoided and that in this way the consumer may be educated to the relative merits of individual species.

Alewives	*Pomolobus æstivalis.* *Pomolobus pseudoharengus.*
Bluefish	*Pomatomus saltatrix.*
Bonito	*Sarda sarda.*
Bullhead	*Ameiurus nebulosus.*
Butterfish	*Poronotus triacanthus.*
Carp	*Cyprinus carpio.*
Cod	*Gadus callarias.*
Cunner	*Tautogolabrus adspersus.*
Cusk	*Brosmius brosme.*
Eels	*Anguilla rostrata.* *Leptocephalus conger.*
Flounders	Pleuronectidæ (species).
Grayfish	*Squalus acanthias.*
Haddock	*Melanogrammus æglifinus.*
Hake	Urophycis tenuis. Urophycis chuss.
Halibut	*Hippoglossus hippoglossus.*
Herring	*Clupea harengus.*
Hickory shad	*Pomolobus mediocris.*
King whiting	*Menticirrhus saxatilis.*

Launce	*Ammodytes americanus.*
Mackerel	*Scomber scombrus.*
Menhaden	*Brevoortia tyrannus.*
Monkfish	*Lophius piscatorius.*
Minnows	Various species small fishes.
Perch, white	*Morone americana.*
Perch, yellow	*Perca flavescens.*
Pickerel	*Esox reticulatus.*
Pollock	*Pollachius virens.*
Pompano	Trachinotus (species).
Rosefish	*Sebastes marinus.*
Round herring	*Etrumeus teres.*
Salmon, Atlantic	*Salmo salar.*
Salmon, humpback	*Oncorhynchus gorbuscha.*
Sculpins	Cottidæ (species).
Scup	*Stenotomus chrysops.*
Sea bass	*Centropristes striatus.*
Sea robin	*Prionotus carolinus.* *Prionotus strigatus.*
Shad	*Alosa sapidissima.*
Sharks	All Selachii except Batoidei.
Skates and rays	Batoidei (species).
Smelt	*Osmerus mordax.*
Squeteague	*Cynoscion regalis.*
Striped bass	*Roccus lineatus.*
Sturgeon	*Acipenser sturio.*
Suckers	Catostomidæ (species).
Sunfish	Centrarchidæ (species).
Swordfish	Xiphias gladius.
Tautog	*Tautoga onitis.*
Tilefish	*Lopholatilus chamæleonticeps.*
Tomcod	*Microgadus tomcod.*
Tuna	*Thunnus thynnus.*
Whiting	*Merluccius bilinearis.*
Wolffish	*Anarhichas lupus.*

GENERAL STATISTICS.

The fisheries of the New England States in 1919 gave employmentto 30,767 persons, of whom 6,346 were on vessels fishing, 533 on vessels transporting fishery products, 10,968 in the shore or boat fisheries, and 12,920 shoresmen in the wholesale fishery trade, canneries, smokehouses, oysterhouses, and other shore industries connected with the fisheries. The number of persons engaged in the fisheries of the different States follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, the year for which the last canvass was made by the Bureau, there has been a decrease in the number of persons employed in all of the States of 6,572 persons, or 17.60 per cent. The decrease by States follows: Massachusetts, 3,348 persons, or 21.33 per cent; Maine, 1,495 persons, or 9.41 per cent; Connecticut, 1,118 persons, or 32.81 per cent; Rhode Island, 566 persons, or 25.59 per cent; and New Hampshire, 45 persons, or 31.03 per cent.

The total amount of capital invested in the fisheries and fishery industries of these States in 1919 was $40,597,097. There has been an increase of $18,066,377, or 80.18 per cent, in money invested in the fisheries and fishery industries of the region since 1905. In Maine the investment amounted to $17,544,969, an increase of $8,572,920, or 95.55 per cent, as compared with 1905. In Massachusetts the investment was $19,111,269, an increase of $8,300,827, or 76.79 per cent, compared with 1905. In Rhode Island the investment amounted to $2,249,536, an increase of $1,184,110, or 111.14 per cent. In Connecticut the investment was $1,645,793, an increase of $10,040, or 0.61 per cent, as compared with 1905; and in New Hampshire the investment in 1919 was $45,530, a decrease of $1,520, or 3.23 per cent, as compared with 1905. The investment included 757 fishing vessels, valued at $8,501,081, having a net tonnage of 24,099 tons and outfits valued at $2,400,500; 221 transporting vessels, valued at $741,005, having a net tonnage of 3,214 tons and outfits valued at $185,425; 10,364 boats, valued at $2,280,713; fishing apparatus used by vessels and boats, valued at $2,888,332; shore and accessory property to the value of $20,354,089; and cash or working capital to the amount of $3,245,952. The principal forms of fishing apparatus arranged in order of value are pound nets, trap nets, and weirs, 1,119 in number, valued at $1,087,997; lobster pots, 239,558, valued at $612,207; seines, 441, valued at $415,507; gill nets, 14,616, valued at $324,246; and lines valued at $287,579.

The use of the otter trawl introduced in the vessel and shore fisheries for the capture of ground fish probably represents the most important change in apparatus since 1905. In 1905 none were reported in operation, while in 1919 there were 492, valued at $37,987.

The combined catch of all the New England States amounted to 467,339,870 pounds, valued at $19,838,657. Of this amount the largest quantity, amounting to 246,951,241 pounds, valued at $10,859,746, is credited to Massachusetts. Maine ranks second, with a catch of 147,956,369 pounds, valued at $3,889,035; Rhode Island third, with a catch of 48,250,883 pounds, valued at $3,296,578; Connecticut fourth, with 23,652,647 pounds, valued at $1,700,638; and New Hampshire fifth, with 528,730 pounds, valued at $92,660.

The more important species taken in these States were: Cod, 84,917,535 pounds, valued at $3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at $2,617,020; lobsters, 10,666,706 pounds, valued at $2,550,980; haddock, 89,405,609 pounds, valued at $2,544,617; and mackerel, 15,785,012 pounds, valued at $1,562,088.

Compared with the Bureau's returns for 1905 there has been a decrease in the products of the fisheries of 12,943,734 pounds, or 2.70 per cent, in the quantity, and an increase of $5,654,452, or 39.87 per cent, in the value. Compared with the returns of the Bureau of the Census for 1908 there has been a decrease in the products of 62,689,130 pounds, or 11.83 per cent, in the quantity and an increase of $4,699,657, or 31.04 per cent, in the value. Compared with 1905 there was an increase in the quantity of products in Maine amounting to 23,232,583 pounds, or 18.62 per cent; in Rhode Island, of 24,354,640 pounds, or 101.92 per cent; but decreases in Connecticut of 51,320,001 pounds, or 68.45 per cent; in Massachusetts, of 8,703,234 pounds, or 3.40 per cent, and in New Hampshire of 507.722 pounds, or 48.99 per cent. In 1919 there was an increase in the value of the products in all of the States except Connecticut, as compared with 1905, as follows: Massachusetts, $3,834,497, or 54.56 per cent; Rhode Island, $1,749,920, or 113.14 per cent; Maine, $1,502,629, or 62.96 per cent; and New Hampshire, $40,716, or 78.38 per cent. In Connecticut the decrease in value amounted to $1,473,310, or 46.42 per cent.

The following table gives the catch of certain species for various years from 1889 to 1919. These have been subdivided into groups along the following general lines: (*a*) Species for which there have been relatively intensive fisheries and which on the basis of the returns reveal little indication of depletion of supply; (*b*) species showing signs of a depleted supply; and (*c*) species for which there has been an increasing demand and a sufficient supply to satisfy that demand.

PRODUCTS, IN POUNDS, OF CERTAIN FISHERIES OF THE NEW ENGLAND STATES, VARIOUS YEARS, 1889 TO 1919.

Year.	Cod.	Hake.	Mackerel.	Swordfish.	Clams, hard.
1889	97,145,645	14,816,306	8,361,408	1,230,339	541,200
1898	89,207,975	37,184,193	8,795,084	1,617,331	994,232
1902	88,254,949	33,182,559	20,358,982	1,689,740	1,223,200
1905	75,065,224	35,470,667	15,981,034	3,296,369	1,568,264
1908	95,284,000	34,121,300	11,492,000	2,703,000	1,381,000
1919	84,917,535	20,222,267	15,785,012	1,325,980	1,082,152

Year.	Halibut.	Alewives.	Shad.	Lobster.	Clams, soft.
1889	10,740,843	7,882,682	1,334,714	30,449,603	11,542,272
1898	10,828,187	6,985,948	1,415,649	14,661,808	11,296,901
1902	12,365,705	8,437,446	1,380,812	14,756,495	8,345,470
1905	3,017,776	8,743,284	1,260,904	11,524,499	6,375,850
1908	4,353,500	7,581,000	1,285,500	14,734,000	7,294,000
1919	1,960,030	3,782,289	939,995	10,666,707	4,992,874

Year.	Haddock.	Pollock.	Herring.	Whiting.	Flounders.
1889	43,473,627	8,442,397	36,316,259	126,089	2,950,978
1898	45,676,155	9,444,887	64,587,461	41,050	4,109,494
1902	47,077,315	17,744,127	191,739,467	2,513,470	4,808,716
1905	76,617,156	28,949,359	83,390,554	4,812,840	5,761,473
1908	59,544,000	29,244,300	121,700,000	713,000	9,753,000
1919	89,405,609	25,009,639	97,636,395	16,199,637	15,541,047

The following tables contain statistics of the number of persons employed, the amount of capital invested, the quantity and value of the products of the fisheries of the New England States in 1919, statistics of certain shellfish products in bushels and number, and comparative statistics of persons, investment, and products for various years from 1880 to 1919:

FISHERIES OF THE NEW ENGLAND STATES, 1919.

Item.	Maine.		New Hampshire.		Massachusetts.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
PERSONS ENGAGED.						
On vessels fishing	1,004				4,459	
On vessels transporting	339		3		66	
In shore fisheries	5,332		85		3,737	
Shoresmen	7,711		12		4,084	
Total	14,386		100		12,346	
INVESTMENT.						
Vessels, fishing:						
Steam	5	$1,002,500			31	$2,484,545
Tonnage	662				3,310	
Outfit		70,050				429,961
Gasoline	173	514,650			308	2,776,508
Tonnage	2,039				8,202	
Outfit		9 ,013				1,059,438
Sail	4	53,000			51	808,315
Tonnage	392				4,734	
Outfit		25,800				352,312

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Maine.		New Hampshire.		Massachusetts.	
INVESTMENT—continued.						
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Vessels transporting:						
Steam	2	$9,000				
Tonnage	28					
Outfit		2,800				
Gasoline	165	510,010	1	$6,300	22	$108,950
Tonnage	1,762		8		460	
Outfit		103,998		3,000		16,689
Sail	2	16,715			3	13,809
Tonnage	121				132	
Outfit		6,375				2,375
Boats:						
Sail, row, etc.	2,759	83,639	31	802	1,308	58,488
Power	3,090	902,080	53	10,675	1,732	891,195
Apparatus, vessel fisheries:						
Seines	84	93,270			100	193,850
Gill nets	1,253	29,689			5,430	107,685
Otter trawls	13	2,520			119	17,850
Lines, hand and trawl		34,747				133,658
Harpoons		2,230				6,655
Lobster pots	1,085	2,195			430	1,050
Dredges	4	400			224	2,516
Tongs and rakes					3	19
Whaling apparatus						29,000
Apparatus, shore fisheries:						
Seines	103	41,055			67	46,045
Gill nets	2,786	71,211			3,688	77,323
Pound nets, trap nets, and weirs	690	514,665			254	387,470
Fyke nets	116	3,685			53	1,585
Bag nets and pocket nets	95	8,675				
Bow nets					13	36
Dip nets and scoop nets	102	776			104	371
Otter trawls	39	1,635			191	9,510
Lines, hand and trawl		61,410		462		51,412
Harpoons		215				540
Spears	42	57			72	171
Cunner traps	80	110			4	6
Eel pots and traps	599	1,198	18	36	1,826	4,155
Lobster pots	153,532	382,258	2,275	6,735	43,012	109,359
Crabs traps	180	330				
Dredges	24	2,500			2,764	16,521
Tongs and grabs					235	1,355
Rakes			2	12	784	5,656
Forks and hoes	1,103	1,167	25	50	475	887
Cockle traps					680	500
Shore and accessory property		11,864,571		11,958		7,000,239
Cash capital		1,029,707		5,500		1,902,945
Total		17,544,969		45,530		19,111,269
PRODUCTS.						
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:						
Fresh	580,811	$7,455			1,097,476	$23,070
Salted	6,860	176			1,259,134	55,995
Smoked	352,293	19,606			39,000	2,845
Bluefish	39	7			4,721	791
Bonito	41	4			189,727	18,016
Butterfish	32,763	3,031			296,828	26,810
Cod:						
Fresh	13,095,145	479,827	98,354	$3,609	66,320,920	2,826,091
Salted	983,244	62,312			3,175,405	166,702
Cunner	30,695	615			9,959	585
Cusk:						
Fresh	1,046,147	33,580	2,400	86	1,561,337	55,068
Salted					16,870	759
Eels	305,050	25,249	2,000	240	374,167	47,714
Flounders	469,594	22,227	8,000	240	10,262,693	478,850
Grayfish					63,667	184
Goosefish or monkfish					2,500	7
Haddock:						
Fresh	11,124,411	332,215	18,764	829	77,804,810	2,191,215
Salted	73,400	2,812			373,574	16,996
Hake:						
Fresh	16,108,575	329,227	3,000	98	4,066,437	156,353
Salted	5,060	256			29,095	1,307
Halibut:						
Fresh	217,476	31,841			1,708,509	296,232
Salted	1,000	80			8,045	1,060
Herring:						
Fresh	86,646,126	455,604			10,811,409	129,408
Salted	6,200	187				
Smoked	161,550	6,715				

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Maine.		New Hampshire.		Massachusetts.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Hickory shad					12,800	$830
King whiting					72	18
Launce					67,800	838
Mackerel:						
Fresh	593,506	$81,428			12,267,132	1,212,461
Salted	8,000	650			1,249,062	109,948
Frigate					61,361	1,862
Menhaden					161,219	2,231
Minnows					1,000	125
Perch:						
White					6,200	920
Yellow					500	25
Pollock:						
Fresh	5,597,163	113,487	25,600	$615	19,192,388	468,169
Salted	34,800	2,440			50,153	1,774
Pompano					14	2
Rosefish	17,322	245			36,773	1,121
Round herring					941	19
Salmon:						
Atlantic	20,610	7,926				
Humpback	310	62				
Sculpin					6,000	15
Scup					78,624	5,666
Sea bass					15,067	1,649
Sea robin					400	1
Shad	414,455	28,393			62,337	4,309
Sharks	39,747	884			328,399	3,664
Skates and rays	2,385	47			100,354	503
Smelt	523,967	94,496			39,150	10,690
Squeteague					5,777	908
Striped bass	592	113			971	231
Sturgeon	8,129	1,714			12,098	3,358
Sturgeon caviar					150	356
Sturgeon roe	143	297			181	163
Suckers	110,400	11,852				
Swordfish	424,813	104,734			711,729	155,330
Tautog	14	2			91,876	8,885
Tilefish					188,180	9,803
Tomcod	147,160	4,511			7,890	239
Tuna	31,909	2,040			42,901	3,548
Whiting:						
Fresh	684,970	4,727			13,918,650	148,854
Salted	3,000	90				
Wolffish	83,958	2,061			291,188	9,219
Other fish					38,232	2,117
Lobster	5,545,884	1,411,548	298,012	73,203	2,387,636	516,393
Shrimp					3,400	1,589
Crabs:						
Hard	70,575	3,595			1,764,961	49,424
Soft					266	40
Squid	377	4			6,134,557	108,864
Clams:						
Hard—						
Public					853,304	271,342
Private					22,640	12,425
Soft—						
Public	2,105,734	163,209	66,600	13,320	2,062,630	232,194
Private					125,000	10,750
Razor					23,300	3,500
Oysters:						
Market—						
Public					5,579	1,383
Private					769,055	278,164
Seed—						
Public					23,100	1,320
Private					80,178	6,552
Scallops	72,512	31,416			1,332,486	439,382
Mussels	16,970	367				
Cockles and winkles					577,400	3,425
Blackfish					40,000	40
Porpoise					750	15
Livers	112,587	1,712			313,575	4,844
Spawn	18,857	778			146,929	8,836
Tongues and cheeks	5,200	190			600	12
Sounds	5,212	96				
Oil:						
Sperm					1,545,413	218,111
Liver	8,625	895				
Ambergris					30	5,000
Alewife scales					10,400	5,200
Irish moss			6,000	420	204,200	15,027
Total	147,956,369	3,889,035	528,730	92,660	246,951,241	10,859,746

Fisheries of the New England States, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
PERSONS ENGAGED.						
On vessels fishing	317		566		6,316	
On vessels transporting	44		81		533	
In shore fisheries	795		1,019		10,968	
Shoresmen	490		623		12,920	
Total	1,646		2,289		30,767	
INVESTMENT.						
Vessels, fishing:						
Steam	9	$141,000	24	$328,243	72	$3,956,288
Tonnage	564		2,240		6,776	
Outfit		51,910		135,346		687,267
Gasoline	55	199,400	67	180,425	603	3,670,983
Tonnage	849		924		12,014	
Outfit		82,025		94,690		1,327,166
Sail			24	12,495	82	873,810
Tonnage			183		5,309	
Outfit				7,955		386,067
Vessels transporting:						
Steam	5	22,000	2	13,200	9	41,200
Tonnage	77		111		216	
Outfit		23,800		9,627		36,227
Gasoline	13	29,200	4	7,800	205	662,290
Tonnage	104		95		2,429	
Outfit		10,500		4,370		138,548
Sail					5	30,515
Tonnage					253	
Outfit						8,750
Barge			2	4,000	2	4,000
Tonnage			316		316	
Outfit				1,900		1,900
Boats:						
Sail, row, etc	196	4,503	399	9,670	4,693	157,102
Power	432	182,780	364	136,881	5,671	2,123,611
Apparatus, vessel fisheries:						
Seines	18	24,695	4	7,800	206	319,615
Gill nets	780	11,445	115	2,680	7,578	154,499
Pound nets	25	75,000			25	75,000
Otter trawls	20	973	14	680	166	22,023
Lines, hand and trawl		785		555		169,745
Harpoons		561		600		10,046
Lobster pots	635	1,985	480	745	2,630	5,975
Dredges	48	2,092	372	8,437	648	13,445
Tongs and rakes					3	19
Whaling apparatus						29,000
Apparatus, shore fisheries:						
Seines	11	899	54	4,893	235	95,892
Gill nets	360	7,300	204	13,910	7,038	169,747
Pound nets, trap nets, and weirs	108	101,750	42	9,112	1,094	1,012,997
Fyke nets	290	5,218	439	3,985	928	14,473
Bag nets and pocket nets					95	8,675
Bow nets					13	36
Dip nets and scoop nets	30	450	7	35	243	1,635
Otter trawls	43	2,425	53	2,391	326	15,964
Lines, hand and trawl		4,192		58		117,834
Harpoons		690		80		1,525
Spears			30	39	144	267
Cunner traps					84	146
Eel pots and traps	995	1,035	801	617	4,239	7,341
Lobster pots	21,936	65,346	16,173	42,534	236,928	606,232
Crab traps					180	330
Dredges	201	1,119	55	395	3,014	20,535
Tongs and grabs	247	1,999	244	1,991	726	5,348
Rakes	29	166	61	367	876	6,201
Forks and hoes	152	148	68	69	1,823	2,321
Shovels	13	43	13	13	56	56
Cockle traps					680	500
Winkle pots	260	880			260	880
Shore and accessory property		978,622		498,699		20,354,089
Cash capital		209,300		98,500		3,245,952
Total		2,249,536		1,645,793		40,597,097

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
PRODUCTS.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives:						
Fresh	269,565	$5,916	177,150	$6,637	2,125,002	$43,078
Salted					1,265,994	56,171
Smoked					391,293	22,451
Bluefish	25,675	3,170	3,710	386	34,145	4,351
Bonito	114,810	10,825	6,120	912	310,701	29,759
Bullheads			1,492	100	1,492	100
Butterfish	758,845	39,188	18,810	2,607	1,107,246	71,636
Carp			40,141	4,922	40,141	4,922
Cod:						
Fresh	1,148,331	49,747	96,136	9,603	80,758,886	3,368,877
Salted					4,158,649	229,014
Cunner	8,000	960			48,654	2,160
Cusk:						
Fresh			6,767	73	2,616,651	88,807
Salted					16,870	759
Eels	274,735	29,637	63,046	9,839	1,018,998	112,679
Flounders	2,451,579	79,567	2,349,181	91,962	15,541,047	672,846
Grayfish					63,667	184
Goosefish or monkfish					2,500	7
Haddock:						
Fresh	10,300	512	350	38	88,958,635	2,524,809
Salted					446,974	19,808
Hake:						
Fresh			10,100	102	20,188,112	485,780
Salted					34,155	1,563
Halibut:						
Fresh			25,000	5,000	1,950,985	333,073
Salted					9,045	1,140
Herring:						
Fresh	169,660	4,010	3,000	71	97,630,195	589,093
Salted					6,200	187
Smoked					161,550	6,715
Hickory shad					12,800	830
King whiting					72	18
Launce					67,800	838
Mackerel:						
Fresh	1,575,923	146,611	91,389	10,990	14,527,950	1,451,490
Salted					1,257,062	110,598
Frigate					61,361	1,862
Menhaden	21,536,000	268,700	6,736,564	93,312	28,433,783	364,243
Minnows					1,000	125
Perch:						
White	5,043	702			11,243	1,622
Yellow			6,108	595	6,608	620
Pickerel			1,079	143	1,079	143
Pollock:						
Fresh	99,400	5,920	10,135	717	24,924,686	588,908
Salted					84,953	4,214
Pompano					14	2
Rosefish					54,095	1,369
Round herring					941	19
Salmon:						
Atlantic	70	12			20,680	7,938
Humpback					310	62
Sculpin					6,000	15
Scup	8,261,140	817,846	1,980	202	8,341,744	823,714
Sea bass	52,041	5,954	3,555	528	70,663	8,131
Sea robin					400	1
Shad			463,203	86,637	939,995	119,339
Sharks					368,146	4,548
Skates and rays			400	10	103,139	560
Smelt			25,217	4,466	588,334	109,652
Squeteague	353,860	33,829	23,076	3,257	382,713	37,994
Striped bass	33,705	5,236	4,810	1,059	40,078	6,639
Sturgeon			25	5	20,252	5,077
Sturgeon caviar					150	356
Sturgeon roe					324	460
Suckers			99,053	7,488	209,453	19,340
Sunfish			105	11	105	11
Swordfish	101,010	19,757	88,428	15,006	1,325,980	294,827
Tautog	371,660	22,191	21,912	2,068	485,492	33,146
Tilefish					188,180	9,803
Tomcod			455	37	155,505	4,787
Tuna	61,350	4,810	5,114	550	141,274	10,948
Whiting:						
Fresh	1,583,700	16,010	9,317	175	16,196,637	169,766
Salted					3,000	90
Wolffish					375,146	11,280
Other fish					38,232	2,117
Lobster	1,694,327	360,679	740,848	189,157	10,666,707	2,550,980

FISHERIES OF THE NEW ENGLAND STATES, 1919—Continued.

Item.	Rhode Island.		Connecticut.		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Shrimp					3,400	$1,589
Crabs:						
Hard	34,330	$1,802			1,[illegible]59,866	51,821
Soft					266	10
Squid	377,579	18,730	3,612	$258	6,516,125	127,856
Clams:						
Hard—						
Public	155,232	59,649	49,976	18,912	1,059,512	349,903
Private					22,640	12,425
Soft—						
Public	403,760	21,075	229,150	32,070	1,867,874	161,868
Private					125,000	10,750
Razor					23,300	3,500
Oysters:						
Market—						
Public			135,651	21,900	112,233	23,283
Private	6,261,759	1,242,585	4,826,668	471,766	11,857,482	1,992,515
Seed—						
Public			740,516	68,349	763,616	60,669
Private			6,493,865	525,001	6,574,043	531,553
Scallops	33,994	11,608	38,400	13,717	1,477,392	199,123
Mussels	10,000	1,000			26,970	1,367
Cockles and winkles	10,500	2,100			587,900	5,525
Blackfish					40,000	40
Porpoise					750	15
Livers					426,162	6,556
Spawn					165,786	9,644
Tongues and cheeks					5,800	202
Sounds					5,212	96
Oil:						
Sperm					1,545,413	218,111
Liver					8,625	895
Ambergris					30	5,000
Alewife scales					10,400	5,200
Irish moss	2,000	240			212,200	15,687
Total	48,250,883	3,296,578	23,652,647	1,700,638	167,339,879	19,838,657

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER.

Products.	Maine.		New Hampshire.		Massachusetts.	
	Quantity.	*Value.*	*Quantity.*	*Value.*	*Quantity.*	*Value.*
Clams:						
Hard (quahogs)—						
Public ....bushels					106,663	$271,342
Private ....do					2,830	12,425
Soft—						
Public ....do	210,573	$163,209	6,660	$13,320	206,263	232,194
Private ....do					12,500	10,750
Razor ....do					2,330	3,500
Oysters:						
Market—						
Public ....do					797	1,383
Private ....do					109,865	278,164
Seed—						
Public ....do					3,300	1,320
Private ....do					11,454	6,552
Scallops ....do	12,085	31,416			222,081	439,382
Mussels ....do	1,697	367				
Cockles ....do					57,740	3,425
Crabs:						
Hard ....number	211,725	3,595			5,294,883	49,124
Soft ....do					798	40

CERTAIN OF THE FOREGOING SHELLFISH PRODUCTS IN BUSHELS AND NUMBER—Continued.

Products.	Rhode Island.		Connecticut.		Total.	
	Quantity.	*Value.*	*Quantity.*	*Value.*	*Quantity.*	*Value.*
Clams:						
Hard (quahogs)—						
Public......bushels..	19,529	$59,649	6,247	$18,912	132,439	$349,903
Private......do....	....	....	....	....	2,839	12,425
Soft—						
Public......do....	49,373	24,075	22,915	32,070	486,787	464,868
Private......do....	....	....	....	....	12,500	10,750
Razor......do....	....	....	....	....	2,330	3,500
Oysters:						
Market—						
Public......do....	....	....	19,522	21,900	20,319	23,283
Private......do....	894,537	1,242,585	689,524	471,766	1,693,926	1,992,515
Seed—						
Public......do....	....	....	105,788	68,349	109,088	69,669
Private......do....	....	....	927,695	525,001	939,149	531,553
Scallops......do....	5,666	14,608	6,400	13,717	246,232	499,123
Mussels......do....	1,000	1,000	....	....	2,697	1,367
Cockles......do....	....	....	....	....	57,740	3,425
Winkles......do....	1,050	2,100	....	....	1,050	2,100
Crabs:						
Hard......number..	....	....	....	....	5,506,608	53,019
Soft......do....	....	....	....	....	798	40

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919.[1]

Item.	1880	1887	1888	1889
PERSONS ENGAGED.				
Maine	11,071	15,323	15,171	14,129
New Hampshire	414	346	362	365
Massachusetts	20,117	17,053	17,037	17,238
Rhode Island	2,310	1,635	1,703	1,757
Connecticut	3,131	3,024	3,037	3,047
Total	37,043	37,381	37,310	36,536
INVESTMENT.				
Maine	$3,341,344	$3,179,233	$3,023,921	$2,889,893
New Hampshire	209,465	106,110	107,144	112,660
Massachusetts	14,334,450	13,205,050	13,110,765	13,245,229
Rhode Island	596,678	992,761	1,022,876	1,020,178
Connecticut	1,421,020	2,897,687	2,869,314	2,826,834
Total	19,902,957	20,380,841	20,134,020	20,094,794
PRODUCTS				
Pounds:				
Maine	....	131,379,591	132,929,594	129,559,864
New Hampshire	....	4,254,727	3,843,479	4,354,568
Massachusetts	....	299,544,343	302,045,686	299,217,669
Rhode Island	....	45,284,872	91,687,487	127,365,475
Connecticut	....	39,750,008	42,401,612	92,672,464
Total	....	520,213,541	572,907,858	653,170,040
Value:				
Maine	$2,742,571	$2,364,906	$2,292,043	$2,111,206
New Hampshire	170,634	99,460	90,044	88,511
Massachusetts	7,959,760	6,464,396	6,355,495	5,858,274
Rhode Island	696,814	683,495	825,092	935,144
Connecticut	933,242	300,746	297,337	1,557,506
Total	12,503,021	9,913,003	9,860,011	10,550,641

[1] The statistics for 1908 are from data published by the Bureau of the Census.

EXTENT OF FISHERIES OF NEW ENGLAND STATES, VARIOUS YEARS, 1880 TO 1919—Continued.

Item.	1898	1902	1905	1908	1919
PERSONS ENGAGED.					
Maine	16,954	19,832	15,881	6,861	11,386
New Hampshire	154	161	145	79	100
Massachusetts	14,363	14,300	15,694	11,577	12,346
Rhode Island	1,687	2,117	2,212	1,193	1,646
Connecticut	2,473	2,840	3,407	2,147	2,289
Total	35,631	39,250	37,339	22,157	30,767
INVESTMENT.					
Maine	$4,013,053	$6,939,503	$8,972,019	$2,411,000	$17,511,969
New Hampshire	52,648	42,002	47,050	23,000	45,530
Massachusetts	13,372,902	10,811,591	10,810,442	5,750,000	19,111,269
Rhode Island	957,142	1,014,280	1,065,426	1,504,000	2,249,488
Connecticut	1,241,291	1,201,055	1,635,753	2,281,000	1,645,793
Total	19,637,036	20,008,434	22,530,720	11,969,000	40,597,049
PRODUCTS.					
Pounds:					
Maine	123,404,561	242,390,371	124,723,786	173,813,000	117,956,369
New Hampshire	3,020,715	1,593,013	1,036,452	677,000	528,730
Massachusetts	202,257,817	230,645,950	255,654,475	241,313,000	246,951,241
Rhode Island	32,854,396	21,613,964	23,896,243	44,254,000	48,250,883
Connecticut	31,920,417	37,832,149	74,972,648	66,942,000	23,652,647
Total	393,457,906	534,075,447	480,283,604	530,029,000	470,995,169
Value:					
Maine	$2,654,919	$2,918,772	$2,386,406	$3,257,000	$3,889,035
New Hampshire	48,987	50,003	51,944	53,000	92,660
Massachusetts	4,463,727	6,482,427	7,025,249	7,095,000	10,859,746
Rhode Island	955,058	1,155,701	1,546,658	1,752,000	3,296,578
Connecticut	1,559,599	1,799,381	3,173,948	2,982,000	1,700,638
Total	9,682,290	12,406,284	14,184,205	15,139,000	19,887,406

BY-PRODUCTS.

Only a few firms are engaged solely in the preparation of by-products in the New England States and several of these are the sole manufacturers of a particular product within the State or section, the greater part of the material being prepared incidental to other branches of the fishery trade. It is therefore impracticable to present a detailed table of this important industry for individual States. In the following table the quantity and value of the products are shown as completely as possible without disclosing private enterprise.

In view of the increased demand for protein feed for hogs, cattle, and poultry, it is suggested that New England producers of scrap and pomace give consideration to the manufacture of fish waste and waste fish into fish meal for feeding purposes.

QUANTITY AND VALUE OF VARIOUS FISHERY BY-PRODUCTS PREPARED IN NEW ENGLAND IN 1919.

Item.	Maine.		Massachusetts.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Oil:						
Liver ... gallons..	[1] 97,077	$106,363	158,797	$180,635	[2] 255,874	$286,998
Herring ... do....	23,861	14,569	....	....	23,861	14,569
Sperm ... do....	....	....	206,055	218,111	[3] 206,055	218,111
Liquid glue ... do....	25,058	34,583	[4] 388,252	471,924	413,310	509,507
Fish scrap and meal ... pounds..	4,115,200	130,461	6,291,997	140,570	10,407,197	271,031
Herring pomace ... do....	1,271,424	16,411	....	....	1,271,424	16,411
Other products	....	....	....	....	....	[5] 333,135
Total	....	302,387	....	1,014,238	....	1,649,762

[1] Includes a small quantity made in New Hampshire.
[2] Of this amount, 1,150 gallons, or 8,625 pounds, valued at $895, were produced by fishermen.
[3] All produced by fishermen.
[4] Includes a small quantity of dry glue.
[5] Includes value of oyster shell grit made in Rhode Island and menhaden oil, dry scrap, and acidulated scrap made in Connecticut.

FISHERIES OF MAINE.

Maine ranks first among the New England States in the number of persons engaged in the fisheries and related industries, but is surpassed by Massachusetts in the amount of capital invested and the quantity and value of fishery products. In 1919 the number of persons engaged in the various branches of the fishery industry in Maine was 14,386, of whom 1,004 were on vessels fishing, 339 on vessels transporting fishery products, 5,332 in the shore or boat fisheries, and 7,711 in the wholesale fishery trade, canning sardines, and other fishery industries.

The amount of capital invested amounted to $17,544,969, which includes 351 fishing and transporting vessels, valued at $2,105,905, with a net tonnage of 5,004 tons and outfits valued at $300,036; 5,849 power, sail, row, and other small boats, valued at $985,719; fishing apparatus to the value of $1,259,031, of which gear to the value of $165,051 was employed in the vessel fisheries and gear to the value of $1,093,980 on boats; shore and accessory property to the value of $11,864,571; and cash or working capital to the amount of $1,029,707.

The products of the fisheries amounted to 147,956,369 pounds, valued at $3,889,035. This represents 31.65 per cent of the total quantity and 19.60 per cent of the total value of the products of the fisheries of the New England States in 1919. Compared with 1905 there was an increase of 18.62 per cent in quantity and 62.96 per cent in value to the fishermen. Compared with 1908 there was a decrease of 14.89 per cent in the quantity and an increase in the value of 19.40 per cent. Among the products of special importance were the following: Lobsters, 5,545,884 pounds, valued at $1,411,548; cod, fresh and salted, 14,078,389 pounds, valued at $542,139; herring, fresh, salted, and smoked, 86,813,876 pounds, valued at $462,506; haddock, fresh and salted, 11,197,811 pounds, valued at $335,027; and hake, fresh and salted, 16,113,635 pounds, valued at $329,483.

FISHERIES BY COUNTIES.

Statistics as to number of persons employed, investment, and products of the fisheries of Maine in 1919 are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	321		180				254	
On vessels transporting	19		64				47	
In shore fisheries	621		1,489		36		676	
Shoresmen	852		1,145				668	
Total	1,813		2,878		36		1,645	

Persons Engaged, Investment, and Products of the Fisheries of Maine in 1919, by Counties—Continued.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
INVESTMENT.								
Vessels fishing:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Steam	1	$2,500					1	$1,000,000
Tonnage	9						653	
Outfit		300						69,750
Gasoline	62	214,250	27	$36,500			40	65,200
Tonnage	808		272				308	
Outfit		40,382		9,855				8,730
Sail			4	53,000				
Tonnage			392					
Outfit				25,800				
Vessels transporting:								
Gasoline	9	26,900	29	69,530			22	81,200
Tonnage	70		290				213	
Outfit		3,075		21,250				13,128
Sail			1	15,000				
Tonnage			75					
Outfit				6,200				
Boats:								
Power	488	173,325	832	286,210			522	147,900
Sail, row, etc	150	4,070	654	15,195	12	$320	537	17,995
Apparatus, vessel fisheries:								
Otter trawls	3	90					5	2,050
Lines		18,112		4,305				3,545
Seines	35	26,320	11	12,700			15	19,300
Gill nets	813	22,590					50	750
Harpoons		1,705						25
Lobster pots			220	495			865	1,700
Dredges							4	400
Apparatus, shore fisheries:								
Pound nets, trap nets, and weirs	17	11,800	243	170,225			75	59,400
Lines, hand and trawl		13,084		25,376				8,255
Gill nets	1,020	29,630	213	6,255	19	550	6	120
Seines	42	14,130	10	10,150			20	3,200
Bag nets and pocket nets			15	1,025	6	450		
Fyke nets	1	200			81	1,485		
Dip nets			4	12			22	43
Lobster pots	20,696	41,734	38,101	96,291			28,270	55,505
Eel pots and traps			60	99	28	55	12	25
Otter trawls	15	475	1	60			5	250
Crab traps	180	330						
Cunner traps	80	140						
Spears			13	15				
Harpoons		30						
Hoes and forks	119	119	424	424			69	70
Dredges			15	1,650			9	850
Shore and accessory property		1,868,540		1,538,545				1,363,515
Cash capital		440,607		116,550				181,820
Total		2,954,438		2,522,718		2,860		3,108,726
PRODUCTS.								
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	4,925	$51	134,655	$3,628			224,200	$484
Salted			60	6				
Smoked			30,973	3,077			109,620	6,187
Bluefish	39	7						
Bonito	44	4						
Butterfish	15,135	1,392					178	21
Catfish and wolffish	36,622	772	86	2			46,309	1,266
Cod:								
Fresh	3,841,651	164,430	2,627,161	67,777			2,751,422	98,607
Salted			951,959	59,960			2,000	300
Cunner	30,695	615						
Cusk	564,601	20,189	113,772	1,599			72,749	1,510
Eels			7,050	950	7,050	$609	1,000	100
Flounders	145,223	4,309	17,830	805			124,537	6,541
Haddock:								
Fresh	1,459,468	40,701	579,031	23,267			7,683,357	220,907
Salted			73,400	2,812				
Hake:								
Fresh	1,991,536	80,874	9,648,570	149,679			2,456,424	44,929
Salted			260	15			500	75

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Cumberland.		Hancock.		Kennebec.		Knox.	
PRODUCTS—continued.								
Halibut:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	38,215	$6,507	21,087	$3,522			72,048	$9,918
Salted			1,000	80				
Herring:								
Fresh	3,390,072	33,763	22,178,901	122,641			9,888,575	45,009
Smoked							29,000	1,700
Mackerel, fresh	223,184	33,918	16,214	2,100			41,747	5,926
Pollock:								
Fresh	1,984,382	45,739	817,583	12,212			1,321,818	24,136
Salted			7,700	245				
Rosefish	15,617	219						
Salmon, Atlantic	961	89	7,050	2,795				
Shad	22,032	1,584	78,286	4,840	7,280	$1,365	120,843	2,429
Sharks	27,729	622					529	15
Skates	2,385	47						
Smelt	136,202	12,345	95,435	16,470	1,350	340	93,600	17,150
Sturgeon	1,618	177	2,000	160			784	207
Suckers	3,000	240			55,300	6,540		
Swordfish	307,711	74,515					27,000	5,840
Tautog	14	2						
Tomcod					65,175	1,955		
Tuna	8,734	600						
Whiting:								
Fresh	610,535	4,016					11,100	61
Salted	3,000	90						
Squid	377	4						
Lobsters	670,050	187,904	1,394,959	346,903			1,362,219	348,850
Crabs, hard	70,575	3,595						
Clams, soft	442,659	48,131	636,135	42,416			162,070	10,376
Scallops			30,800	14,200			41,712	17,216
Mussels							16,970	367
Sounds	692	13	120	1			4,200	42
Spawn	10,546	363					272	20
Livers	74,949	1,009	1,100	13			3,063	40
Total	16,135,178	768,836	39,485,158	882,175	136,155	10,809	26,669,546	870,229

Item.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	88							
On vessels transporting	4						8	
In shore fisheries	588		53		263		146	
Shoresmen	92		61		5		154	
Total	772		114		268		308	
INVESTMENT.								
Vessels fishing: Gasoline	17	$82,700						
Tonnage	164							
Outfit		7,051						
Vessels transporting: Gasoline	2	4,200					8	$18,800
Tonnage	16						69	
Outfit		1,165						2,225
Boats:								
Power	298	73,010	4	$600	136	$28,140	56	14,075
Sail, row, etc	410	11,440	39	1,550	162	4,890	186	10,054
Apparatus, vessel fisheries:								
Otter trawls	1	50						
Lines		1,590						
Seines	18	25,500						
Gill nets	15	400						
Apparatus, shore fisheries:								
Pound nets, trap nets, and weirs	25	15,050	1	100	32	22,500	103	77,315
Lines, hand and trawl		4,145		1,200		2,901		200
Gill nets	759	18,755	60	705	287	8,776		
Seines	18	7,550			3	500		
Bag nets and pocket nets	16	1,200	6	550	9	750	13	1,300
Fyke nets	41	1,160			23	840		
Dip nets	4	6						
Lobster pots	16,366	33,175			3,213	6,505	600	1,200

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
INVESTMENT—continued.								
Apparatus, shore fisheries—Continued.	*Number.*	*Value.*	*Number*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Eel pots and traps	43	$75	30	$60	289	$546	55	$115
Otter trawls	11	500			7	350		
Spears	25	30						
Harpoons		55				30		
Hoes and forks	78	90			9	17		
Shore and accessory property		141,640		82,600		12,710		195,216
Cash capital		34,530		10,000		1,500		20,000
Total		465,067		97,365		90,955		340,500
PRODUCTS.								
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds*	*Value.*	*Pounds.*	*Value.*
Fresh	40,200	$296	19,000	$400	3,200	$85	7,000	$190
Salted	6,800	170						
Smoked	104,700	3,392			74,000	5,700		
Butterfish	800	80			16,650	1,538		
Catfish and wolffish	100	7						
Cod:								
Fresh	809,711	26,486			330,728	16,079	14,300	600
Salted	3,000	180						
Cusk	46,971	1,440			14,720	587		
Eels	52,000	4,060	24,000	2,400	175,650	12,525	8,000	800
Flounders	52,403	3,748			39,950	3,196		
Haddock, fresh	188,714	5,593			32,382	1,187	2,000	80
Hake, fresh	1,079,617	18,805			309,940	12,238	4,300	130
Halibut, fresh	811	122			11,040	1,750		
Herring:								
Fresh	5,174,117	41,658			641,400	5,011	5,479,880	22,518
Smoked	120,000	4,200						
Mackerel:								
Fresh	170,511	24,049			72,143	8,801	8,707	1,354
Salted	8,000	650						
Pollock, fresh	168,170	9,076			109,650	1,773	4,000	110
Rosefish	800	12						
Salmon, Atlantic			2,650	1,131	4,812	1,745	3,857	1,845
Shad	139,384	11,174	13	8	39,050	6,330	3,121	220
Sharks	9,644	193						
Smelt	53,500	13,242	1,900	475	74,230	18,811	23,150	5,862
Striped bass					535	101	57	12
Sturgeon	950	184			2,777	986		
Sturgeon roe					143	297		
Suckers	40,500	3,810			11,600	1,262		
Tomcod	37,160	1,116	21,000	600			15,000	375
Tuna	17,300	1,088			5,875	352		
Whiting, fresh	400	4			59,600	596		
Lobsters	619,886	152,327			147,664	39,739	8,800	640
Clams, soft	192,600	15,252			7,860	899		
Spawn	163	8						
Livers	4,375	73						
Total	9,443,287	342,495	71,563	5,014	2,185,599	141,588	5,582,472	34,736

Item.	Washington.		York.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	58		103		1,004	
On vessels transporting	197				339	
In shore fisheries	1,263		197		5,332	
Shoresmen	4,725		9		7,711	
Total	6,243		309		14,386	
INVESTMENT.						
Vessels fishing:						
Steam					5	$1,002,500
Tonnage					662	
Outfit						70,050
Gasoline	13	$33,500	14	$81,500	173	514,650
Tonnage	176		311		2,039	
Outfit		11,228		13,767		91,013
Sail					4	53,000
Tonnage					392	
Outfit						25,800

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Washington.		York.		Total.	
INVESTMENT—continued.						
Vessels transporting:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Steam	2	$9,000			2	$9,000
Tonnage	28				28	
Outfit		2,800				2,800
Gasoline	95	306,410			165	510,040
Tonnage	1,104				1,762	
Outfit		63,155				103,908
Sail	1	1,715			2	16,715
Tonnage	46				121	
Outfit		175				6,375
Boats:						
Power	613	139,945	141	$38,875	3,090	902,080
Sail, row, etc	567	16,550	42	1,575	2,759	83,639
Apparatus, vessel fisheries:						
Otter trawls			4	330	13	2,520
Lines		745		6,450		34,747
Seines	5	9,450			84	93,270
Gill nets			375	5,949	1,253	29,689
Harpoons				500		2,230
Lobster pots					1,085	2,195
Dredges					4	400
Apparatus, shore fisheries:						
Pound nets, trap nets, and weirs	194	158,275			690	514,665
Lines, hand and trawl		4,245		2,004		61,410
Gill nets	65	1,573	357	4,849	2,786	71,214
Seines	6	4,700	4	3,825	103	44,055
Bag nets and pocket nets	3[illegible]	3,490			95	8,675
Fyke nets					146	3,685
Dip nets	58	295	14	420	102	776
Lobster pots	38,685	126,630	7,601	21,218	153,532	382,258
Eel pots and traps	63	194	19	38	599	1,198
Otter trawls					39	1,635
Crab traps					180	330
Cunner traps					80	140
Spears			4	12	42	57
Harpoons				100		215
Hoes and forks	336	431	8	16	1,103	1,167
Dredges					24	2,500
Shore and accessory property		6,646,220		15,585		11,864,571
Cash capital		222,700		2,000		1,029,707
Total		7,763,336		109,004		17,544,969
PRODUCTS.						
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	147,650	$2,32[illegible]			580,811	$7,455
Salted					6,860	176
Smoked	24,000	1,250			352,293	19,606
Bluefish					39	7
Bonito					44	4
Butterfish					32,763	3,031
Catfish and wolffish			841	$14	83,958	2,061
Cod:						
Fresh	1,204,742	36,935	1,515,730	68,913	13,095,145	479,827
Salted	16,925	1,445	6,360	427	983,244	62,312
Cunner					30,695	615
Cusk	15,049	353	218,285	7,902	1,046,147	33,589
Eels	18,309	2,125	12,000	1,680	305,050	25,249
Flounders	2,740	251	86,911	3,377	469,594	22,227
Haddock:						
Fresh	142,685	5,522	1,036,774	34,958	11,124,411	332,215
Salted					73,400	2,812
Hake:						
Fresh	140,278	2,862	477,910	19,710	16,108,575	329,227
Salted	4,300	166			5,060	256
Halibut:						
Fresh	53,345	6,422	20,930	3,600	217,476	31,841
Salted					1,000	80
Herring:						
Fresh	39,893,181	185,004			86,646,126	455,664
Salted	6,200	187			6,200	187
Smoked	12,550	815			161,550	6,715
Mackerel:						
Fresh			1,000	5,280	593,506	81,428
Salted					8,000	650
Pollock:						
Fresh	638,680	12,657	252,880	7,784	5,597,163	113,487
Salted	25,100	2,095	2,000	100	34,800	2,440

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF THE FISHERIES OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Washington.		York.		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Rosefish			905	$14	17,322	$245
Salmon:						
Atlantic	1,280	$321			20,610	7,926
Humpback	310	62			310	62
Shad	1,000	390	446	53	414,455	28,393
Sharks			1,845	54	39,747	884
Skates					2,385	47
Smelt	36,300	8,226	8,000	1,575	523,967	94,496
Striped bass					592	113
Sturgeon					8,129	1,714
Sturgeon roe					143	297
Suckers					110,400	11,852
Swordfish			90,102	21,379	424,813	104,734
Tautog					14	2
Tomcod	5,825	465			147,160	4,511
Tuna					31,909	2,040
Whiting:						
Fresh	3,337	56			684,970	4,727
Salted					3,000	90
Squid					377	4
Lobsters	849,306	206,425	493,000	128,760	5,545,884	1,411,518
Crabs, hard					[1] 76,575	3,595
Clams, soft	651,910	43,365	12,500	2,770	[2] 2,105,734	163,209
Scallops					[3] 72,512	31,416
Mussels					[4] 16,970	367
Tongues and cheeks	200	40	5,000	150	5,200	190
Sounds	200	30			5,212	96
Spawn	29	1	7,847	386	18,857	778
Livers	17,025	331	12,075	186	112,587	1,712
Oil, liver	3,750	375	4,875	520	[5] 8,625	895
Total	43,919,195	529,561	4,328,216	312,592	147,956,369	3,889,035

[1] 211,725 in number.
[2] 210,573 bushels.
[3] 12,085 bushels.
[4] 1,697 bushels.
[5] 1,150 gallons.

FISHERIES BY APPARATUS.

In the fisheries of Maine in 1919 pots ranked above all other forms of apparatus in the value of their catch, with 5,793,784 pounds of lobsters, valued at $1,432,004, and 247,950 pounds of eels, valued at $20,480. Lines ranked second with 32,992,588 pounds, valued at $978,134, the principal species taken with lines arranged in the order of their value being: Cod, 7,432,231 pounds, valued at $397,322; hake, 15,230,183 pounds, valued at $309,878; and haddock, 3,857,610 pounds, valued at $129,678. The yield of the pound net, trap net, and weir fishery amounted to 76,231,256 pounds, valued at $452,146, of which 74,043,982 pounds, valued at $362,339, were herring. Otter trawls taking mostly haddock, cod, and flounders, yielded 9,316,245 pounds, valued at $296,356. Various species were taken in seines to the amount of 15,626,164 pounds, valued at $220,530, and in gill nets to the amount of 4,283,308 pounds, valued at $156,546. The catch with hoes and forks, consisting principally of soft clams, amounted to 2,122,704 pounds, valued at $163,576; and that with harpoons, consisting mostly of swordfish, amounted to 452,633 pounds, valued at $106,499. The combined catch of all forms of fishing apparatus employed in both the shore and vessel fisheries amounted to 147,956,369 pounds, valued at $3,889,035.

The following tables show by counties, apparatus, and species the products of the vessel and shore fisheries of Maine in 1919:

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Cumberland.		Hancock.		Knox.		Lincoln.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls:								
Butterfish					25	$6		
Catfish and wolf-fish					45,660	1,241		
Cod					1,389,051	59,729		
Flounders	20,034	$631			67,301	3,088	8,695	$260
Haddock					7,001,906	196,054		
Hake					52,262	2,144		
Halibut					46,207	7,856		
Pollock					64,940	1,560		
Sharks					19	1		
Sturgeon					784	207		
Spawn					150	11		
Total	20,034	631			8,668,305	271,897	8,695	260
Lines:								
Catfish and wolf-fish	5,815	152	86	$2	649	25	100	7
Cod—								
Fresh	1,384,643	59,534	285,519	6,908	505,993	17,025	69,484	2,683
Salted			951,000	59,660				
Cusk	483,865	17,310	1,816	29	21,129	562	13,936	497
Flounders	5,823	95	30	1	286	6	123	2
Haddock—								
Fresh	696,608	19,616	14,920	734	320,181	9,813	18,080	482
Salted			73,400	2,812				
Hake	839,392	34,380	108,385	1,999	853,597	15,378	138,749	3,001
Halibut—								
Fresh	34,353	5,842	3,707	556	3,566	540	11	2
Salted			1,000	80				
Pollock—								
Fresh	146,531	4,952	43,443	626	206,982	3,641	3,931	106
Salted			7,700	245				
Rosefish	14,332	199					800	12
Sharks	1,827	49			200	5	644	13
Skates	188	3						
Sounds			120	1				
Spawn	7,240	263			122	9	163	8
Livers	24,893	454			2,413	32	4,375	73
Total	3,645,510	142,849	1,491,126	73,653	1,915,118	47,036	250,396	6,886
Seines:								
Alewives	3,800	45					5,000	39
Butterfish	628	80			153	15		
Cod			1,934	83			612	26
Flounders	20	1						
Haddock							25	1
Hake			110	5				
Herring	3,167,907	31,542	776,500	7,655	1,029,975	8,244	2,827,367	25,763
Mackerel—								
Fresh	25,488	4,004	11,214	1,650	20,126	3,239	98,344	15,029
Salted							8,000	650
Pollock	139,094	3,342	283,580	4,928	725,592	12,513	85,561	1,545
Salmon, Atlantic	7	2						
Shad	9,368	695	68,286	4,140	118,343	2,229	103,336	6,440
Sharks	5,275	142			310	9		
Smelt	16,422	1,565						
Sturgeon	202	15						
Whiting	2,065	16			11,100	61	400	4
Livers	1,023	16	1,100	13	650	8		
Total	3,371,299	41,465	1,142,724	18,474	1,906,249	26,318	3,128,645	49,497
Gill nets:								
Catfish and wolf-fish	978	33						
Cod—Fresh	543,253	22,660					11,500	345
Cusk	1,620	103						
Flounders	2,690	60						
Haddock	164,591	4,556					1,230	38
Hake	37,107	1,449					950	18
Halibut	18	2						
Mackerel	46,115	6,011			12,500	1,500		
Pollock	626,359	15,032					1,450	27
Rosefish	55	2						

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Cumberland.		Hancock.		Knox.		Lincoln.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Gill nets—Continued.								
Shad	262	$23						
Sharks	4,150	101						
Skates	55	2						
Sturgeon	400	47						
Lobsters	50	24						
Spawn	1,110	34						
Livers	5,906	106						
Total	1,434,719	50,245			12,500	$1,500	15,130	$428
Harpoons: Swordfish	305,200	73,963			27,000	5,840		
Lobster pots: Lobsters			11,815	$3,750	48,125	12,033		
Dredges: Scallops					12,968	5,349		
Grand total	8,776,762	309,153	2,618,695	95,877	12,590,265	369,973	3,402,866	57,071

Apparatus and species.	Washington.		York.		Total.	
Otter trawls:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Butterfish					25	$6
Catfish and wolffish					15,660	1,241
Cod					1,389,051	59,729
Flounders			31,000	$1,050	127,030	5,029
Haddock					7,001,906	196,054
Hake					52,262	2,144
Halibut					46,207	7,856
Pollock			270	9	65,210	1,569
Sharks					19	1
Sturgeon					784	207
Spawn					150	11
Total			31,270	1,059	8,728,304	273,847
Lines:						
Catfish and wolffish			662	11	7,312	197
Cod—						
Fresh	270,390	$8,278	1,045,546	44,994	3,561,575	139,422
Salted	500	60			951,500	59,720
Cusk	11,040	275	208,076	7,519	739,862	26,192
Flounders	240	1			6,502	105
Haddock—						
Fresh	18,075	688	829,952	23,236	1,897,816	54,569
Salted					73,400	2,812
Hake	17,643	651	385,266	15,797	2,343,032	71,206
Halibut—						
Fresh	15,180	1,985	17,880	3,039	74,697	11,964
Salted					1,000	80
Pollock—						
Fresh	42,630	701	32,550	784	476,067	10,810
Salted					7,700	245
Rosefish			905	14	16,037	225
Sharks			155	3	2,826	70
Skates					188	3
Sounds					120	1
Spawn	29	1	7,529	369	15,083	650
Livers	25	1	11,125	174	42,831	734
Total	375,752	12,641	2,539,646	95,940	10,217,548	379,005
Seines:						
Alewives					8,800	84
Butterfish					781	95
Cod					2,546	109
Flounders					20	1
Haddock					25	1
Hake					110	5
Herring	2,348,400	9,785			10,150,149	82,989
Mackerel—						
Fresh					155,172	23,922
Salted					8,000	650
Pollock	215,000	2,960			1,448,827	25,288
Salmon, Atlantic					7	2
Shad					299,333	13,504
Sharks					5,585	151
Smelt					16,422	1,565
Sturgeon					202	15
Whiting					13,565	81
Livers					2,773	37
Total	2,563,490	12,745			12,112,317	148,499

YIELD OF VESSEL FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Gill nets:						
Catfish and wolffish			79	$2	1,057	$35
Cod—						
Fresh			165,130	7,100	719,883	30,105
Salted			4,360	327	4,360	327
Cusk			1,145	42	2,765	145
Flounders			271	7	2,961	67
Haddock			47,226	1,137	213,047	5,731
Hake			25,169	1,032	63,226	2,499
Halibut					18	2
Mackerel					58,615	7,511
Pollock			104,960	2,628	732,769	17,687
Rosefish					55	2
Shad			446	53	708	76
Sharks			690	21	4,840	122
Skates					55	2
Sturgeon					400	47
Lobsters					50	24
Spawn			318	17	1,428	51
Livers			950	12	6,856	118
Total			350,744	12,378	1,813,093	64,551
Harpoons: Swordfish			83,302	24,179	421,502	103,982
Lobster pots: Lobsters					62,970	15,783
Dredges: Scallops					12,968	5,349
Grand total	2,939,152	$25,386	3,010,962	133,55[illegible]	33,368,702	991,016

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Cumberland.		Hancock.		Kennebec.		Knox.	
Pound nets, trap nets, and weirs:								
Alewives—	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	1,125	$6	99,636	$3,128				
Salted			60	6				
Smoked			34,373	2,577			55,670	$3,340
Bluefish	39	7						
Bonito	44	4						
Butterfish	14,507	1,312						
Herring—								
Fresh	197,420	1,974	20,902,401	110,086			8,858,600	36,765
Smoked							23,000	1,700
Mackerel	113,686	17,927					9,121	1,187
Pollock	426,957	8,945	6,700	100				
Salmon, Atlantic	954	87	7,050	2,795				
Shad	9,302	650						
Sharks	16,477	330						
Smelt			1,600	405				
Sturgeon	1,016	115						
Tautog	14	2						
Tuna	4,089	275						
Whiting—								
Fresh	608,470	4,000						
Salted	3,000	90						
Squid	377	4						
Total	1,397,477	35,728	21,051,820	119,097			8,952,391	42,992
Lines:								
Catfish and wolffish	29,829	587						
Cod—								
Fresh	1,276,020	54,905	1,979,108	52,206			856,078	21,853
Salted			3,959	300			2,000	300
Cusk	79,116	2,776	111,956	1,570			51,620	948
Flounders			7,800	404			5,000	100
Haddock	577,269	15,939	564,111	22,533			361,270	15,040
Hake—								
Fresh	1,115,037	45,045	9,525,075	147,450			1,505,565	26,557
Salted			260	15			500	75
Halibut	3,844	663	17,380	2,966			22,275	1,522

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Cumberland.		Hancock.		Kennebec.		Knox.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lines—Continued.								
Pollock, fresh	127,241	$2,637	104,860	$5,103			321,304	$6,422
Rosefish	1,230	18						
Skates	2,142	12						
Smelt			73,650	13,250			25,000	5,500
Sounds	692	13					4,200	42
Spawn	2,196	66						
Livers	13,127	133						
Total	3,257,746	123,124	12,688,159	216,097			3,157,812	78,359
Gill nets:								
Alewives, smoked							15,000	900
Cod, fresh	637,735	27,331	360,600	8,580				
Flounders	2,000	90						
Haddock	21,000	590						
Hake			15,000	225				
Mackerel	37,895	5,976						
Pollock			10,000	125				
Shad					7,280	$1,365		
Sturgeon			2,000	160				
Total	698,630	33,987	387,600	9,090	7,280	1,365	15,000	900
Seines:								
Herring	24,715	217	500,000	1,300				
Mackerel			5,000	150				
Pollock	518,197	10,831	69,000	1,030				
Shad	3,100	216	10,000	700			2,500	200
Smelt	119,780	10,780	11,400	1,200			63,600	10,150
Total	665,822	22,071	595,400	8,280			66,100	10,350
Bag nets and pocket nets:								
Smelt			8,785	1,615	1,350	340		
Tomcod					26,500	795		
Total			8,785	1,615	27,850	1,135		
Fyke nets:								
Eels					500	60		
Suckers	3,000	240			55,300	6,540		
Tomcod					38,675	1,160		
Total	3,000	240			94,475	7,760		
Dip nets:								
Alewives—								
Fresh			35,000	500			224,200	484
Smoked			5,600	500			38,950	1,947
Smelt							5,000	1,500
Total			40,600	1,000			268,150	3,931
Eel pots, eel traps, and lobster pots:								
Eels			3,050	350	6,550	549	1,000	100
Lobsters	670,000	187,880	1,380,114	343,153			1,314,094	336,817
Total	670,000	187,880	1,383,164	343,503	6,550	549	1,315,094	336,917
Otter trawls:								
Flounders	114,656	3,432	10,000	400			51,950	3,347
Hake							45,000	850
Total	114,656	3,432	10,000	400			96,950	4,179
Crab traps and cunner traps:								
Crabs, hard	70,575	3,595						
Cunner	30,695	615						
Total	101,270	4,210						
Spears: Eels			1,000	600				
Harpoons:								
Swordfish	2,511	552						
Tuna	4,645	325						
Total	7,156	877						
Hoes and forks:								
Clams, soft	442,659	48,131	636,135	42,416			162,070	10,376
Mussels							16,970	367
Total	442,659	48,131	636,135	42,416			179,040	10,743
Dredges: Scallops			30,800	14,200			28,744	11,867
Grand total	7,358,416	459,683	36,836,463	786,298	136,155	10,809	14,079,281	500,256

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
Pound nets, trapnets, and weirs:								
Alewives—	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	9,600	$103	9,000	$150	2,500	$50	7,000	$190
Smoked	24,700	992			74,000	5,700		
Butterfish	800	80			16,650	1,538		
Cod					900	54	2,300	120
Eels					30,350	2,204		
Herring—								
Fresh	1,446,750	9,645			581,400	4,411	5,479,880	22,518
Smoked	120,000	4,200						
Mackerel	11,242	1,431			72,143	8,801	8,707	1,354
Pollock					97,400	1,463	4,000	110
Salmon, Atlantic			70	30	4,812	1,745	3,857	1,845
Shad	5,168	909			21,910	3,297	3,121	220
Smelt	850	170			4,935	1,234		
Striped bass					535	101	57	12
Sturgeon					585	189		
Sturgeon roe					30	90		
Suckers	4,000	160						
Tomcod	500	15						
Whiting, fresh					59,600	596		
Total	1,623,610	17,705	9,070	180	967,750	31,473	5,508,922	26,369
Lines:								
Cod, fresh	353,336	12,361			225,378	10,973	12,000	480
Cusk	26,664	827			14,720	587		
Haddock	84,692	2,813			31,042	1,147	2,000	80
Hake, fresh	400,614	7,777			141,390	6,365	4,300	130
Halibut	800	120			11,040	1,750		
Pollock, fresh	171,646	3,767			12,250	310		
Salmon, Atlantic			630	269				
Smelt	16,600	4,150			51,125	12,784		
Total	1,054,352	31,815	630	269	486,945	33,916	18,300	690
Gill nets:								
Alewives, fresh			10,000	250	700	35		
Cod—								
Fresh	374,779	11,071			104,450	5,052		
Salted	3,000	180						
Cusk	6,371	116						
Haddock	84,687	2,259			1,340	40		
Hake	419,304	5,909			5,750	175		
Mackerel	3,500	426						
Pollock	150,582	2,556						
Salmon, Atlantic			1,950	832				
Shad	28,880	3,625	13	8	17,140	3,033		
Sharks	9,000	180						
Smelt			300	75	150	38		
Sturgeon	900	180			2,192	797		
Sturgeon roe					113	207		
Total	1,081,003	26,502	12,263	1,165	131,835	9,377		
Seines:								
Herring	900,000	6,250			60,000	600		
Mackerel	57,425	7,163						
Pollock	55,000	1,075						
Shad	2,000	200						
Smelt	19,950	4,850			5,400	1,350		
Sturgeon	50	4						
Total	1,034,425	19,542			65,400	1,950		
Bag nets and pocket nets:								
Smelt	16,100	4,072	1,600	400	8,500	2,375	23,450	5,862
Tomcod	30,000	900	24,000	600			15,000	375
Total	46,100	4,972	25,600	1,000	8,500	2,375	38,450	6,237
Fyke nets:								
Eels					750	75		
Smelt					4,120	1,030		
Suckers	36,500	3,650			11,600	1,262		
Tomcod	6,660	201						
Total	43,160	3,851			16,470	2,367		

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Lincoln.		Penobscot.		Sagadahoc.		Waldo.	
	Pounds.	*Value.*	*Pounds*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Dip nets:								
Alewives—								
Fresh	25,600	$154						
Salted	6,800	170						
Smoked	80,000	2,400						
Total	112,400	2,724						
Eel pots, eel traps, and lobster pots:								
Eels	34,500	2,660	24,000	$2,400	144,550	$10,246	8,000	$800
Lobsters	619,886	152,327			147,664	39,739	8,800	640
Total	654,386	154,987	24,000	2,400	292,214	49,985	16,800	1,440
Otter trawls:								
Flounders	43,585	3,486			39,950	3,196		
Hake	120,000	2,100			162,800	5,698		
Total	163,585	5,586			202,750	8,894		
Spears: Eels	17,500	1,400						
Harpoons: Tuna	17,300	1,088			5,875	352		
Hoes and forks: Clams, soft	192,600	15,252			7,860	890		
Grand total	6,040,421	285,424	71,563	5,014	2,185,599	141,588	5,582,472	34,736

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Pound nets, trap nets, and weirs:						
Alewives—						
Fresh	85,750	$4,421			214,611	$5,048
Salted					60	6
Smoked	4,000	300			192,743	12,909
Bluefish					39	7
Bonito					44	4
Butterfish					31,957	2,930
Cod	2,000	57			5,200	231
Eels	2,000	150			32,350	2,354
Flounders	2,500	250			2,500	250
Herring—						
Fresh	36,415,781	170,213			73,882,232	355,612
Salted	200	12			200	12
Smoked	12,550	815			161,550	6,715
Mackerel					214,899	30,700
Pollock	184,900	3,610			719,957	14,228
Salmon—						
Atlantic	645	126			17,388	6,628
Humpback	310	62			310	62
Shad					39,501	5,076
Sharks					16,477	330
Smelt	6,245	1,536			13,630	3,315
Striped bass					592	113
Sturgeon					1,601	304
Sturgeon roe					30	90
Suckers					4,000	160
Tautog					14	2
Tomcod					500	15
Tuna					1,089	275
Whiting—						
Fresh	3,335	50			671,405	4,646
Salted					3,000	90
Squid					377	4
Total	36,720,216	178,602			76,231,256	452,146
Lines:						
Catfish and wolffish					29,829	587
Cod—						
Fresh	932,352	28,600	260,500	$11,717	5,891,772	196,095
Salted	16,425	1,385	2,000	100	24,384	2,085
Cusk	4,009	78	9,000	340	297,085	7,125
Eels			2,000	280	2,000	280
Flounders			45,400	1,816	58,200	2,320
Haddock	124,610	4,831	141,400	9,911	1,886,394	72,297

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lines—Continued.						
Hake—						
Fresh	122,635	$2,211	67,475	$2,881	12,882,091	$238,416
Salted	4,300	166			5,060	256
Halibut	38,165	4,437	3,050	561	96,554	12,019
Pollock—						
Fresh	196,150	5,386	82,500	3,416	1,318,954	27,341
Salted	25,100	2,095	2,000	100	27,100	2,195
Rosefish					1,230	18
Salmon, Atlantic					630	269
Sharks			1,000	30	1,000	30
Skates					2,142	42
Smelt					166,375	35,684
Tongues and cheeks	200	40	5,000	150	5,200	190
Sounds	200	40			5,092	95
Spawn					2,196	66
Livers	17,000	390			60,127	823
Oil	3,750	375	4,875	520	8,625	895
Total	1,484,896	50,037	626,200	34,822	22,775,040	599,129
Gill nets:						
Alewives—						
Fresh					10,700	285
Smoked					15,000	900
Catfish and wolffish			100	1	100	1
Cod—						
Fresh			44,554	2,102	1,522,118	54,136
Salted					3,000	180
Cusk			64	1	6,435	117
Flounders			240	4	2,240	94
Haddock			18,196	674	125,223	3,563
Hake					440,054	6,309
Herring—						
Fresh	3,000	40			3,000	40
Salted	6,000	175			6,000	175
Mackerel			9,000	1,080	50,395	7,482
Pollock			32,600	947	193,182	3,628
Salmon, Atlantic	500	150			2,450	982
Shad	4,000	390			57,313	8,421
Sharks					9,000	180
Smelt	18,350	4,045			18,800	4,158
Sturgeon					5,092	1,137
Sturgeon roe					113	207
Total	31,850	4,800	104,754	4,809	2,470,215	91,995
Seines:						
Flounders			10,000	500	10,000	500
Herring	1,020,000	4,250			2,504,745	16,247
Mackerel			52,000	4,200	114,425	11,813
Pollock					642,197	12,936
Shad					17,600	1,316
Smelt	700	110	4,000	775	224,830	29,215
Sturgeon					50	4
Total	1,020,700	4,360	66,000	5,475	3,513,847	72,031
Bag nets and pocket nets:						
Smelt	11,005	2,535			70,790	17,199
Tomcod	5,825	465			101,325	3,135
Total	16,830	3,000			172,115	20,334
Fyke nets:						
Eels					1,250	135
Smelt					4,120	1,030
Suckers					106,400	11,692
Tomcod					45,335	1,361
Total					157,105	14,218
Dip nets:						
Alewives—						
Fresh	61,900	900			346,700	2,033
Salted					6,800	170
Smoked	20,000	950			144,550	5,797
Herring	106,000	716			106,000	716
Salmon, Atlantic	135	45			135	45
Smelt			4,000	800	9,000	2,300
Total	188,035	2,611	4,000	800	613,185	11,066

YIELD OF SHORE FISHERIES OF MAINE IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Washington.		York.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Eel pots, eel traps, and lobster pots:						
Eels	16,300	$1,975	10,000	$1,400	247,950	$20,480
Lobsters	849,306	206,125	493,000	128,760	5,182,861	1,395,741
Total	865,606	208,100	503,000	130,160	5,730,811	1,416,221
Otter trawls:						
Flounders					260,141	13,861
Hake					327,800	8,648
Total					587,941	22,509
Crab traps and cunner traps:						
Crabs, hard					70,575	3,595
Cunner					30,695	615
Total					101,270	4,210
Spears: Eels					21,500	2,000
Harpoons:						
Swordfish			800	200	3,311	752
Tuna					27,820	1,765
Total			800	200	31,131	2,517
Hoes and forks:						
Clams, soft	651,910	43,365	12,500	2,770	2,105,734	163,209
Mussels					16,970	367
Total	651,910	43,365	12,500	2,770	2,122,704	163,576
Dredges: Scallops					59,544	26,067
Grand total	40,980,043	495,175	1,317,254	179,036	114,587,667	2,898,019

SALMON FISHERY OF PENOBSCOT RIVER AND BAY.

The greater part of the catch of Atlantic salmon in Maine is usually taken in Penobscot River and Bay. In 1920, the latest year for which statistics are available, there were 128 persons engaged in the salmon fishery in these waters. The investment included 68 weirs and traps, valued at $6,175; 15 gill nets, valued at $240; rods and lines to the value of $1,500; 7 gasoline boats, valued at $700; 85 rowboats, etc., valued at $2,845; and shore and accessory property, valued at $1,365; a total of $12,825. The catch amounted to 1,598 salmon in number, or 15,135 pounds, having a value to the fishermen of $7,210. The catch in 1919 was 1,322 salmon in number, or 13,557 pounds, valued at $5,771. The following tables give the extent of this fishery by localities, in 1918, 1919, and 1920, and comparative statistics of the catch for various years from 1895 to 1920:

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY IN 1918, 1919, AND 1920.

Town.	Weirs and traps.						Gill nets.					
	1918		1919		1920		1918		1919		1920	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Bucksport	1	$50	2	$125	2	$125						
Orland	15	750	16	800	18	900						
Penobscot	4	325	7	550	7	525						
Verona	21	2,500	21	2,750	21	2,750						
Bangor and Brewer							8	$80	8	$100	8	$100
Hampden	1	100	1	100	1	100	3	60	2	40	1	20
Orrington							6	120	6	120	6	120
South Orrington	2	255										
Lincolnville	11	940	11	940	11	940						
Sandy Point	4	475	4	475	4	475						
Winterport	3	300	3	300	4	360						
Total	62	5,695	65	6,040	68	6,175	17	260	16	260	15	240

EXTENT, BY LOCALITIES, OF THE SALMON FISHERY OF PENOBSCOT RIVER AND BAY IN 1918, 1919, AND 1920—Continued.

Town.	Rods and lines.			Gasoline boats.					
	1918	1919	1920	1918		1919		1920	
	Value.	*Value.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Orland	......	......	......	2	$150	2	$150	2	$150
Verona	......	......	......	2	175	2	175	2	175
Bangor and Brewer	$900	$1,200	$1,500	......	......	......	......	......	......
Hampden	......	......	......	2	300	2	300	1	100
South Orrington	......	......	......	1	100	......	......	......	......
Lincolnville	......	......	......	1	150	1	150	1	150
Sandy Point	......	......	......	1	125	1	125	1	125
Winterport	......	......	......	1	100	1	100	......	......
Total	900	1,200	1,500	10	1,100	9	1,000	7	700

Town.	Rowboats, etc.						Shore and accessory property.			Total investment.		
	1918		1919		1920		1918	1919	1920	1918	1919	1920
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*						
Bucksport	2	$35	4	$70	4	$70	$10	$20	$25	$95	$215	$220
Orland	19	385	19	385	20	400	150	150	150	1,435	1,485	1,600
Penobscot	6	85	8	115	8	115	40	55	60	450	720	700
Verona	20	440	20	440	20	440	175	150	150	3,290	3,515	3,515
Bangor and Brewer	23	1,060	23	1,060	23	1,060	......	......	......	2,040	2,360	2,660
Hampden	3	105	3	105	3	105	550	550	550	1,115	1,095	875
Orrington	6	180	6	180	6	180	......	......	......	300	300	300
South Orrington	4	130	......	......	......	......	50	......	......	535	......	......
Lincolnville	7	340	7	340	7	340	150	150	150	1,580	1,580	1,580
Sandy Point	4	140	4	140	3	110	90	90	90	830	830	800
Winterport	4	140	4	140	1	25	190	190	190	730	730	575
Total	98	3,040	98	2,975	85	2,845	1,405	1,355	1,365	12,400	12,830	12,825

Town.	Persons engaged.			Catch of salmon.[1]								
	1918	1919	1920	1918			1919			1920		
				No.	*Lbs.*	*Value.*	*No.*	*Lbs.*	*Value.*	*No.*	*Lbs.*	*Value.*
Bucksport	1	3	3	30	300	$105	48	480	$192	23	207	$98
Orland	13	14	16	56	560	191	55	550	225	94	846	372
Penobscot	3	4	4	240	2,400	807	181	1,810	773	259	2,331	1,127
Verona	11	11	11	609	6,090	2,188	421	4,210	1,605	636	5,724	2,465
Bangor and Brewer	31	31	31	115	1,380	307	133	1,330	568	140	1,540	832
Hampden	4	4	3	17	180	103	12	120	52	20	205	111
Orrington	12	12	12	80	880	91	120	1,200	511	45	495	266
South Orrington	2	......	......	70	770	188	......	......	......	......	......	......
Lincolnville	6	6	6	148	1,480	544	105	1,050	525	124	1,116	558
Sandy Point	3	3	3	99	1,089	378	85	1,020	500	104	1,054	524
Searsport	......	......	......	......	......	......	10	100	50	21	189	95
Stockton Springs	......	......	......	103	1,133	395	61	732	364	26	260	140
Winterport	3	3	4	86	950	203	91	955	406	106	1,168	622
Total	124	126	128	1,653	17,212	5,500	1,322	13,557	5,771	1,598	15,135	7,210

[1] The salmon credited to Orland in 1918, 1919, and 1920, and to Searsport in 1919 and 1920 were taken incidentally with apparatus fished for other species.

CATCH OF SALMON IN PENOBSCOT RIVER AND BAY FOR VARIOUS YEARS.

Year.	Number.	Pounds.	Value.	Year.	Number.	Pounds.	Value.
1895	4,395	65,011	$11,356	1902	3,269	45,782	$9,950
1896	6,403	80,225	12,716	1903	4,859	67,470	14,935
1897	3,985	51,522	7,911	1904	4,776	63,395	14,451
1898	3,225	42,560	8,342	1905	6,378	74,158	17,503
1899	3,515	45,688	10,424	1918	1,653	17,212	5,500
1900	3,541	44,660	7,832	1919	1,322	13,557	5,771
1901	6,821	86,055	12,263	1920	1,598	15,135	7,210

HUMPBACK SALMON.

In recent years humpback or pink salmon from the Pacific coast have been planted by the Bureau in the Dennys, Pembroke, St. Croix, Penobscot, and other rivers in Maine, beginning with the year 1906, and runs of adult fish have appeared during a number of years. The fish occurred in greatest abundance in the early autumn of 1919, when there were large runs in Dennys and Pembroke Rivers, and smaller runs in various other rivers. In July, 1919, a weir fisherman of Perry caught 17 humpback salmon in Little River and sold about 12 fish at $1 each. They averaged from 4 to 6 pounds in weight. The total catch marketed in 1919 was 310 pounds, valued at $62. Many were taken and released and probably a considerable number were consumed locally. There seems to be no doubt that this species, if properly protected, can maintain itself in certain New England rivers and become a valuable addition to the local fish supply.

INDUSTRIES.

Wholesale fishery trade.—In 1919, including one plant engaged solely in the production of liver oil, 99 firms engaged in the wholesale trade in fresh and salted fishery products, valued at $1,722,094, using cash capital to the amount of $274,550 and giving employment to 872 persons, to whom $616,858 were paid in wages. As the preparation of by-products is for the most part conducted incidentally to activities in the wholesale trade, the canning and smoked fish industries, the prepared products have been listed under the respective industries. The following table gives the extent of the wholesale trade in fresh and salted fishery products of Maine in 1919:

WHOLESALE TRADE IN FRESH AND SALTED FISHERY PRODUCTS, BY COUNTIES.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	17	$346,928	35	$164,250	19	$1,058,906
Cash capital		38,500		49,000		147,550
Persons engaged	149		144		445	
Wages paid		124,393		51,105		398,993
Products:						
Liver oil ... gallons	44,561	58,089	28,750	27,280	11,893	10,517
Other products						44,587
Total		58,089		27,280		55,104

Item.	Lincoln, Penobscot, and York.		Washington.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	9	$96,160	19	$55,850	[1] 99	$1,722,094
Cash capital		17,100		22,400		274,550
Persons engaged	43		91		872	
Wages paid		23,638		18,729		616,858
Products:						
Liver oil ... gallons	5,450	4,596			90,654	100,482
Other products						44,587
Total		4,596				145,069

[1] Includes one plant engaged solely in production of liver oil.

Smoked-fish industry.—In 1919 there were 50 firms engaged primarily in smoking fishery products in Maine. These plants utilized 23,142,814 pounds of fishery products, valued at $359,750.

The prepared products amounted to 4,415,582 pounds, valued at $626,835. The most important items were: Boneless smoked herring, 1,729,219 pounds, valued at $256,740; whole smoked herring, 1,141,278 pounds, valued at $102,334; and finnan haddie, 785,333 pounds, valued at $95,480. The value of the secondary products was $73,687, which included 730 tons of fish scrap, valued at $38,500; 1,271,424 pounds of pomace, valued at $16,411; and 28,044 gallons of herring oil and liver oil, valued at $18,664.

SMOKED-FISH INDUSTRY OF MAINE IN 1919.

Item.	Number.	Value.
Plants	[1] 50	$716,589
Cost of materials		109,577
Cash capital		131,700
Persons engaged	707	
Wages paid		260,179
PRODUCTS.		
Utilized:		
Alewives......pounds	650	26
Cod, salted, dried.do	569,055	60,970
Haddock..........do	8,122,798	192,485
Herring—		
Fresh........do	9,575,127	69,629
Smoked [2].....do	247,000	12,712
Fish skins, waste, etc., pounds	3,228,184	10,928
Pomace.......pounds	1,400,000	13,000
Total	23,142,814	359,750
Prepared:		
Smoked alewives, pounds	335	60
Finnan haddie, pounds	[3] 785,333	95,480
PRODUCTS—continued.		
Prepared—Continued.		
Kippered herring, pounds	[4] 156,500	$15,845
Smoked herring—		
Bloaters...pounds	327,330	20,629
Lengthwise..do	37,053	2,511
Medium scale, pounds	238,534	13,036
Boneless..pounds	1,729,219	256,740
Whole........do	1,141,278	102,334
Other products		[5] 120,200
Total	4,415,582	626,835
Secondary:		
Oil—		
Herring....gallons	23,171	14,086
Liver..........do	4,873	4,578
Pomace.......pounds	1,271,424	16,411
Fish scrap.........do	1,460,000	38,500
Other products		112
Total		73,687

[1] Includes one firm in Cumberland County and three in Washington County also engaged in making herring oil, pomace, and fish scrap.
[2] All smoked herring under products utilized were imported from Canada and used for preparing boneless herring.
[3] Includes the output of one plant in Penobscot County and two in Cumberland County listed with canners.
[4] Includes the output of one plant in Penobscot County listed with canners.
[5] Includes the value of herring pickled by one firm in Washington County.

Canning industry.—The canning industry of Maine is of growing importance, the chief products packed being sardines, finnan haddie, and clams. In 1919, 77 plants were operated, representing a value of $4,315,878 and employing cash or working capital to the amount of $625,257. The cost of materials amounted to $4,768,040; the number of persons employed was 6,116, to whom $1,795,506 were paid in wages; and the value of the products utilized was $1,145,614, of which the most important were: Herring, 128,163,663 pounds, valued at $875,627; haddock, 6,983,629 pounds, valued at $149,496; and soft clams, 1,801,070 pounds, valued at $119,083. It is of interest to note that 19,670 bushels of mussels were utilized, and it is believed that the work of the Bureau in encouraging the use of this product has aided in the development of this fishery. The manufactured products included 2,774,656 cases of canned products, valued at $13,086,886, and secondary products such as scrap, meal, and oil to the value of $82,328. The canned products included 2,450,268 cases of sardines, valued at $11,933,986; 228,127 cases of finnan haddie, valued at $603,696, and 85,426 cases of clam products, valued at $439,221.

The clam pack represents the output of nine firms in Washington County, five in Cumberland County, nine in Hancock County, four in Knox County, two in Lincoln County, one in Penobscot County, and one in York County. Of these firms, seven also canned sardines, one mussels, and three smoked fish. As it has been found impracticable to show the pack of clams by grades and counties without disclosing private enterprise, the pack in detailed form has been omitted from the appended table. The pack was made up of the following items: 259 cases of clams in 4-ounce containers, valued at $1,471; 24,935 cases of 5-ounce cans, valued at $113,373; 2,954 cases of 6-ounce cans, valued at $10,930; 6,641 cases of 8-ounce cans, valued at $49,847; 679 cases of 8½-ounce cans, valued at $3,058; 4,406 cases of 10-ounce cans, valued at $20,730; 200 cases of 11-ounce cans, valued at $760; 19,234 cases of 1-pound cans, valued at $115,068; 4,199 cases of 2-pound cans, valued at $25,194; 1,327 cases of No. 3 cans, valued at $6,348; 74 cases of clam juice in 5-ounce cans, valued at $222; 3,843 cases of clam juice in 10-ounce cans, valued at $4,903; 16 cases in No. 1 cans, valued at $48; 503 cases in No. 10 cans, valued at $946; and 16,156 cases of clam chowder and bouillon in containers of various sizes, valued at $86,323.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	9	$591,262	17	$469,590	8	$240,537
Cost of materials		394,446		756,025		194,373
Cash capital		337,107		57,550		55,070
Persons engaged	569		958		377	
Wages paid		179,780		317,380		111,347
PRODUCTS.						
Utilized:						
Cod, pounds			4,320	86		
Haddock, do	6,983,629	149,496				
Herring, do	3,452,898	35,572	21,325,259	152,271	5,424,020	30,945
Clams, soft, do	48,930	3,444	637,770	37,984	184,910	11,907
Clams, soft, steamed, do			[1] 67,300	9,189		
Mussels, bushels					19,670	367
Canned: [2]						
Sardines—						
In oil—Quarters, cases	57,071	452,237	314,909	1,754,761	71,769	369,714
In mustard—						
Quarters, do	1,340	6,164	9,434	43,559	1,406	6,467
Halves, do			7,862	66,000		
Three-quarters, do	12,531	52,477	47,882	258,025	8,871	39,357
In tomato sauce—						
Quarters, do	1,225	7,446	11,458	60,962	1,302	6,704
Halves, do	1,071	10,280			2,816	28,732
1 pound, do	811	9,732			26	312
Plain—Halves, do	356	2,631				
Finnan haddie—						
6½-ounce, do	197,546	486,134				
8-ounce, do	25	325				
10½-ounce, do	29,378	111,638				
1 pound, do	1,178	5,599				
Total	302,532	1,144,663	391,545	2,183,307	86,190	451,286
Secondary: Fish scrap and meal, pounds					356,200	14,886
Grand total		1,144,663		2,183,307		466,172

[1] Steamed by the fishermen.

[2] Sardine quarters are packed 100 cans to the case and other sardines usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans per case. The number of cans per case of canned clams vary as follows: The 6-oz., 8½-oz., 10-oz., 11-oz, 2-lb., and No. 3 average 2 dozen per case, while the 4-oz., 5-oz., 8-oz., and 1-lb. average 4 dozen per case. The clam juice, 5-oz., 10-oz., and No. 1 cans, average 2 dozen per case, and the No. 10 are packed one-half dozen to the case. The one-half pound kippered herring are packed 8 dozen to the case, and the 1-lb. cans are packed 4 and 6 dozen to the case.

CANNING INDUSTRY OF MAINE IN 1919, BY COUNTIES—Continued.

Item.	Lincoln, Penobscot, and York.		Washington.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	4	$84,023	[1] 39	$2,930,466	77	$4,315,878
Cost of materials		15,873		3,407,323		4,768,040
Cash capital		21,430		154,100		625,257
Persons engaged	106		4,106		6,116	
Wages paid		18,213		1,168,786		1,795,506
PRODUCTS.						
Utilized:						
Cod ... pounds			36,016	955	40,336	1,041
Haddock ... do					6,983,629	149,496
Herring ... do	101,553	1,800	97,859,933	655,039	128,163,663	875,627
Clams, soft ... do	134,190	9,582	727,970	46,977	1,733,770	109,894
Clams, soft, steamed ... do					67,300	9,189
Mussels ... bushels					19,670	367
Canned:[2]						
Sardines—						
In oil—						
Quarters ... cases			1,458,681	6,750,953	1,902,430	9,327,665
Halves ... do			878	11,500	878	11,500
In mustard—						
Quarters ... do			115,484	546,607	127,664	602,797
Halves ... do					7,862	66,000
Three-quarters ... do			242,363	973,555	311,647	1,323,414
In tomato sauce—						
Quarters ... do			76,407	457,073	90,392	532,185
Halves ... do			1,166	5,522	5,053	44,534
1 pound ... do			1,334	6,413	2,171	16,457
Plain—						
Halves ... do			127	490	483	3,121
No. 1 ... do			1,688	6,313	1,688	6,313
Kippered herring—						
Half pound ... do					1,917	15,386
1 pound ... do					7,631	86,385
Finnan haddie—						
6½-ounce ... do					197,546	486,134
8-ounce ... do					25	325
10½-ounce ... do					29,378	111,638
1 pound ... do					1,178	5,599
Clams (various sizes) ... do					85,426	439,221
Miscellaneous ... do					1,287	8,212
Total			1,898,128	8,758,426	2,774,656	13,086,886
Secondary:						
Fish scrap and meal ... pounds			1,972,000	66,959	2,328,200	81,845
Herring oil ... gallons			690	483	690	483
Total				67,442		82,328
Grand total				8,825,868		13,169,214

[1] This includes one plant located at Belfast, in Waldo County.
[2] See footnote 2 on p. 149.

Sardine industry in 1919 and 1920.—In 1919, 53 plants were engaged in canning sardines, employing 5,463 persons, to whom $1,685,409 were paid in wages. The plants were valued at $3,764,875, the cost of materials used was $4,556,963, and the working capital amounted to $256,107. The herring utilized amounted to 125,309,415 pounds, valued at $852,450. The total pack was 2,450,268 cases, valued at $11,933,986, of which 1,902,430 cases, valued at $9,327,665, were quarter oils.

In 1920 the number of plants operated was 50, valued at $3,816,388; the cost of materials amounted to $3,907,878; the working capital was $250,000; and the number of persons employed was 5,109, to whom $1,787,402 were paid in wages. The herring utilized amounted to 104,700,010 pounds, valued at $767,141, and the pack was 1,877,757 cases, valued at $7,435,056, of which 1,458,670 cases, valued at $5,669,352, were quarter oils.

The detailed statistics of the sardine industry of Maine in 1919 and 1920, by counties, are shown in the appended tables:

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES.

1919.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	5	$172,673	10	$456,090	5	$225,146
Cost of material		241,504		741,150		185,186
Cash capital		26,107		46,000		40,000
Persons engaged	392		832		235	
Wages paid		128,187		303,621		100,769
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring utilized	3,395,203	$34,992	21,325,259	$152,271	5,424,020	$30,945
Canned sardines: [1]						
In oil—	*Cases.*	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*
Quarters	57,071	$452,237	314,909	$1,754,761	71,769	$369,714
Halves						
In mustard—						
Quarters	1,340	6,164	9,434	43,559	1,406	6,467
Halves			7,862	66,000		
Three-quarters	12,531	52,477	47,882	258,025	8,871	39,357
In tomato sauce—						
Quarters	1,225	7,446	11,458	60,962	1,302	6,704
Halves	1,071	10,280			2,816	28,732
One pound	811	9,732			26	312
Plain—						
Half-pound	356	2,631				
Number one						
Total sardines	74,405	510,967	391,545	2,183,307	86,190	451,286

Item.	Washington.		Total.	
	Number.	*Value.*	*Number.*	*Value.*
Plants	[1] 33	$2,910,966	53	$3,764,875
Cost of material		3,389,123		4,556,963
Cash capital		144,000		256,107
Persons engaged	4,004		5,463	
Wages paid		1,152,832		1,685,409
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring utilized	95,164,933	$634,242	125,309,415	$852,450
Canned sardines: [2]				
In oil—	*Cases.*	*Value.*	*Cases.*	*Value.*
Quarters	1,458,681	$6,750,953	1,902,430	$9,327,665
Halves	878	11,500	878	11,500
In mustard—				
Quarters	115,484	546,607	127,664	602,797
Halves			7,862	66,000
Three-quarters	242,363	973,555	311,647	1,323,414
In tomato sauce—				
Quarters	76,407	457,073	90,392	532,185
Halves	1,166	5,522	5,053	44,534
One pound	1,334	6,413	2,171	16,457
Plain—				
Half-pound	127	490	483	3,121
Number one	1,688	6,313	1,688	6,313
Total sardines	1,898,128	8,758,426	2,450,268	11,933,986

[1] Includes one plant located at Belfast, in Waldo County.

[2] Quarters are packed 100 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

SARDINE INDUSTRY OF MAINE IN 1919 AND 1920, BY COUNTIES—Continued.

1920.

Item.	Cumberland.		Hancock.		Knox and Waldo.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	6	$204,132	8	$567,643	3	$245,009
Cost of material		133,071		392,975		81,772
Cash capital		37,000		37,000		6,500
Persons engaged	432		649		171	
Wages paid		89,285		169,752		64,520
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring utilized	3,073,468	$30,114	9,878,319	$80,701	2,034,800	$15,915
Canned sardines: [1]						
In oil—	*Cases.*	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*
Quarters	36,510	$206,232	142,985	$789,168	22,077	$149,628
Halves			2,228	22,280		
In mustard—						
Quarters	1,226	4,523	6,261	31,824	51	204
Three-quarters	5,492	16,650	18,067	89,842	785	3,242
In tomato sauce—						
Quarters	3,317	15,155	6,143	25,499	2,949	11,796
Halves	150	1,080			1,331	15,956
Three-quarters						
One pound	18,075	75,846			3,712	33,408
Total sardines	64,770	319,486	175,684	958,613	30,905	214,234

Item.	Washington.		Total.	
	Number.	*Value.*	*Number.*	*Value.*
Plants	[1] 33	$2,799,604	50	$3,816,388
Cost of material		3,300,060		3,907,878
Cash capital		169,500		250,000
Persons engaged	3,857		5,109	
Wages paid		1,463,845		1,787,402
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Herring utilized	89,713,423	$640,411	104,700,010	$767,141
Canned sardines: [2]				
In oil—	*Cases.*	*Value.*	*Cases.*	*Value.*
Quarters	1,257,098	$4,524,324	1,458,670	$5,669,352
Halves			2,228	22,280
In mustard—				
Quarters	43,945	185,493	51,483	222,044
Three-quarters	158,625	586,330	182,969	696,064
In tomato sauce—				
Quarters	145,905	641,832	158,314	694,282
Halves			1,481	17,036
Three-quarters	348	1,643	348	1,643
One pound	477	3,101	22,264	112,355
Total sardines	1,606,398	5,942,723	1,877,757	7,435,056

[1] Includes two plants located in Waldo County.
[2] Quarters are packed 100 cans to the case and others usually 48 cans to the case, except half-pound ovals, which sometimes contain 72 cans to the case.

FISHERIES OF NEW HAMPSHIRE.

The coastal fisheries of New Hampshire are unimportant in comparison with the fisheries of the other New England States and are confined to Rockingham County, the only coastal county. In 1919 the number of persons employed was 100, of whom 3 were on a vessel transporting fishery products, 85 in the shore and boat fisheries, and 12 shoresmen in wholesale fish establishments. The amount of capital invested was $45,530 and included: A transporting vessel with outfit, valued at $9,300; 31 small boats, valued at $802; 53 power boats, valued at $10,675; fishing apparatus in the shore fisheries to the value of $7,295; shore and accessory property with a value of $11,958, and cash capital amounting to $5,500.

The products amounted to 528,730 pounds, valued at $92,660. The species of chief importance were as follows: Lobsters, 298,012 pounds, valued at $73,203; soft clams, 66,600 pounds, valued at $13,320; and cod, 98,354 pounds, valued at $3,609.

Compared with 1905, there has been a decrease of 45 in the number of persons employed, of $1,520 in the capital invested, and of 507,722 pounds in the quantity of products; but an increase in the value of the products of $40,716. There has been an increase in the catch of lobsters as compared with 1905 of 41,960 pounds in quantity and $40,628 in value and a decrease in the collection of Irish moss of 54,000 pounds in quantity and $1,980 in the value.

FISHERIES OF ROCKINGHAM COUNTY.

The following table shows the number of persons employed, the investment, and the quantity and value of the products of the fisheries of Rockingham County, N. H., in 1919:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF ROCKINGHAM COUNTY, N. H., IN 1919.

Item.	Number.	Value.	Item.	Number.	Value.
PERSONS ENGAGED.			INVESTMENT—continued.		
On vessels transporting	3		Shore and accessory property		$11,958
Inshore fisheries	85		Cash capital		5,500
Shoresmen	12		Total		45,530
Total	100		PRODUCTS.		
INVESTMENT.				Pounds.	Value.
Vessels transporting: Gasoline	1	$6,300	Cod	98,354	3,609
Tonnage	8		Cusk	2,400	86
Outfit		3,000	Eels	2,000	240
Boats:			Flounders	8,000	240
Sail, row, etc	31	802	Haddock	18,764	829
Power	53	10,675	Hake	3,000	98
Apparatus, shore fisheries:			Pollock	25,600	615
Hand line		70	Lobsters	298,012	73,203
Trawl lines		392	Clams, soft	[1] 66,600	13,320
Lobster pots	2,275	6,735	Irish moss	6,000	420
Eel pots	18	36	Total	528,730	92,660
Clam hoes	25	50			
Moss rakes	2	12			

[1] 6,660 bushels.

FISHERIES BY APPARATUS.

No vessels were employed in the capture of fish in 1919. The largest quantity in the shore fisheries, consisting of 298,012 pounds of lobsters, valued at $73,203, was taken with lobster pots. The catch with hand lines, amounting to 156,118 pounds, valued at $5,477, was second, and the catch of soft clams with clam hoes, third. The principal species taken with hand lines were cod, pollock, haddock, and flounders. The following table gives the products of the shore fisheries in 1919 by apparatus and species:

Yield of the Shore Fisheries of New Hampshire in 1919, by Apparatus and Species.

Apparatus and species.	Pounds.	Value.	Apparatus and species.	Pounds.	Value.
Lines:			Lobster pots: Lobsters	298,012	$73,203
Cod	98,354	$3,609	Eel pots: Eels	2,000	240
Cusk	2,400	86	Clam hoes: Soft clams	66,600	13,320
Flounders	8,000	240	Moss rakes: Irish moss	6,000	420
Haddock	18,764	829			
Hake	3,000	98	Grand total	528,730	92,660
Pollock	25,600	615			
Total	156,118	5,477			

WHOLESALE FISHERY TRADE.

There were only 2 wholesale fresh-fish establishments in Rockingham County in 1919, valued at $7,540, using cash capital to the amount of $5,500 and employing 12 persons, to whom $12,678 were paid in wages.

FISHERIES OF MASSACHUSETTS.

The fisheries of Massachusetts in 1919 were more productive than those of all the other New England States combined. The number of persons employed was 12,346, of whom 4,459 were on fishing vessels, 66 on vessels transporting fishery products, 3,737 in the shore and boat fisheries, and 4,084 shoresmen in the wholesale plants, canneries, salteries, smokehouses, by-products plants, and other shore establishments.

The investment included 421 fishing and transporting vessels, valued at $6,192,118, having a net tonnage of 16,838 tons and outfits valued at $1,860,766; 3,040 power, sail, row, and other small boats, valued at $949,683; apparatus employed in the vessel and boat fisheries to the value of $1,205,518; shore and accessory property valued at $7,000,239, and cash capital to the amount of $1,902,945, making a total investment of $19,111,269.

The products of the fisheries amounted to 246,951,241 pounds, valued at $10,859,746. The most important species arranged in the order of their value were: Cod, 69,496,325 pounds, valued at $2,992,793; haddock, 78,178,384 pounds, valued at $2,208,211; common mackerel, 13,516,194 pounds, valued at $1,322,409; lobsters, 2,387,636 pounds, valued at $516,393; flounders, 10,262,693 pounds, valued at $478,850; pollock, 19,242,541 pounds, valued at $469,943; and scallops, 1,332,486 pounds, or 222,081 bushels, valued at $439,382.

Compared with the Bureau's returns for 1905 there has been a decrease in the number of persons employed of 3,348, an increase in the investment amounting to $8,300,827, a decrease in the quantity of products taken amounting to 8,703,234 pounds, and an increase in the value amounting to $3,834,497. The species for which there has been a notable increase in 1919 as compared with 1905, with the amount of increase follow: Flounders, 6,219,010 pounds; squid, 5,348,807 pounds; whiting, 9,618,960 pounds; lobsters, 1,104,565 pounds; scallops, 1,069,249 pounds; and hard crabs, 1,704,961 pounds. Those for which there has been a marked decrease as compared with 1905 are: Alewives, 1,673,820 pounds; cusk, 5,877,991 pounds; hake, 16,605,435 pounds; halibut, 1,796,447 pounds; and herring, 7,553,045 pounds.

FISHERIES BY COUNTIES.

The statistics of the number of persons employed, investment, and products of the fisheries in Massachusetts in 1919 are given by counties in the appended table:

Persons Engaged, Investment, and Products of Fisheries of Massachusetts in 1919, by Counties.

Item.	Barnstable.		Bristol.		Dukes.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	504		218		54	
On vessels transporting	6					
Inshore fisheries	1,386		355		229	
Shoresmen	638		169		34	
Total	2,534		742		317	
INVESTMENT.						
Vessels fishing:						
Steam	1	$12,000				
Tonnage	55					
Outfit		4,400				
Gasoline	68	186,150	15	$52,500	14	$59,100
Tonnage	626		160		128	
Outfit		88,940		24,900		16,210
Sail	12	139,500	6	98,200		
Tonnage	1,259		829			
Outfit		126,525		24,200		
Vessels transporting:						
Gasoline	3	8,500				
Tonnage	17					
Outfit		450				
Boats:						
Sail, row, etc	633	39,000	149	3,145	70	3,043
Power	500	238,770	161	43,375	167	74,125
Apparatus, vessel fisheries:						
Purse seines	15	32,800	8	3,650	3	2,100
Gill nets	661	13,835	340	5,550	555	10,080
Otter trawls	35	2,645	4	300	5	300
Lines, hand and trawl		8,294		960		2,694
Harpoons		800		925		725
Lobster pots	75	150	80	200	275	700
Dredges	158	1,571	2	30	12	60
Tongs			1	9		
Whaling apparatus		12,000		17,000		
Apparatus, shore fisheries:						
Purse seines	4	2,600			1	150
Haul seines	13	1,085	6	415	3	540
Gill nets	881	13,370	20	275	40	640
Pound nets, trap nets, and weirs	151	326,700	18	8,200	31	22,100
Fyke nets	44	1,010	7	475	2	100
Bow nets	13	36				
Dip nets	63	138				
Otter trawls	36	1,970	2	170	52	2,875
Lines, hand and trawl		10,250		152		91
Harpoons				60		480
Spears	27	51	29	83		
Cunner traps			4	6		
Cockle traps	400	360				
Lobster pots	2,750	5,549	7,352	15,762	5,543	15,661
Eel pots	738	1,503	55	100	587	1,545
Dredges	1,086	7,561	256	1,280	416	2,080
Tongs	115	674	70	390		
Rakes	537	2,219	92	1,054	54	1,080
Forks and hoes	139	286	1	1	7	14
Shore and accessory property		1,492,266		124,035		66,405
Cash capital		83,650		16,000		9,000
Total		2,867,608		443,402		291,898
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives:						
Fresh	313,466	$5,634	104,795	$2,075	551,150	$14,141
Salted	801,600	36,620	60,534	2,220	140,000	6,300
Smoked	39,000	2,845				
Bluefish	3,932	696			121	24
Bonito	33,956	2,549	40	4	95,461	9,929
Butterfish	180,500	15,577	11,700	850	56,899	5,853

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES—Continued.

Item.	Barnstable.		Bristol.		Dukes.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Catfish and wolffish	20,976	$330				
Cod:						
Fresh	6,132,372	229,207	176,870	$10,697	201,259	$14,313
Salted	6,500	450				
Cunners			7,150	500		
Cusk, fresh	16,428	436				
Eels	112,708	16,912	24,778	2,880	79,500	11,505
Flounders	3,979,872	161,782	187,123	9,058	913,238	59,457
Grayfish	1,000	10	62,667	174		
Goosefish			2,500	7		
Haddock, fresh	5,865,917	172,356			65,554	4,553
Hake, fresh	644,902	15,839	2,763	180	15,086	1,501
Halibut, fresh	19,318	4,385	20,000	5,000		
Herring	6,445,441	80,284	88,765	1,373	25	3
Hickory shad	11,650	780	1,150	50		
Kingfish			72	18		
Launce	67,800	838				
Mackerel:						
Fresh	3,596,851	337,779	263,445	26,526	335,337	41,320
Frigate					61,361	1,862
Menhaden	69,303	1,605	46,516	272	5,400	54
Minnows	1,000	125				
Perch, white			200	20	6,000	900
Pollock, fresh	1,242,907	29,749	140	5	45,871	1,398
Pompano	14	2				
Rosefish	305	9				
Round herring	941	19				
Sculpin			6,000	15		
Scup	10,344	759	52	6	65,278	4,626
Sea bass	345	110	2,289	50	10,365	1,182
Sea robin			400	1		
Shad	5,645	1,553	352	85	37	7
Sharks	314,525	3,220	3,175	71		
Skates and rays	885	17	93,649	381		
Smelt	257	38	97	13		
Squeteague	613	74	962	151	4,202	683
Striped bass	307	115	605	103	59	13
Sturgeon	5,183	1,191				
Sturgeon caviar	30	85				
Sturgeon roe	175	150				
Swordfish	112,935	20,860	109,141	22,865	121,538	25,740
Tautog	35,427	2,589	46,369	5,421	822	49
Tilefish			38,000	1,330		
Tomcod	2,200	6	4,690	183		
Tuna	37,048	2,716	53	2		
Whiting	11,173,383	135,485	57,709	948	62,727	365
Other species	9,500	100	8,411	388	20,321	1,629
Squid	5,837,988	104,364	141,129	2,184	16,459	253
Blackfish	40,000	40				
Porpoise	750	15				
Clams:						
Hard—						
Public	293,520	99,348	195,360	63,600	79,120	27,300
Private	22,640	12,425				
Soft—						
Public	136,000	13,189	6,000	900	5,000	875
Private	125,000	10,750				
Razor	23,300	3,500				
Oysters:						
Market—						
Public	875	150	1,120	400		
Private	723,835	265,397	21,945	5,380		
Seed—Private	68,978	5,912				
Scallops	501,264	145,523	42,300	14,200	301,020	88,325
Cockles	2,400	1,025				
Lobsters	99,420	26,988	256,618	54,402	610,497	104,610
Shrimp	3,100	1,550				
Spawn	37,107	1,601				
Livers	150	1				
Sperm oil	678,375	92,450	867,038	125,661		
Ambergris	30	5,000				
Alewife scales	4,000	2,000				
Total	49,916,193	2,077,114	2,964,672	360,649	3,869,707	428,770

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES—Continued.

Item.	Essex.		Nantucket.		Norfolk.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	2,345		43			
On vessels transporting	30		3			
Inshore fisheries	621		100		45	
Shoresmen	2,058		6		2	
Total	5,057		152		47	
INVESTMENT.						
Vessels fishing:						
Steam	11	$502,065	1	$4,000		
Tonnage	931		15			
Outfit		119,866		1,650		
Gasoline	146	1,950,303	13	24,200		
Tonnage	5,302		122			
Outfit		671,348		16,075		
Sail	23	379,500	1	100		
Tonnage	1,780		5			
Outfit		110,222		15		
Vessels transporting:						
Gasoline	5	59,350	1	300		
Tonnage	290		6			
Outfit		3,170				
Sail	3	13,800				
Tonnage	132					
Outfit		2,375				
Boats:						
Sail, row, etc	163	4,435	20	700	21	$680
Power	321	152,390	78	25,655	31	7,450
Apparatus, vessel fisheries:						
Purseseines	64	130,700	1	600		
Gill nets	3,089	63,875	100	1,600		
Otter trawls	36	4,145	6	360		
Lines, hand and trawl		82,495				
Harpoons		2,780		200		
Dredges			42	795		
Rakes			2	40		
Apparatus, shore fisheries:						
Purse seines	20	39,000				
Haul seines	11	575				
Gill nets	1,724	40,363	10	1,500		
Pound nets, trap nets, and weirs	43	19,650	3	3,000		
Dip nets	12	63				
Otter trawls	25	1,440	32	835		
Lines, hand and trawl		14,797		265		70
Spears	6	11			8	20
Cockle traps	280	140				
Lobster pots	10,859	26,929	622	1,866	2,289	6,440
Eel pots	119	326	180	540	15	45
Dredges			384	1,720		
Rakes			40	1,010	5	30
Forks and hoes	134	208			11	22
Shore and accessory property		3,563,906		30,165		3,145
Cash capital		374,795		3,000		1,200
Total		8,335,022		120,191		19,102
PRODUCTS.						
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	29,815	$344	16,400	$164		
Salted			27,000	1,080		
Bluefish	668	71				
Bonito	670	54	59,400	5,470		
Butterfish	20,469	2,126				
Catfish and wolffish	64,236	1,991				
Cod:						
Fresh	39,449,727	1,695,709	192,400	8,120	22,000	$1,760
Salted	3,137,905	162,452	30,000	3,600		
Cunners	2,809	85				
Cusk:						
Fresh	1,073,168	37,681				
Salted	16,870	759				
Eels	113,991	10,177	30,000	4,500	3,000	530
Flounders	2,171,726	93,786	611,210	49,090	8,000	800
Haddock:						
Fresh	25,468,781	714,799	16,100	508	500	40
Salted	373,574	16,996				

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES—Continued.

Item.	Essex.		Nantucket.		Norfolk.	
PRODUCTS—continued.						
Hake:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	1,957,170	$79,601				
Salted	29,095	1,307				
Halibut:						
Fresh	1,435,835	249,254				
Salted	8,045	1,060				
Herring	2,241,108	29,625	2,000	$300		
Mackerel:						
Fresh	6,953,882	661,856	89,700	7,925		
Salted	1,249,062	109,948				
Perch, yellow	500	25				
Pollock:						
Fresh	13,956,759	341,242	28,400	1,486	1,000	$0.80
Salted	50,153	1,774				
Rosefish	20,150	487				
Scup			2,450	245		
Sea bass	18	2	2,000	300		
Shad	33,366	1,297	12,800	750		
Sharks	9,594	319				
Skates and rays	3,510	56				
Smelt	7,796	1,864			22,200	6,425
Sturgeon	1,080	103	4,500	1,800		
Sturgeon caviar			120	271		
Sturgeon roe	6	13				
Swordfish	275,502	64,951	1,300	214		
Tautog	158	6			2,000	180
Tilefish	116,670	7,000				
Tuna	5,000	750				
Whiting	2,564,231	11,343	53,600	660		
Squid	121,831	1,671	3,350	83		
Clams:						
Hard, public	600	75	247,944	68,836		
Soft, public	460,060	58,206			63,470	9,620
Scallops			103,452	46,230		
Cockles	300,000	1,350				
Crabs, hard	18,167	395			18,475	554
Lobsters	677,387	161,249	19,446	8,759	77,054	19,390
Shrimp	300	39				
Tongues	600	12				
Spawn	57,462	3,401				
Livers	282,875	4,366				
Irish moss					25,500	1,912
Total	104,762,381	4,531,677	1,553,572	210,391	243,199	41,291

Item.	Plymouth.		Suffolk.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	2		1,293		4,459	
On vessels transporting			27		66	
Inshore fisheries	485		513		3,737	
Shoresmen	99		1,078		4,084	
Total	586		2,911		12,346	
INVESTMENT.						
Vessels fishing:						
Steam			21	$1,966,480	34	$2,484,545
Tonnage			2,309		3,310	
Outfit				304,045		429,961
Gasoline	1	$2,500	51	501,755	308	2,776,508
Tonnage	8		1,856		8,202	
Outfit		120		241,845		1,059,438
Sail			12	191,015	54	808,315
Tonnage			861		4,734	
Outfit				91,350		352,312
Vessels transporting:						
Gasoline			13	40,800	22	108,950
Tonnage			147		460	
Outfit				13,060		16,680
Sail					3	13,800
Tonnage					132	
Outfit						2,375

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES—Continued.

Item.	Plymouth.		Suffolk.		Total.	
INVESTMENT—continued.						
Boats:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Sail, row, etc.	219	$5,655	33	$1,830	1,3[illegible]8	$58,488
Power	289	90,570	191	258,860	1,732	891,195
Apparatus, vessel fisheries:						
Purse seines			9	24,000	100	193,850
Gill nets			685	12,745	5,430	107,685
Otter trawls			33	10,100	119	17,850
Lines, hand and trawl				39,215		133,658
Harpoons				1,225		6,655
Lobster pots					130	1,050
Dredges	10	60			224	2,516
Tongs					1	9
Rakes					2	40
Whaling apparatus						29,000
Apparatus, shore fisheries:						
Purse seines	1	300			26	42,050
Haul seines	2	180	6	1,200	41	3,995
Gill nets	38	1,675	975	19,500	3,688	77,323
Pound nets, trap nets, and weirs	8	7,820			254	387,470
Fyke nets					53	1,585
Bow nets					13	36
Dip nets	22	132	7	41	104	371
Otter trawls	2	120	42	2,100	191	9,510
Lines, hand and trawl		719		25,068		51,412
Harpoons						540
Spears	2	6			72	171
Cunner traps					4	6
Cockle traps					680	500
Lobster pots	11,317	31,182	2,250	5,970	43,012	109,359
Eel pots	132	396			1,826	4,455
Dredges	622	3,880			2,764	16,521
Tongs	50	291			235	1,355
Rakes	56	263			784	5,656
Forks and hoes	130	265	53	91	475	837
Shore and accessory property		106,136		1,614,181		7,000,239
Cash capital		7,300		1,408,000		1,902,945
Total		259,570		6,774,476		19,111,269
PRODUCTS.						
Alewives:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	81,050	$704	800	$8	1,097,476	$23,070
Salted	230,000	9,775			1,259,134	55,995
Smoked					39,000	2,845
Bluefish					4,721	791
Bonito			200	12	189,727	18,018
Butterfish	4,775	517	22,485	1,887	296,828	26,810
Catfish and wolffish			205,976	6,898	291,188	9,219
Cod:						
Fresh	182,113	7,926	19,964,179	858,359	66,320,920	2,826,091
Salted	1,000	200			3,175,405	166,702
Cunners					9,959	585
Cusk:						
Fresh	3,000	84	468,741	16,867	1,561,337	55,068
Salted					16,870	759
Eels	9,700	1,203	499	7	374,167	47,714
Flounders	42,700	1,994	2,348,824	102,883	10,262,693	478,850
Grayfish					63,667	184
Goosefish					2,500	7
Haddock:						
Fresh	4,750	183	46,383,268	1,298,776	77,804,810	2,191,215
Salted					373,574	16,996
Hake:						
Fresh	3,100	125	1,443,416	59,107	4,066,437	156,352
Salted					29,095	1,307
Halibut:						
Fresh			233,356	37,593	1,708,509	296,232
Salted					8,045	1,060
Herring	1,810,600	11,519	223,470	6,304	10,811,409	129,408
Hickory shad					12,800	830
Kingfish					72	18
Launce					67,800	838
Mackerel:						
Fresh	48,887	5,991	979,030	131,064	12,267,132	1,212,461
Salted					1,249,062	109,948
Frigate					61,361	1,862
Menhaden	40,000	300			161,219	2,231
Minnows					1,000	125

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES—Continued.

Item.	Plymouth.		Suffolk.		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Perch:						
White					6,200	$920
Yellow					500	25
Pollock:						
Fresh	15,600	$474	3,901,711	$93,735	19,192,388	468,169
Salted					50,153	1,774
Pompano					14	2
Rosefish			16,318	628	36,773	1,124
Round herring					941	19
Sculpin					6,000	15
Scup	500	30			78,624	5,666
Sea bass	50	5			15,067	1,649
Sea robin					400	1
Shad			10,137	617	62,337	4,309
Sharks			1,105	54	328,399	3,664
Skates and rays			2,310	49	100,354	503
Smelt	7,500	2,025	1,300	325	39,150	10,690
Squeteague					5,777	908
Striped bass					971	231
Sturgeon			1,335	264	12,098	3,358
Sturgeon caviar					150	356
Sturgeon roe					181	163
Swordfish			91,313	20,700	711,729	155,330
Tautog	7,100	640			91,876	8,885
Tilefish			33,510	1,473	188,180	9,803
Tomcod			1,000	50	7,890	239
Tuna	800	80			42,901	3,548
Whiting	7,000	53			13,918,650	148,854
Other species					38,232	2,117
Squid	13,800	309			6,134,557	108,864
Blackfish					40,000	40
Porpoise					750	15
Clams:						
Hard—						
Public	36,760	12,183			[1] 853,304	271,342
Private					[2] 22,640	12,425
Soft—						
Public	1,146,100	122,885	246,000	26,519	[3] 2,062,630	232,194
Private					[4] 125,000	10,750
Razor					[5] 23,300	3,500
Oysters:						
Market—						
Public	3,584	833			[6] 5,579	1,383
Private	23,275	7,387			[7] 769,055	278,164
Seed—						
Public	23,100	1,320			[8] 23,100	1,320
Private	11,200	640			[9] 80,178	6,552
Scallops	381,450	145,104			[10] 1,332,486	439,382
Cockles	275,000	1,050			[11] 577,400	3,425
Crabs:						
Hard	8,000	165	1,720,319	48,310	[12] 1,764,961	49,424
Soft	266	40			[13] 266	40
Lobsters	575,829	119,580	71,385	21,415	2,387,636	516,393
Shrimp					3,400	1,589
Tongues					600	12
Spawn			52,360	3,834	146,929	8,836
Livers			30,550	477	313,575	4,844
Sperm oil					[14] 1,545,413	218,111
Ambergris					30	5,000
Alewife scales	6,400	3,200			10,400	5,200
Irish moss	178,700	13,115			204,200	15,027
Total	5,186,689	471,639	78,454,828	2,738,215	246,951,241	10,859,746

[1] 106,663 bushels.
[2] 2,830 bushels.
[3] 206,263 bushels.
[4] 12,500 bushels.
[5] 2,330 bushels.
[6] 797 bushels.
[7] 109,865 bushels.
[8] 3,300 bushels.
[9] 11,454 bushels.
[10] 222,081 bushels.
[11] 57,740 bushels.
[12] 5,294,883 in number.
[13] 798 in number.
[14] 206,055 gallons.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in both the vessel and shore fisheries of Massachusetts in 1919 amounted to 246,951,241 pounds, valued at $10,859,746. Lines were the most productive form, yielding 108,703,430 pounds, valued at $4,311,755, the principal species taken being: Cod, 62,604,055 pounds, valued at $2,699,786; haddock, 33,154,060 pounds, valued at $945,599; halibut, 1,649,305 pounds, valued at $285,860; hake, 3,436,229 pounds, valued at $130,755; and pollock, 4,698,115 pounds, valued at $116,328. Otter trawls ranked second, with 58,584,932 pounds, valued at $1,906,360, of which 42,593,223 pounds, valued at $1,195,092, were haddock. Gill nets, employed chiefly in the taking of mackerel, pollock, haddock, and cod, yielded 18,204,216 pounds, valued at $814,940. The catch with seines amounted to 14,159,335 pounds, valued at $792,721. The most important species taken in seines was mackerel, the catch of which amounted to 8,552,827 pounds, valued at $738,220. Various species were taken in pound nets, trap nets, and weirs to the amount of 32,314,809 pounds, valued at $655,005. Other important forms of apparatus used in both the vessel and shore fisheries were dredges, with 2,023,428 pounds of oysters, scallops, and clams, valued at $680,331; tongs, rakes, hoes, and forks, with 3,387,906 pounds of oysters, scallops, clams, and Irish moss, valued at $577,203; and lobster pots with 4,152,597 pounds of lobsters and crabs, valued at $565,817.

The following tables give the products of the vessel and shore fisheries by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls:						
Cod—Fresh	1,260	$60	650	$25		
Flounders	2,888,935	110,022	92,000	4,800	243,420	$12,805
Haddock—Fresh	220	13				
Hake	385	5	80	2		
Pollock—Fresh			120	4		
Scallops			300	200		
Total	2,890,800	110,100	93,150	5,031	243,420	12,805
Lines:						
Catfish and wolffish	7,364	235				
Cod—Fresh	3,012,246	94,045	174,325	10,575	155,928	12,592
Cusk—Fresh	12,295	382				
Flounders	12,178	434				
Haddock—Fresh	5,224,160	151,401			64,000	4,480
Hake—Fresh	207,258	7,232	350	25	15,000	1,500
Halibut—Fresh	9,107	2,681	20,000	5,000		
Pollock—Fresh	229,186	4,895				
Rosefish	305	9				
Tautog			4,125	450		
Tilefish			38,000	1,330		
Spawn	37,107	1,601				
Total	8,751,206	262,915	236,800	17,380	234,928	18,572
Seines:						
Butterfish	248	29				
Cod	12,371	358				
Cusk	1,030	21				
Flounders	4,668	164				
Haddock	2,990	83				
Hake	5,450	202				
Herring	513,600	9,158				
Mackerel, fresh	1,616,538	126,082	127,500	13,750	37,500	4,950
Pollock	53,470	1,579				
Smelt	257	38				
Total	2,210,622	137,714	127,500	13,750	37,500	4,950

Yield of Vessel Fisheries of Massachusetts in 1919, by Counties, Apparatus, and Species—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Gill nets:						
Mackerel	248, 748	$27, 397	92, 900	$7, 890	218, 330	$27, 890
Total	248, 748	27, 397	92, 900	7, 890	218, 330	27, 890
Harpoons: Swordfish	112, 935	20, 860	106, 741	22, 265	106, 038	23, 120
Whaling gear:						
Ambergris	30	5, 000				
Sperm oil	678, 375	92, 450	867, 038	125, 661		
Total	678, 405	97, 450	867, 038	125, 661		
Lobster pots: Lobsters	1, 200	400	2, 740	685	18, 682	3, 228
Dredges:						
Clams, hard	4, 800	1, 200				
Oysters—						
Market, private	356, 685	142, 040	21, 000	5, 250		
Seed, private	17, 290	1, 482				
Scallops	68, 610	22, 375			2, 400	1, 000
Total	447, 385	167, 097	21, 000	5, 250	2, 400	1, 000
Tongs and rakes: Clams, hard			2, 800	1, 050		
Grand total	15, 341, 301	823, 933	1, 550, 669	198, 962	861, 298	91, 565

Apparatus and species.	Essex.		Nantucket.		Plymouth.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls:						
Butterfish	330	$23				
Catfish and wolffish	4, 616	312				
Cod—						
Fresh	2, 494, 530	107, 285	41, 000	$2, 050		
Salted	40, 000	2, 200				
Cusk—						
Fresh	24, 765	892				
Salted	15, 000	675				
Flounders	1, 179, 280	47, 147	336, 000	26, 880		
Haddock—						
Fresh	8, 326, 644	234, 134	1, 000	50		
Salted	194, 000	6, 790				
Hake	32, 658	1, 338				
Halibut	13, 622	2, 316				
Hallock—						
Fresh	443, 280	10, 638				
Salted	14, 045	456				
Rosefish	9, 140	229				
Whiting	445	4				
Total	12, 792, 355	414, 439	378, 000	28, 980		
Lines:						
Catfish and wolffish	42, 237	1, 136				
Cod—						
Fresh	34, 344, 909	1, 479, 211				
Salted	3, 097, 905	160, 252				
Cusk—						
Fresh	821, 692	28, 627				
Salted	1, 870	84				
Flounders	6, 016	213				
Haddock—						
Fresh	14, 653, 310	410, 530				
Salted	179, 574	10, 206				
Hake—						
Fresh	1, 258, 021	50, 721				
Salted	29, 095	1, 307				
Halibut—						
Fresh	1, 416, 132	245, 904				
Salted	8, 045	1, 060				
Pollock—						
Fresh	1, 503, 661	36, 792				
Salted	27, 258	883				
Rosefish	3, 470	124				
Sharks	1, 118	28				
Skates	20	1				

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Essex.		Nantucket.		Plymouth.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Lines—Continued.						
Tilefish	116,670	$7,000				
Livers	2,225	38				
Spawn	54,750	3,255				
Total	57,567,978	2,437,372				
Seines:						
Bonito	300	30				
Butterfish	40	4				
Cod	5,900	254				
Haddock	1,025	29				
Hake	3,318	136				
Herring	556,112	6,105				
Mackerel—						
Fresh	4,788,267	400,778	2,000	$200		
Salted	1,249,062	109,948				
Pollock	2,095,253	46,863				
Shad	822	138				
Sharks	180	11				
Spawn	1,100	58				
Total	8,701,379	564,354	2,000	200		
Gill nets:						
Bonito	280	15				
Butterfish	1,060	58				
Cod	1,241,606	50,195				
Haddock	2,019,379	55,729				
Hake	194,641	7,988				
Mackerel	1,391,665	181,983	24,000	2,400		
Pollock	9,217,089	229,255				
Rosefish	825	33				
Shad	7,800	153				
Sharks	100	1				
Skates	30	1				
Shrimp	300	39				
Livers	195,650	3,053				
Spawn	30	1				
Total	14,270,455	528,504	24,000	2,400		
Harpoons: Swordfish	275,502	64,951	1,300	214		
Dredges:						
Clams, hard			132,000	39,050		
Scallops			8,700	3,500	4,680	$1,320
Total			140,700	42,550	4,680	1,320
Tongs and rakes: Clams, hard			4,800	1,800		
Grand total	93,607,669	4,009,620	550,800	76,144	4,680	1,320

Apparatus and species.	Suffolk.		Total.	
	Pounds.	Value.	Pounds.	Value.
Otter trawls:				
Butterfish	21,549	$1,782	21,879	$1,805
Catfish and wolffish	62,671	1,647	67,287	1,959
Cod—				
Fresh	2,453,117	105,491	4,990,557	214,911
Salted			40,000	2,200
Cusk—				
Fresh	6,550	236	31,315	1,128
Salted			15,000	675
Eels	490	7	490	7
Flounders	1,062,262	47,269	5,801,897	248,923
Haddock—				
Fresh	34,057,878	953,728	42,385,742	1,187,925
Salted			194,000	6,790
Hake	397,579	16,298	430,702	17,643
Halibut	53,627	9,116	67,249	11,432
Pollock—				
Fresh	311,442	7,475	754,842	18,117
Salted			14,045	456
Rosefish	2,405	90	11,545	319
Shad	7	1	7	1
Sharks	990	52	990	52

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Suffolk.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*
Otter trawls—Continued.				
Skates	1, 810	$39	1, 810	$9
Sturgeon	1, 335	264	1, 335	264
Whiting			445	4
Scallops			300	200
Total	38, 433, 712	1, 143, 495	54, 831, 437	1, 714, 850
Lines:				
Catfish and wolffish	15, 509	454	65, 110	1, 825
Cod—				
Fresh	15, 189, 656	653, 053	52, 877, 064	2, 249, 476
Salted			3, 097, 905	160, 252
Cusk—				
Fresh	358, 353	12, 890	1, 192, 340	41, 899
Salted			1, 870	84
Flounders	15, 909	646	34, 103	1, 293
Haddock—				
Fresh	10, 467, 834	293, 006	30, 409, 304	859, 417
Salted			179, 574	10, 206
Hake—				
Fresh	884, 876	36, 202	2, 365, 505	95, 680
Salted			29, 095	1, 307
Halibut—				
Fresh	178, 280	28, 231	1, 623, 519	281, 816
Salted			8, 045	1, 060
Pollock—				
Fresh	1, 556, 431	37, 447	3, 289, 278	79, 134
Salted			27, 258	883
Rosefish	11, 078	430	14, 853	563
Sharks	115	2	1, 233	30
Skates			20	1
Tautog			4, 125	450
Tilefish	33, 510	1, 473	188, 180	9, 803
Livers	2, 250	51	4, 475	89
Spawn	39, 396	2, 890	131, 253	7, 746
Total	28, 753, 197	1, 066, 775	95, 544, 109	3, 803, 014
Seines:				
Alewives	800	8	800	8
Bonito	200	12	500	42
Butterfish	905	101	1, 193	134
Cod	2, 654	115	20, 925	727
Cusk			1, 030	21
Flounders			4, 668	164
Haddock			4, 015	112
Hake	670	27	9, 438	365
Herring			1, 069, 712	15, 263
Mackerel—				
Fresh	380, 214	44, 464	6, 952, 019	590, 224
Salted			1, 249, 062	109, 948
Pollock	644, 845	15, 476	2, 793, 568	63, 918
Shad	10, 000	600	10, 822	738
Sharks			180	11
Smelt			257	38
Spawn			1, 100	58
Total	1, 040, 288	60, 803	12, 119, 289	781, 771
Gill nets:				
Bonito			280	15
Butterfish			1, 060	58
Cod	129, 075	5, 550	1, 370, 681	55, 745
Haddock	384, 286	10, 760	2, 403, 665	66, 489
Hake	15, 090	619	209, 731	8, 607
Mackerel	273, 092	32, 296	2, 248, 735	279, 856
Pollock	1, 310, 981	31, 464	10, 528, 070	260, 719
Rosefish			825	33
Shad			7, 800	153
Sharks			100	1
Skates			30	1
Shrimp			300	39
Livers	28, 300	426	223, 950	3, 479
Spawn			30	1
Total	2, 140, 824	81, 115	16, 995, 257	675, 196
Harpoons: Swordfish	91, 313	20, 700	693, 829	152, 110

YIELD OF VESSEL FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Suffolk.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*
Whaling gear:				
Ambergris			30	$5,000
Sperm oil			1,515,413	218,111
Total			1,515,443	223,111
Lobster pots: Lobsters			22,622	4,313
Dredges:				
Clams, hard			136,800	40,250
Oysters—				
Market, private			377,685	147,290
Seed, private			17,290	1,482
Scallops			84,390	28,195
Total			616,165	217,217
Tongs and rakes: Clams, hard			7,600	2,850
Grand total	70,459,334	$2,372,888	182,375,751	7,574,432

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS DIP NETS, AND SEINES.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.	
Pound nets, trap nets, and weirs:								
Alewives—	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Fresh	194,566	$3,484	77,795	$1,540	96,050	$1,706	17,315	$244
Salted	35,000	1,750			140,000	6,300		
Bluefish	3,932	696			121	24	668	71
Bonito	33,956	2,549	40	4	95,461	9,929	90	9
Butterfish	176,061	14,966	11,700	850	56,899	5,853	19,039	2,041
Catfish and wolffish							14	1
Cod	113,668	4,822	795	37	81	6	173,006	5,400
Cunners							2,809	85
Eels	3,850	455	4,500	450				
Flounders	161,086	7,828	19,753	1,017	13,043	1,162	1,805	58
Frigate mackerel					61,361	1,862		
Grayfish	1,000	10	62,667	174				
Goosefish			2,500	7				
Haddock	2,631	13			554	33	2,236	63
Hake	395	4	183	3	86	1	4,810	110
Herring	5,931,481	71,121	88,765	1,373	25	3	1,321,184	17,285
Hickory shad	11,650	780	1,150	50				
Kingfish			72	18				
Launce	3,800	38						
Mackerel	1,419,313	148,182	28,605	2,871	55,007	5,035	122,886	13,034
Menhaden	69,303	1,605	46,516	272	5,400	54		
Perch, white					6,000	900		
Pollock	103,725	3,135	20	1	2,371	113	185,792	3,243
Pompano	14	2						
Round herring	941	19						
Sculpin			6,000	15				
Scup	8,634	494	52	6	63,578	4,393		
Sea bass			2,289	50	3,865	532	18	2
Sea robin			400	1				
Shad	5,645	1,553	54	17	37	7	435	47
Sharks	11,300	183	3,175	71			3,000	75
Skates and rays			93,649	381				
Smelt			97	13				
Squeteague	613	74	962	151	4,202	683		
Striped bass	287	110	605	103	59	13		
Sturgeon	5,183	1,191					180	22
Sturgeon caviar	30	85						
Sturgeon roe	175	150					6	13
Tautog	23,627	1,362	13,519	1,316	222	19	158	6
Tomcod	2,200	6	2,390	93				
Tuna	37,048	2,716	53	2			5,000	750
Whiting	11,173,383	135,485	57,709	948	62,727	365	2,563,786	11,339

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Pound nets, trap nets, and weirs—Continued.								
Other species	9,500	$100	8,411	$388	20,321	$1,629	...	...
Squid	5,837,988	104,364	141,129	2,184	16,459	253	121,831	$1,671
Porpoise	750	15	...	...	...	...	...	...
Total	25,382,735	509,347	675,555	14,406	703,929	40,875	4,546,068	55,569
Dredges:								
Clams, hard	4,800	1,800	...	...	...	...	...	...
Oysters, market, private	138,915	52,237	...	...	...	...	...	...
Scallops	397,656	114,328	42,000	14,000	298,620	87,325	...	...
Total	541,371	168,365	42,000	14,000	298,620	87,325	...	...
Otter trawls:								
Cod					...	...	450	19
Flounders	891,315	41,712	69,000	2,800	639,275	44,490	713,567	30,798
Rosefish	...	...	...	...	...	...	6,715	101
Scup	...	...	...	...	1,000	180	...	...
Sea bass	...	...	...	...	6,000	600	...	...
Total	891,315	41,712	69,000	2,800	646,275	45,270	720,732	30,918
Gill nets:								
Butterfish	247	44	...	...	...	...	...	...
Cod	...	...	...	...	...	...	149,788	7,702
Flounders	...	...	...	...	...	...	4,500	135
Haddock	...	...	...	...	...	...	18,000	810
Herring	...	...	...	...	...	...	7,200	205
Mackerel	266,926	30,304	10,500	1,500	13,500	2,125	362,428	35,506
Pollock	...	...	...	...	...	...	1,800	54
Sharks	...	...	...	...	...	...	5,196	204
Skates	...	...	...	...	...	...	2,000	10
Sturgeon	...	...	...	...	...	...	900	81
Total	267,173	30,348	10,500	1,500	13,500	2,125	551,812	44,707
Dip nets:								
Alewives—								
Fresh	14,400	396	...	...	...	...	...	...
Salted	240,000	8,400	...	...	...	...	...	...
Flounders	...	...	...	...	...	...	500	25
Herring	...	...	...	...	...	...	152,950	4,268
Perch, yellow	...	...	...	...	...	...	500	25
Scallops	34,950	8,800	...	...	...	...	...	...
Total	289,350	17,596	...	...	...	...	153,950	4,318
Seines:								
Alewives—								
Fresh	63,000	1,279	27,000	535	455,100	12,435	12,500	100
Salted	364,600	19,190	60,534	2,220	...	...	...	...
Smoked	2,000	150	...	...	...	...	...	...
Butterfish	700	105	...	...	...	...	...	...
Cod	3,000	120	...	...	...	...	...	...
Eels	...	...	...	...	21,000	1,200	71,270	1,981
Herring	360	5	...	...	...	...	203,662	1,762
Launce	64,000	800	...	...	...	...	...	...
Mackerel	43,100	5,617	235	40	10,000	1,200	288,211	30,503
Minnows	1,000	125	...	...	...	...	...	...
Pollock	...	...	...	...	...	...	159,036	3,817
Shad	...	...	298	68	...	...	24,309	959
Shrimp	3,100	1,550	...	...	...	...	...	...
Alewife scales	3,000	1,500	...	...	...	...	...	...
Total	547,860	30,441	88,067	2,863	486,100	14,835	758,988	39,122

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Nantucket.		Plymouth.		Suffolk.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Pound nets, trap nets, and weirs:								
Alewives—								
Fresh	16,400	$164	80,050	$674			482,176	$7,812
Salted	27,000	1,080	230,000	9,775			432,000	18,905
Bluefish							4,721	791
Bonito	59,400	5,470					188,947	17,961
Butterfish			4,775	517			268,474	24,227
Catfish and wolffish							14	1
Cod	1,400	70					288,950	10,335
Cunners							2,809	85
Eels							8,350	905
Flounders	4,210	530					199,897	10,595
Frigate mackerel							61,361	1,862
Grayfish							63,667	184
Goosefish							2,500	7
Haddock							5,421	109
Hake							5,474	118
Herring	2,000	300	406,600	4,464			7,750,055	94,546
Hickory shad							12,800	830
Kingfish							72	18
Launce							3,800	38
Mackerel	63,700	5,325	8,687	803			1,698,198	175,250
Menhaden							121,219	1,931
Perch, white							6,000	900
Pollock	900	36					292,808	6,528
Pompano							14	2
Round herring							911	19
Sculpin							6,000	15
Scup	2,450	245					74,714	5,138
Sea bass	2,000	300					8,172	884
Sea robin							400	1
Shad	12,800	750					18,971	2,374
Sharks							17,475	329
Skates and rays							93,649	381
Smelt							97	13
Squeteague							5,777	908
Striped bass							951	226
Sturgeon							5,363	1,213
Sturgeon caviar							30	85
Sturgeon roe							181	163
Tautog							37,526	2,703
Tomcod							4,590	99
Tuna							42,101	3,468
Whiting	53,600	660	7,000	53			13,918,205	148,850
Other species							38,232	2,117
Squid	3,350	83	13,800	309			6,134,557	108,864
Porpoise							750	15
Alewife scales			6,400	3,200			6,400	3,200
Total	249,210	15,013	757,312	19,795			32,314,809	655,005
Dredges:								
Clams, hard							4,800	1,800
Oysters—								
Market—								
Public			175	63			175	63
Private			16,275	4,887			155,190	57,124
Seed—								
Public			23,100	1,320			23,100	1,320
Private			11,200	640			11,200	640
Scallops	94,752	42,730	379,770	143,784			1,212,798	402,167
Total	94,752	42,730	430,520	150,694			1,407,263	463,114
Otter trawls:								
Catfish and wolffish					125	$5	125	5
Cod	20,000	900			7,219	310	27,669	1,229
Flounders	271,000	21,680	25,000	1,000	1,082,298	46,252	3,691,455	188,732
Haddock					13,481	377	13,481	377
Hake					3,958	172	3,958	172
Pollock					257	6	257	6
Rosefish					2,835	108	9,550	209
Scup							1,000	180
Sea bass							6,000	600
Total	291,000	22,580	25,000	1,000	1,110,173	47,230	3,753,495	191,510

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY POUND NETS, TRAPS, WEIRS, DREDGES, OTTER TRAWLS, GILL NETS, DIP NETS, AND SEINES—Continued.

Apparatus and species.	Nantucket.		Plymouth.		Suffolk.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Gill nets:								
Butterfish							247	$44
Cod			700	$38			150,488	7,740
Flounders							4,500	135
Haddock							18,000	810
Herring			4,000	55			11,200	260
Mackerel			30,000	4,500	325,724	$54,304	1,009,078	128,239
Pollock							1,800	54
Shad					130	16	130	16
Sharks							5,196	204
Skates							2,000	10
Sturgeon	4,500	$1,800					5,400	1,881
Sturgeon caviar	120	271					120	271
Tuna			800	80			800	80
Total	4,620	2,071	35,500	4,673	325,854	54,320	1,208,959	139,744
Dip nets:								
Alewives—								
Fresh							14,400	396
Salted							240,000	8,400
Flounders							500	25
Herring			1,400,000	7,000	115,670	3,070	1,668,620	14,338
Perch, yellow							500	25
Crabs, soft			266	40			266	40
Scallops							34,950	8,800
Total			1,400,266	7,040	115,670	3,070	1,959,236	32,024
Seines:								
Alewives—								
Fresh			1,000	30			558,600	14,379
Salted							425,134	21,410
Smoked							2,000	150
Butterfish					31	4	731	109
Cod							3,000	120
Eels							92,270	3,181
Herring					107,800	3,234	311,822	5,001
Launce							64,000	800
Mackerel			10,200	688			351,746	38,048
Menhaden			40,000	300			40,000	300
Minnows							1,000	125
Pollock							159,036	3,817
Shad							24,607	1,027
Shrimp							3,100	1,550
Alewife scales							3,000	1,500
Total			51,200	1,018	107,831	3,238	2,040,046	91,517

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lines:						
Butterfish	3,244	$433				
Catfish and wolffish	13,612	95				
Cod—						
Fresh	2,989,827	129,802	1,100	$60	45,250	$1,715
Salted	6,500	450				
Cusk	3,103	33				
Eels			625	100		
Flounders	14,790	1,047	3,170	260	17,500	1,000
Haddock	635,916	20,846			1,000	40
Hake	431,414	8,396	2,150	150		
Halibut	10,211	1,704				
Mackerel	2,226	197	3,705	475	1,000	120
Pollock—Fresh	856,526	20,140			43,500	1,285
Scup	1,710	265			700	53
Sea bass	345	110			500	50
Sharks	303,225	3,037				
Skates	885	17				
Striped bass	20	5				
Tautog	11,800	1,227	28,725	3,655	600	30
Livers	150	1				
Total	5,285,504	187,805	39,475	4,700	110,050	4,293

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—Continued.

Apparatus and species.	Barnstable.		Bristol.		Dukes.	
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Public	281,520	$95,523	192,560	$62,550	79,120	$27,300
Private	22,640	12,425				
Soft—						
Public	136,000	13,189	6,000	900	5,000	875
Private	125,000	10,750				
Razor	23,300	3,500				
Oysters, market—						
Public	875	150	1,120	400		
Private	228,235	71,120	945	130		
Scallops	48	20				
Total	817,618	206,677	200,625	63,980	84,120	28,175
Eel pots: Eels	62,443	7,874	2,253	180	18,500	2,305
Lobster pots: Lobsters	98,220	26,588	253,878	53,717	591,815	101,382
Spears:						
Eels	13,235	2,006	6,800	1,200		
Flounders	6,900	575				
Total	20,135	2,581	6,800	1,200		

Apparatus and species.	Essex.		Nantucket.		Norfolk.	
Lines:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Catfish and wolffish	17,369	$542				
Cod—						
Fresh	1,039,538	45,643	130,000	$5,100	22,000	$1,760
Salted			30,000	3,600		
Cusk	226,711	8,162				
Eels	1,790	225				
Flounders	266,058	15,410			8,000	800
Haddock	448,187	13,504	15,100	458	500	40
Hake	463,722	19,308				
Halibut	6,081	1,034				
Mackerel	425	52				
Pollock—						
Fresh	350,848	10,580	27,500	1,450	1,000	80
Salted	8,850	435				
Skates	1,460	44				
Smelt	7,796	1,864			22,200	6,425
Tautog					2,000	180
Tongues	600	12				
Spawn	1,582	87				
Livers	85,000	1,275				
Total	2,926,017	118,177	202,600	10,608	55,700	9,285
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—Public	600	75	111,144	27,986		
Soft—Public	460,060	58,206			63,470	9,620
Irish moss					25,500	1,912
Total	460,660	58,281	111,144	27,986	88,970	11,532
Eel pots: Eels	32,025	6,190	30,000	4,500	1,000	130
Lobster pots:						
Lobsters	677,387	161,249	19,446	8,759	77,054	19,390
Crabs, hard	18,167	395			18,475	554
Total	695,554	161,644	19,446	8,759	95,529	19,944
Spears: Eels	8,906	1,781			2,000	400

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY LINES, TONGS, RAKES, HOES, FORKS, EEL POTS, LOBSTER POTS, AND SPEARS—Continued.

Apparatus and species.	Plymouth.		Suffolk.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lines:						
Butterfish					3,244	$433
Catfish and wolffish			127,671	$4,792	158,652	5,429
Cod—						
Fresh	181,413	$7,888	2,182,458	93,840	6,591,586	285,808
Salted	1,000	200			37,500	4,250
Cusk	3,000	84	103,838	3,741	336,652	12,020
Eels					2,415	325
Flounders	17,700	994	188,355	8,716	515,573	28,227
Haddock	4,750	183	1,459,729	40,905	2,565,182	75,976
Hake	3,100	125	141,243	5,789	1,041,629	33,768
Halibut			1,449	246	17,741	2,984
Mackerel					7,356	844
Pollock—						
Fresh	15,600	474	77,755	1,867	1,372,729	35,876
Salted					8,850	435
Scup	500	30			2,910	348
Sea bass	50	5			895	165
Sharks					303,225	3,037
Skates			500	10	2,845	71
Smelt	7,500	2,025	1,300	325	38,796	10,639
Striped bass					20	5
Tautog	7,100	640			50,225	5,732
Tomcod			1,000	50	1,000	50
Tongues					600	12
Spawn			12,964	944	14,546	1,031
Livers					85,150	1,276
Total	241,713	12,648	4,298,262	161,225	13,159,321	508,741
Tongs, rakes, hoes, and forks:						
Clams—						
Hard—						
Public	35,960	11,933			700,904	225,367
Private					22,640	12,425
Soft—						
Public	1,146,100	122,885	246,000	26,519	2,062,630	232,194
Private					125,000	10,750
Razor					23,300	3,500
Oysters, market—						
Public	3,409	770			5,404	1,320
Private	7,000	2,500			236,180	73,750
Scallops					48	20
Irish moss	178,700	13,115			204,200	15,027
Total	1,371,169	151,203	246,000	26,519	3,380,306	574,353
Eel pots: Eels	9,200	1,148			155,421	22,327
Lobster pots:						
Lobsters	575,829	119,580	71,385	21,415	2,365,014	512,080
Crabs, hard	8,000	165	1,720,319	48,310	1,764,961	49,424
Total	583,829	119,745	1,791,704	69,725	4,129,975	561,504
Spears:						
Eels	500	55			31,441	5,442
Flounders					6,900	575
Total	500	55			38,341	6,017

YIELD OF SHORE FISHERIES OF MASSACHUSETTS IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

BY BOW NETS, FYKE NETS, HARPOONS, COCKLE TRAPS, AND CUNNER TRAPS.

Apparatus and species.	Barnstable.		Bristol.		Dukes.		Essex.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Bow nets: Alewives—										
Fresh	41,500	$475							41,500	$475
Salted	162,000	7,280							162,000	7,280
Smoked	37,000	2,695							37,000	2,695
Scales	1,000	500							1,000	500
Total	241,500	10,950							241,500	10,950
Fyke nets:										
Eels	33,180	6,577	10,600	$950	40,000	$8,000			83,780	15,527
Flounders			3,200	181					3,200	181
Perch, white			200	20					200	20
Tomcod			2,300	90					2,300	90
Total	33,180	6,577	16,300	1,241	40,000	8,000			89,480	15,818
Harpoons: Swordfish			2,400	600	15,500	2,620			17,900	3,220
Cockle traps: Cockles	1,450	725					300,000	$1,350	301,450	2,075
Cunner traps: Cunners			7,150	500					7,150	500

WITHOUT APPARATUS.

Species.	Barnstable.		Plymouth.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Blackfish	40,000	$40			40,000	$40
Clams, hard	2,400	825	800	$250	3,200	1,075
Oysters, seed, private	51,688	4,430			51,688	4,430
Cockles	950	300	275,000	1,050	275,950	1,350
Total	95,038	5,595	275,800	1,300	370,838	6,895

INDUSTRIES.

Wholesale fishery trade.—In 1919 there were 139 wholesale fishery establishments in Massachusetts, valued at $2,928,405, with a cash capital amounting to $1,522,545, in which 1,468 persons were engaged, to whom $1,790,495 were paid in wages.

Five of these firms engaged in the manufacture of oil and fertilizer incidental to their wholesale business. The quantity of fish oil manufactured amounted to 56,250 gallons, valued at $60,147, and of fertilizer to 324,750 pounds, valued at $2,000.

Smoked, canned, and by-product industries.—In the appended table the statistics of the smoked, canned, and by-product industries of Massachusetts in 1919 are shown in detail. The quantity of fish smoked, salted, and pickled amounted to 12,807,782 pounds, valued at $863,927, the principal items being finnan haddie, 4,506,216 pounds, valued at $352,692, and salted and pickled herring, 3,299,950 pounds, valued at $100,530. The pack of canned products amounted to 52,474 cases, valued at $362,926, and the value of the by-products was $1,050,317.

INDUSTRIES OF MASSACHUSETTS IN 1919.

Item.	Smoked fish, and salted and pickled herring.		Canned.		By-products.		Total.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Plants	[1] 16	$694,688	6	$1,513,725	[2] 12	$447,389	34	$2,655,802
Cost of materials		139,644		654,079				
Cash capital		122,500		154,500		122,400		399,400
Persons engaged	365		1,490		331		2,186	
Wages paid		332,979		1,082,065		428,929		1,843,973
MANUFACTURED PRODUCTS.								
Liver and menhaden oil..gallons..					[3] 207,627	236,110	207,627	236,110
Liquid glue..do....					[4] 388,252	474,924	388,252	474,924
Fish scrap and fertilizer...pounds..					14,895,358	339,283	14,895,358	339,283
Kippered herring, pounds	233,378	28,440					233,378	28,440
Finnan haddie, pounds	4,506,216	352,692					4,506,216	352,692
Smoked herring:								
Plain and Bismarks.pounds..	3,045,400	201,550					3,045,400	201,550
Bloaters...do....	1,290,600	131,350					1,290,600	131,350
Smoked alewives, halibut, salmon, and sharks, pounds	432,238	49,365					432,238	49,365
Salted and pickled herring..pounds..	3,299,950	100,530					3,299,950	100,530
Clams (various sizes)......cases..			12,340	72,089			12,340	72,089
Clam chowder and clam extract (various sizes).cases..			2,384	10,824			2,384	10,824
Miscellaneous species of fish (various sizes)..cases..			[5] 37,750	280,013			37,750	280,013
Total	12,807,782	863,927	52,474	362,926		1,050,317		2,277,170

[1] Does not include two plants which are shown under canning industry.
[2] Includes two menhaden plants operated in Connecticut.
[3] Includes small quantities of shark, blackfish, and porpoise oils.
[4] Includes a small quantity of dry glue.
[5] Includes "sardines," cod, haddock, herring, mackerel, whiting, and fish roe.

FISHERIES OF RHODE ISLAND.

Rhode Island ranked third among the New England States in 1919 in the investment, quantity, and value of its fishery products, and fourth in the number of persons engaged. The number of persons employed was 1,646, of whom 317 were on fishing vessels, 44 on vessels transporting fishery products, 795 in the shore and boat fisheries, and 490 shoresmen in the wholesale fish establishments.

The investment amounted to $2,249,536 and included 82 fishing and transporting vessels, valued at $392,164, with a net tonnage of 1,594 tons and outfits valued at $168,235; 628 power, sail, row, and other small boats, valued at $187,283; apparatus employed in the vessel and boat fisheries to the value of $314,496; shore and accessory property valued at $978,622, and working cash capital to the amount of $209,300.

The products of the fisheries amounted to 48,250,883 pounds, valued at $3,296,578. The five most important species, arranged in the order of their value, were: Oysters, 6,261,759 pounds, or 894,537 bushels, valued at $1,242,585; scup, 8,261,140 pounds, valued at $817,846; lobsters, 1,694,327 pounds, valued at $360,679; menhaden, 21,536,000 pounds, valued at $268,700, and mackerel, 1,575,923 pounds, valued at $146,611.

Compared with 1905, there has been a decrease of 566 in the number of persons employed in the fisheries of the State, but an increase in the investment amounting to $1,184,062, in the total quantity of products of 24,354,640 pounds and in the value of $1,749,920. There was a large increase in the catch of the following species as compared with 1905: Menhaden, 20,509,800 pounds in quantity and $265,678 in value; scup, 2,721,100 pounds in quantity and $679,816 in value; whiting, 1,313,630 pounds in quantity and $12,244 in value; flounders, 1,308,114 pounds in quantity and $44,139 in value; lobsters, 1,053,873 pounds in quantity and $296,321 in value; and mackerel,

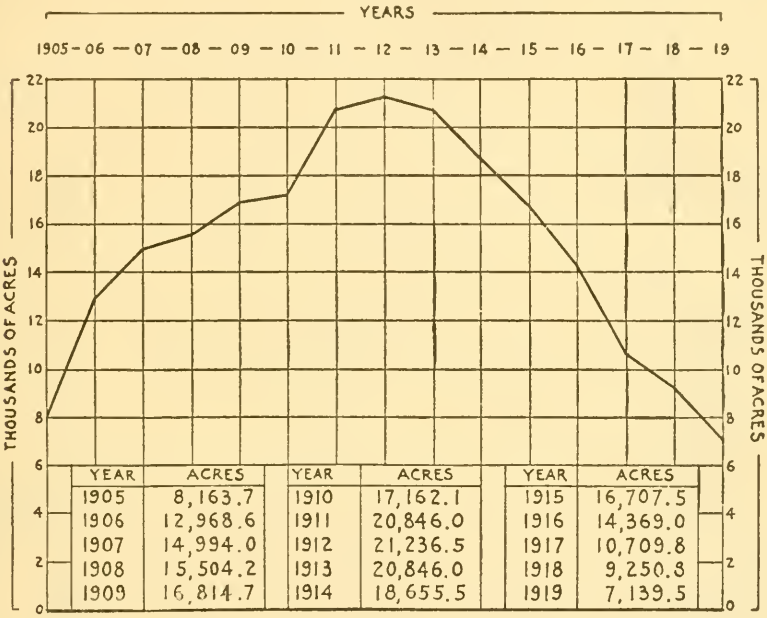


FIG. 9.—Acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, inclusive.

737,993 pounds in quantity and $98,557 in value. The species for which there has been a significant decrease, with the amount of the decrease, follow: Squeteague, 2,868,925 pounds in quantity and $52,649 in value; haddock, 505,435 pounds in quantity and $14,276 in value; and alewives, 329,025 pounds in quantity and $1,115 in value. No shad, hickory shad, or king whiting were reported in the catch in 1919. The take of Irish moss amounted to only 2,000 pounds, valued at $240, in 1919, as compared with 16,000 pounds, valued at $1,120, in 1905.

The accompanying graph (fig. 9), showing the number of acres of oyster ground leased to individuals in Rhode Island, by years, from 1905 to 1919, indicates with marked clearness the rise and fall in that State of its most important fishery. According to canvasses made by this Bureau, the yield in 1905 amounted to 916,088 bushels, in 1910 to 2,268,278 bushels, and in 1919 to 894,537 bushels, which substantiates in a measure the general trend of the oyster industry as indicated by this graph.

Although the figures appearing in the appended table show the number of acres leased from the State, they do not represent the actual number of acres under cultivation during each year. From data secured in 1910 the number of acres under cultivation was 15,927.2, or 93 per cent of the total number leased during that year.

FISHERIES BY COUNTIES.

The statistics as to the number of persons employed, investment, and products of the fisheries in Rhode Island are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES.

Items.	Bristol.		Kent.		Newport.	
	Number.	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
PERSONS ENGAGED.						
On vessels fishing	24		2		211	
On vessels transporting	1				33	
In shore fisheries	39		104		449	
Shoresmen	104		28		104	
Total	168		134		797	
INVESTMENT.						
Vessels fishing:						
Gasoline	7	$25,300	1	$3,500	30	$92,200
Tonnage	113		13		406	
Outfit		12,481		1,200		46,874
Steam					7	124,000
Tonnage					277	
Outfit						45,950
Vessels transporting:						
Gasoline	1	1,000			6	16,000
Tonnage	10				55	
Outfit		100				4,600
Steam					5	22,000
Tonnage					77	
Outfit						23,800
Boats:						
Sail, row, etc	16	350	24	410	93	2,580
Power	22	6,175	76	20,065	229	117,290
Apparatus, vessel fisheries:						
Purse seines					18	24,695
Gill nets					780	14,445
Pound nets					25	75,000
Lines, hand and trawl						785
Otter trawls	1	45			14	688
Harpoons						561
Lobster pots					410	1,310
Dredges	14	620	2	75	4	130
Apparatus, shore fisheries:						
Seines	2	175			7	574
Gill nets					360	7,300
Pound nets and trap nets	6	1,800			75	70,350
Fyke nets			20	310	240	4,368
Dip nets					30	450
Lines, hand and trawl		42				4,185
Otter trawls					39	2,270
Harpoons						690
Lobster pots	321	1,030	146	413	15,942	47,610
Eel pots	480	530			60	85
Dredges	12	122	142	744	40	218
Tongs	21	185	92	743	58	583
Rakes	1	5	5	40	7	27
Hoes	12	12	54	54	7	7
Grabs					6	18
Shovels	10	10	11	11		
Winkle pots					260	880
Shore and accessory property		107,982		9,562		462,753
Cash capital		34,500		4,800		79,000
Total		192,464		41,927		1,294,276

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES—Continued.

Items.	Bristol.		Kent.		Newport.	
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives					260,550	$5,736
Bluefish					21,345	2,485
Bonito					114,810	10,825
Butterfish	20,000	$1,000			712,320	36,592
Cod					1,123,331	48,647
Cunner					8,000	960
Eels	67,450	7,042			131,730	14,075
Flounders	41,330	1,240	510	$15	1,687,699	53,740
Haddock					10,300	512
Herring					114,550	3,509
Mackerel					1,531,423	141,689
Menhaden					21,536,000	268,700
Perch, white					5,043	702
Pollock					99,400	5,920
Scup					8,206,000	812,456
Sea bass					48,741	5,454
Squeteague					285,440	26,675
Swordfish					101,010	19,757
Tautog	30,780	1,561	280	15	274,825	15,275
Tuna					50,130	4,010
Whiting					1,405,200	14,140
Lobster	24,300	4,780	9,413	1,993	1,270,562	273,086
Crabs					26,000	1,300
Squid					180,265	8,065
Clams:						
Hard	5,560	2,130	49,944	18,845	34,544	13,106
Soft	15,290	919	108,120	6,432	23,160	1,268
Scallops	400	200	31,074	13,125	2,016	1,032
Mussels					10,000	1,000
Winkles					10,500	2,100
Oysters, market, private	1,481,942	282,592	81,508	16,124	56,700	11,472
Irish moss					2,000	240
Total	1,687,052	301,464	280,849	56,549	39,373,594	1,804,528

Items.	Providence.		Washington.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	55		25		317	
On vessels transporting	2		8		44	
In shore fisheries	73		130		795	
Shoresmen	231		23		490	
Total	361		186		1,646	
INVESTMENT.						
Vessels fishing:						
Gasoline	7	$52,000	10	$26,400	55	$199,400
Tonnage	229		88		849	
Outfit		13,520		7,950		82,025
Steam	2	17,000			9	141,000
Tonnage	87				564	
Outfit		5,960				51,910
Vessels transporting:						
Gasoline	1	1,200	5	11,000	13	29,200
Tonnage	5		34		104	
Outfit		1,400		4,400		10,500
Steam					5	22,000
Tonnage					77	
Outfit						23,800
Boats:						
Sail, row, etc	29	483	34	680	196	4,503
Power	21	4,575	84	34,675	432	182,780
Apparatus, vessel fisheries:						
Purse seines					18	24,695
Gill nets					780	14,445
Pound nets					25	75,000
Lines, hand and trawl						785
Otter trawls			5	240	20	973
Harpoons						561
Lobster pots			225	675	635	1,985
Dredges	20	955	8	312	48	2,092

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES—Continued.

Items.	Providence.		Washington.		Total.	
INVESTMENT—continued.						
Apparatus, shore fisheries:	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Seines	1	$50	1	$100	11	$899
Gill nets					360	7,300
Pound nets and trap nets			27	29,600	108	101,750
Fyke nets			30	540	290	5,218
Dip nets					30	450
Lines, hand and trawl				265		4,492
Otter trawls			4	155	43	2,425
Harpoons						690
Lobster pots			5,527	16,293	21,936	65,346
Eel pots	280	255	175	165	995	1,035
Dredges			7	35	201	1,119
Tongs	62	405	8	65	241	1,981
Rakes	4	16	12	78	29	166
Hoes	55	53	24	22	152	148
Grabs					6	18
Shovels	22	22			43	43
Winkle pots					260	880
Shore and accessory property		370,570		27,755		978,622
Cash capital		81,500		9,500		209,300
Total		549,964		170,905		2,249,536
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives			9,015	$180	269,565	$5,916
Bluefish			4,330	685	25,675	3,170
Bonito					114,810	10,825
Butterfish			26,525	1,596	758,845	39,188
Cod			25,000	1,100	1,148,331	49,747
Cunner					8,000	960
Eels	25,390	$2,698	50,165	5,822	274,735	29,637
Flounders			722,040	24,572	2,451,579	79,567
Haddock					10,300	512
Herring			25,110	501	169,660	4,010
Mackerel			44,500	4,922	1,575,923	146,611
Menhaden					21,536,000	268,700
Perch, white					5,043	702
Pollock					99,400	5,920
Salmon			70	12	70	12
Scup			55,140	5,390	8,261,140	817,846
Sea bass			3,300	500	52,041	5,954
Squeteague			68,420	7,154	353,860	33,829
Striped bass			33,705	5,236	33,705	5,236
Swordfish					101,010	19,757
Tautog			65,775	5,340	371,660	22,191
Tuna			11,220	800	61,350	4,810
Whiting			178,500	1,870	1,583,700	16,010
Lobster			390,052	80,820	1,694,327	360,679
Crabs			8,330	502	34,330	1,802
Squid			197,314	10,665	377,579	18,730
Clams:						
Hard	27,128	10,918	39,056	14,650	[1] 156,232	59,649
Soft	205,770	12,371	51,420	3,085	[2] 403,760	24,075
Scallops			504	251	[3] 33,994	14,608
Mussels					[4] 10,000	1,000
Winkles					[5] 10,500	2.100
Oysters, market, private	4,428,018	885,600	213,591	46,797	[6] 6,261,759	1,242,585
Irish moss					2,000	240
Total	4,686,306	911,587	2,223,082	222,450	48,250,883	3,296,578

[1] 19,529 bushels. [2] 40,376 bushels. [3] 5,666 bushels. [4] 1,000 bushels. [5] 1,050 bushels. [6] 894,537 bushels.

FISHERIES BY APPARATUS.

The combined yield of all forms of apparatus employed in the vessel and shore fisheries of Rhode Island in 1919 amounted to 48,250,883 pounds, valued at $3,296,578. Dredges employed principally in the oyster vessel fishery were the most productive form of apparatus, yielding 6,142,623 pounds of oysters and mussels, valued at $1,217,637; while dredges, tongs, rakes, hoes, shovels, and grabs used in the shore fisheries took 723,122 pounds of oysters, clams, and scallops, valued at $124,280. Pound nets used in both the vessel and shore fisheries yielded 13,759,923 pounds, valued at $1,051,315, of which 8,261,140 pounds, valued at $799,846, were scup. Other important species taken in pound nets were: Butterfish, 625,095 pounds, valued at $32,493; mackerel, 321,343 pounds, valued at $30,139; squeteague, 311,260 pounds, valued at $29,574; and flounders, 911,965 pounds, valued at $27,574. The catch with pots amounted to 1,790,182 pounds, valued at $370,399. Lobsters were the principal species taken in pots, amounting to 1,694,327 pounds, valued at $360,679. Purse seines yielded 21,959,000 pounds, valued at $308,150, of which 21,536,000 pounds were menhaden, valued at $268,700, and 423,200 pounds were mackerel, valued at $39,450.

Other important forms of apparatus employed in both the vessel and shore fisheries, arranged in the order of their importance, based on the value of their catch, were: Lines, with 1,389,986 pounds, mostly cod, bonito, and eels, valued at $75,724; gill nets, with 759,980 pounds of mackerel, valued at $70,632; otter trawls, with 1,481,340 pounds, valued at $50,389, consisting principally of flounders; and harpoons, with 101,010 pounds of swordfish, valued at $19,757.

The catch of winkles with pots amounted to 10,500 pounds, valued at $2,100. These are caught in winkle pots and are used for bait for cod. The pots are similar to the ordinary lobster pots, with the entrance at the top instead of at the end. The bait employed in the pots is of about the same character as that used in lobster pots.

The following tables give the products of the vessel and shore fisheries of Rhode Island in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Bristol.		Kent.		Newport.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:						
Mackerel					423,200	$39,450
Menhaden					21,536,000	268,700
Total					21,959,200	308,150
Gill nets: Mackerel					519,450	48,385
Pound nets:						
Alewives					60,110	1,202
Bluefish					11,200	1,140
Butterfish					133,750	6,695
Cod					40,100	2,010
Eels					3,520	452
Flounders					465,300	13,950
Mackerel					23,100	1,890
Scup					7,685,500	764,000
Sea bass					1,500	160
Squeteague					41,800	4,160
Tautog					13,550	675
Whiting					751,000	7,510
Squid					45,100	2,015
Total					9,275,530	805,859
Lines:						
Cod					846,711	37,280
Pollock					34,000	1,750
Tautog					8,000	600
Total					888,711	39,630
Otter trawls: Flounders	5,000	$150			830,500	28,075
Harpoons: Swordfish					42,100	7,910

YIELD OF VESSEL FISHERIES OF RHODE ISLAND IN 1919, BY COUNTIES, APPARATUS, AND SPECIES—Continued.

Apparatus and species.	Bristol.		Kent.		Newport.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Lobster pots:						
Lobsters					17, 500	$3, 830
Crabs					26, 000	1, 300
Total					43, 500	5, 130
Dredges:						
Mussels					10, 000	1, 000
Oysters, market, private	1, 418, 942	$269, 992	21, 000	$4, 020	54, 950	11, 000
Total	1, 418, 942	269, 992	21, 000	4, 020	64, 950	12, 000
Grand total	1, 423, 942	270, 142	21, 000	4, 020	33, 623, 941	1, 255, 139

Apparatus and species.	Providence.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:						
Mackerel					423, 200	$39, 450
Menhaden					21, 536, 000	268, 700
Total					21, 959, 000	308, 150
Gill nets: Mackerel					519, 450	48, 385
Pound nets:						
Alewives					60, 110	1, 202
Bluefish					11, 200	1, 140
Butterfish					133, 750	6, 695
Cod					40, 100	2, 010
Eels					3, 520	452
Flounders					465, 300	13, 950
Mackerel					23, 100	1, 890
Scup					7, 685, 500	764, 000
Sea bass					1, 500	160
Squeteague					41, 800	4, 160
Tautog					13, 550	675
Whiting					751, 000	7, 510
Squid					45, 100	2, 015
Total					9, 275, 530	805, 859
Lines:						
Cod					846, 711	37, 280
Pollock					34, 000	1, 750
Tautog					8, 000	600
Total					888, 711	39, 630
Otter trawls: Flounders			365, 200	$13, 490	1, 200, 700	41, 715
Harpoons: Swordfish					42, 100	7, 910
Lobster pots:						
Lobsters			16, 500	3, 500	34, 000	7, 330
Crabs					26, 000	1, 300
Total			16, 500	3, 500	60, 000	8, 630
Dredges:						
Mussels					10, 000	1, 000
Oysters, market, private	4, 427, 500	$885, 500	210, 231	46, 125	6, 132, 623	1, 216, 637
Total	4, 427, 500	885, 500	210, 231	46, 125	6, 142, 623	1, 217, 637
Grand total	4, 427, 500	885, 500	591, 931	63, 115	40, 088, 314	2, 477, 916

YIELD OF SHORE FISHERIES OF RHODE ISLAND IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES, POUND NETS, AND LINES.

Apparatus and species.	Bristol.		Newport.		Providence.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Seines:										
Eels					10,920	$1,211			10,920	$1,211
Flounders	5,000	$150							5,000	150
Herring			30,160	$758					30,160	758
Mackerel							6,300	$700	6,300	700
Perch, white			5,013	702					5,043	702
Tautog	10,000	500							10,000	500
Total	15,000	650	35,203	1,460	10,920	1,211	6,300	700	67,423	4,021
Pound nets:										
Alewives			200,410	4,534			9,015	180	209,455	4,714
Bluefish			10,145	1,345			4,330	685	14,475	2,030
Bonito			39,810	3,320					39,810	3,320
Butterfish	20,000	1,000	578,570	29,897			26,525	1,596	625,095	32,493
Cod			73,840	2,730			25,000	1,100	98,840	3,830
Eels	20,000	2,000	117,990	12,181			4,500	450	142,490	14,631
Flounders	30,000	900	175,985	5,292			240,680	7,432	446,665	13,621
Herring			114,390	2,751			25,110	501	139,500	3,252
Mackerel			284,943	26,117			36,400	4,022	321,343	30,139
Pollock			44,400	2,680					44,400	2,680
Salmon							70	12	70	12
Scup			520,500	48,456			55,140	5,390	575,640	53,846
Sea bass			46,231	5,255			3,300	500	49,531	5,755
Squeteague			243,610	22,515			67,620	7,059	311,260	29,574
Striped bass							31,555	4,836	31,555	4,836
Tautog	20,000	1,000	199,065	10,642			39,800	3,140	258,865	14,782
Tuna							10,220	720	10,220	720
Whiting			654,200	6,630			178,500	1,870	832,700	8,500
Squid			135,165	6,050			197,314	10,665	332,479	16,715
Total	90,000	4,900	3,439,314	190,398			955,079	50,158	1,484,393	245,456
Lines:										
Bonito			75,000	7,505					75,000	7,505
Cod			162,680	6,627					162,680	6,627
Eels	15,000	1,600	6,200	1,010			37,250	4,410	58,450	7,020
Flounders	1,330	40					21,550	740	22,880	780
Mackerel			40,200	3,600			1,800	200	42,000	3,800
Pollock			21,000	1,490					21,000	1,490
Sea bass			1,010	39					1,010	39
Squeteague							800	95	800	95
Striped bass							2,150	400	2,150	400
Tautog	780	61	29,090	1,485			25,975	2,200	55,845	3,746
Tuna			50,130	4,010			1,000	80	51,130	4,090
Crabs							8,330	502	8,330	502
Total	17,110	1,701	385,310	25,766			98,855	8,627	501,275	36,094

BY GILL NETS, FYKE NETS, DIP NETS, OTTER TRAWLS, AND HARPOONS.

Apparatus and species.	Kent.		Newport.		Washington.		Total.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Gill nets: Mackerel			240,530	$22,247			240,530	$22,247
Fyke nets:								
Flounders	510	$15	35,184	1,021	5,000	$150	40,694	1,186
Tautog	280	15	25,120	1,873			25,400	1,888
Total	790	30	60,304	2,894	5,000	150	66,094	3,074
Dip nets: Cunner			8,000	960			8,000	960
Otter trawls:								
Flounders			180,730	5,402	89,610	2,760	270,340	8,162
Haddock			10,300	512			10,300	512
Total			191,030	5,914	89,610	2,760	280,640	8,674
Harpoons: Swordfish			58,910	11,847			58,910	11,847
Grand total	790	30	558,774	43,862	94,610	2,910	654,174	46,802

Yield of Shore Fisheries of Rhode Island in 1919, by Apparatus, Counties, and Species—Continued.

BY POTS.

Species.	Bristol.		Kent.		Newport.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Eels	32, 450	$3, 442			4, 020	$429
Lobsters	24, 300	4, 780	9, 413	$1, 993	1, 253, 062	269, 256
Winkles					10, 500	2, 100
Total	56, 750	8, 222	9, 413	1, 993	1, 267, 582	271, 785

Species.	Providence.		Washington.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Eels	14, 470	$1, 487	8, 415	$962	59, 355	$6, 320
Lobsters			373, 552	77, 320	1, 660, 327	353, 319
Winkles					10, 500	2, 100
Total	14, 470	1, 487	381, 967	78, 282	1, 730, 182	361, 769

BY DREDGES, TONGS, RAKES, HOES, SHOVELS, GRABS, AND HANDS.

Species.	Bristol.		Kent.		Newport.	
Clams:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Hard	5, 560	$2, 130	49, 944	$18, 845	34, 544	$13, 106
Soft	15, 290	919	108, 120	6, 432	23, 160	1, 268
Scallops	400	200	31, 074	13, 125	2, 016	1, 032
Oysters, market, private	63, 000	12, 600	60, 508	12, 104	1, 750	472
Irish moss					2, 000	240
Total	84, 250	15, 849	249, 646	50, 506	63, 470	16, 118

Species.	Providence.		Washington.		Total.	
Clams:	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Hard	27, 128	$10, 918	39, 056	$14, 650	156, 232	$59, 649
Soft	205, 770	12, 371	51, 420	3, 085	403, 760	24, 075
Scallops			504	251	33, 994	14, 608
Oysters, market, private	518	100	3, 360	672	129, 136	25, 948
Irish moss					2, 000	240
Total	233, 416	23, 389	94, 340	18, 658	725, 122	124, 520

WHOLESALE FISHERY TRADE.

The appended table shows the extent of the wholesale trade in Rhode Island in 1919. A considerable quantity of poultry grit, made by grinding oyster shells, was manufactured by one concern. To avoid the disclosure of individual enterprise the products of this plant are not included in the table.

Wholesale Trade in Fresh Fish, Oysters, Clams, Scallops, and Lobsters in Rhode Island in 1919.[1]

Item.	Number.	Value.	Item.	Number.	Value.
Establishments	40	$928, 355	Persons engaged	472	
Cash capital		209, 300	Wages paid		$422, 330

[1] Includes one firm engaged in the manufacture of oyster-shell grit.

FISHERIES OF CONNECTICUT.

In 1919 Connecticut ranked third in the number of persons engaged and fourth in the investment and quantity and value of the products. The number of persons employed on fishing and transporting vessels was 647, in the shore or boat fisheries 1,019, and in the wholesale establishments, including the fertilizer plants, 623, representing a total of 2,289. The investment amounted to $1,645,793, which includes 123 fishing and transporting vessels, valued at $546,163, with a net tonnage of 3,869 tons and outfits valued at $253,888; 763 power, sail, row, and other boats, valued at $146,551; fishing apparatus employed in the vessel and shore fisheries to the value of $101,992; shore and accessory property valued at $498,699; and working cash capital to the amount of $98,500.

The products of the fisheries amounted to 23,652,647 pounds, valued at $1,700,638. The most important products were oysters, 12,197,703 pounds, or 1,742,529 bushels, valued at $1,087,016; menhaden, 6,736,564 pounds, valued at $93,312; flounders, 2,349,181 pounds, valued at $91,962; lobsters, 740,848 pounds, valued at $189,157; and shad, 463,203 pounds, valued at $86,637.

Compared with 1905, there has been a decrease in the number of persons employed of 1,118, an increase in the investment amounting to $10,040, and a decrease in the quantity of products taken amounting to 51,320,001 pounds and in the value amounting to $1,473,310. The species for which the decrease in 1919 has been most marked as compared with 1905, with the amount of decrease, follow: Menhaden, 22,993,824 pounds; alewives, 1,054,878 pounds; swordfish, 362,287 pounds; squeteague, 138,503 pounds; bluefish, 124,292 pounds; and sea bass, 93,161 pounds. In the oyster fishery there has been a decrease, compared with the catch in 1905, amounting to 1,944,895 bushels, or 52.74 per cent, and with the catch in 1910, of 1,529,471 bushels, or 46.74 per cent.

FISHERIES BY COUNTIES.

Statistics of the number of persons employed, investment, and products of the fisheries in Connecticut are given by counties in the following table:

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES.

Item.	Fairfield.		Hartford.		Middlesex.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	337					
On vessels transporting	22					
In shore fisheries	88		126		275	
Shoresmen	254				2	
Total	701		126		277	
INVESTMENT.						
Vessels fishing:						
Steam	16	$195,193				
Tonnage	1,116					
Outfit		104,038				

Persons Engaged, Investment, and Products of Fisheries of Connecticut in 1919, by Counties—Continued.

Item.	Fairfield.		Hartford.		Middlesex.	
INVESTMENT—continued.						
Vessels fishing—Continued.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
Gasoline	41	$98,025				
Tonnage	568					
Outfit		53,740				
Sail	19	9,195				
Tonnage	135					
Outfit		5,035				
Vessels transporting:						
Steam	2	13,200				
Tonnage	111					
Outfit		9,627				
Boats:						
Sail, row, etc	35	2,040	73	$1,582	73	$1,814
Power	39	11,325	8	825	93	22,455
Apparatus, vessel fisheries:						
Otter trawls	7	300				
Harpoons		30				
Lobster pots	430	645				
Dredges	289	5,398				
Apparatus, shore fisheries:						
Seines	6	710	27	1,834	17	1,244
Gill nets	1	10	83	1,066	92	9,369
Pound nets					9	2,935
Fyke nets			266	2,043	37	447
Scoop nets			3	15		
Otter trawls	3	110			7	280
Lobster pots	2,085	4,060			1,353	3,053
Eel pots					145	123
Dredges	51	359				
Tongs	28	190			6	55
Rakes	17	116				
Hoes	8	10			15	18
Shore and accessory property		279,084		1,703		7,986
Cash capital		29,000				
Total		821,440		9,068		49,779
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives			40,161	$2,008	98,713	$2,122
Bluefish			965	95		
Bullheads			60	6	365	17
Butterfish					50	3
Carp			11,854	1,637	18,509	2,145
Eels			4,768	1,038	6,420	608
Flounders	85,105	$3,727			184,160	6,202
Menhaden	300	25			18,314	1,110
Perch, yellow			2,434	235	1,213	109
Pickerel			128	20	340	35
Shad			34,959	8,627	329,829	59,309
Smelt	4,114	886				
Squeteague					2,721	231
Striped bass					850	110
Sturgeon					25	5
Suckers			55,576	4,564	28,527	1,918
Sunfish			80	8	25	3
Swordfish	1,480	295				
Tautog					809	61
Lobsters	72,924	23,885			80,355	23,092
Clams:						
Hard	39,472	14,589				
Soft	8,000	725			12,200	804
Oysters:						
Market—						
Public	18,942	2,880			4,004	810
Private	2,570,197	227,935			5,614	1,001
Seed—						
Public	633,885	58,345				
Private	4,976,454	372,677				
Total	8,410,873	705,969	150,985	18,238	793,043	99,695

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES—Continued.

Item.	New Haven.		New London.		Total.	
PERSONS ENGAGED.	*Number.*	*Value.*	*Number.*	*Value.*	*Number.*	*Value.*
On vessels fishing	112		87		566	
On vessels transporting	59				81	
In shore fisheries	272		258		1,019	
Shoresmen	301		66		623	
Total	771		411		2,289	
INVESTMENT.						
Vessels fishing:						
Steam	6	$73,050	2	$60,000	21	$328,243
Tonnage	952		172		2,240	
Outfit		18,708		12,600		135,346
Gasoline	19	60,550	7	21,850	67	180,425
Tonnage	273		83		921	
Outfit		25,325		15,625		94,690
Sail	3	1,200	2	2,100	21	12,495
Tonnage	33		15		183	
Outfit		1,050		1,870		7,955
Vessels transporting:						
Steam					2	13,200
Tonnage					111	
Outfit						9,627
Gasoline	1	7,800			4	7,800
Tonnage	95				95	
Outfit		4,370				4,370
Barges	2	4,000			2	4,000
Tonnage	316				316	
Outfit		1,900				1,900
Boats:						
Sail, row, etc	156	2,773	62	1,461	399	9,670
Power	61	14,215	163	88,061	364	136,881
Apparatus, vessel fisheries:						
Purse seines			4	7,800	4	7,800
Gill nets			115	2,680	115	2,680
Lines				555		555
Otter trawls	1	30	6	350	11	680
Harpoons				570		600
Lobster pots	50	100			480	715
Dredges	83	3,039			372	8,437
Apparatus, shore fisheries:						
Seines			4	1,105	54	4,893
Gill nets			28	3,465	204	13,910
Pound nets	2	577	31	5,600	42	9,112
Fyke nets	4	75	132	1,420	439	3,985
Scoop nets			4	20	7	35
Lines		18		40		58
Otter trawls	10	351	33	1,613	53	2,391
Harpoons				80		80
Lobster pots	3,835	8,238	8,900	27,183	16,173	42,534
Eel pots	22	37	634	457	801	617
Dredges	4	36			55	395
Tongs	207	1,724	3	25	244	1,994
Rakes	44	251			61	367
Hoes	45	41			68	69
Shovels	13	13			13	13
Spears	28	34	2	5	30	39
Shore and accessory property		147,665		62,261		498,699
Cash capital		50,200		19,300		98,500
Total		427,380		338,126		1,645,793
PRODUCTS.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Alewives	500	$5	37,776	$2,502	177,150	$6,637
Bluefish	660	80	2,085	211	3,710	386
Bonito			6,120	912	6,120	912
Bullheads			1,067	77	1,492	100
Butterfish			18,760	2,604	18,810	2,607
Carp			9,778	1,140	40,141	4,922
Cod			96,136	9,603	96,136	9,603
Cusk			6,767	73	6,767	73
Eels	14,153	1,960	37,705	6,233	63,046	9,839
Flounders	99,175	4,801	1,980,441	77,232	2,349,181	91,962
Haddock			350	38	350	38
Hake	100	2	10,100	100	10,200	102
Halibut			25,000	5,000	25,000	5,000
Herring			3,000	71	3,000	71
Mackerel	7,400	1,572	83,989	9,418	91,389	10,990

PERSONS ENGAGED, INVESTMENT, AND PRODUCTS OF FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES—Continued.

Item.	New Haven.		New London.		Total.	
PRODUCTS—continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Menhaden	102,350	$350	6,615,600	$91,827	6,736,564	$93,312
Perch, yellow			2,461	251	6,108	595
Pickerel			611	88	1,079	143
Pollock			10,135	717	10,135	717
Scup			1,980	202	1,980	202
Sea bass	210	60	3,345	468	3,555	528
Shad	327	83	98,088	18,618	463,203	86,637
Skates			400	10	400	10
Smelt			21,103	3,580	25,217	4,466
Squeteague	808	58	19,547	2,968	23,076	3,257
Striped bass	21	5	3,939	944	4,810	1,059
Sturgeon					25	5
Suckers			14,950	1,006	99,053	7,488
Sunfish					105	11
Swordfish			86,948	14,711	88,428	15,006
Tautog	500	50	20,633	1,957	21,942	2,068
Tomcod			455	37	455	37
Tuna			5,114	550	5,114	550
Whiting			9,317	175	9,317	175
Lobsters	163,674	45,633	423,895	96,547	740,848	189,157
Squid			3,612	258	3,612	258
Clams:						
Hard	10,504	4,323			[1] 49,976	18,912
Soft	208,950	30,541			[2] 229,150	32,070
Scallops			38,400	13,717	[3] 38,400	13,717
Oysters:						
Market—						
Public	106,708	15,210	7,000	3,000	[4] 136,654	21,900
Private	2,250,857	242,830			[5] 4,826,668	471,766
Seed—						
Public	106,631	10,004			[6] 740,516	68,349
Private	1,517,411	152,324			[7] 6,493,865	525,001
Total	4,591,239	509,891	9,706,507	366,845	23,652,647	1,700,638

[1] 6,247 bushels.
[2] 22,915 bushels.
[3] 6,400 bushels.
[4] 19,522 bushels.
[5] 689,524 bushels.
[6] 105,788 bushels.
[7] 927,695 bushels.

FISHERIES BY APPARATUS.

Dredges employed in the oyster fisheries of Connecticut in 1919 were the most productive form of apparatus. In the vessel fisheries dredges took 11,844,084 pounds, or 1,692,012 bushels, of oysters, valued at $1,037,717, and in the shore fisheries dredges, tongs, rakes, and hoes took oysters to the amount of 353,619 pounds, or 50,517 bushels, valued at $49,299, and clams to the amount of 279,126 pounds, or 29,162 bushels, valued at $50,982. The catch with pots amounted to 768,078 pounds, valued at $192,629, of which 740,848 pounds, valued at $189,157, were lobsters. Otter trawls caught flounders, giant scallops, and hake to the amount of 2,359,221 pounds, valued at $103,031. The catch with purse seines amounted to 6,625,240 pounds, valued at $93,812, the principal species taken being menhaden to the amount of 6,608,400 pounds, valued at $91,765. Gill nets, used principally in the taking of shad, yielded 443,551 pounds, valued at $76,175. The quantity of shad taken with gill nets amounted to 374,823 pounds, or 86,567 in number, valued at $69,201, of which 53,822 were roes and 32,745 were bucks. Various species were taken with lines, amounting to 201,763 pounds, valued at $24,241; with pound nets, amounting to 379,371 pounds, valued at $22,047; and with seines, amounting to 189,160 pounds, valued at $21,680. All forms of apparatus employed in both the vessel and shore fisheries yielded a total of 23,652,647 pounds, valued at $1,700,638.

The following tables give the products of the vessel and shore or boat fisheries in 1919, by counties, apparatus, and species:

YIELD OF VESSEL FISHERIES OF CONNECTICUT IN 1919, BY COUNTIES, APPARATUS, AND SPECIES.

Apparatus and species.	Fairfield.		New Haven.		New London.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Purse seines:								
Mackerel					16,840	$2,047	16,840	$2,047
Menhaden					6,608,400	91,765	6,608,400	91,765
Total					6,625,240	93,812	6,625,240	93,812
Gill nets: Mackerel					41,688	4,310	41,688	4,310
Lines:								
Cod					93,694	9,503	93,694	9,503
Halibut					25,000	5,000	25,000	5,000
Pollock					9,810	687	9,810	687
Total					128,504	15,190	128,504	15,190
Dredges: Oysters—								
Market—								
Public	1,400	$160	3,500	$610			4,900	770
Private	2,555,161	225,544	2,201,143	232,176			4,756,304	457,720
Seed—								
Public	527,583	48,369	72,632	6,817			600,215	55,186
Private	4,965,254	371,717	1,517,411	152,324			6,482,665	524,041
Total	8,049,398	645,790	3,794,686	391,927			11,844,084	1,037,717
Otter trawls:								
Flounders	45,605	2,527	3,330	200	439,841	14,943	488,776	17,670
Hake					10,000	100	10,000	100
Scallops					2,816	853	2,816	853
Total	45,605	2,527	3,330	200	452,657	15,896	501,592	18,623
Lobster pots: Lobsters	14,131	5,141	2,476	793			16,607	5,934
Harpoons: Swordfish	1,480	295			76,828	12,501	78,308	12,796
Grand total	8,110,614	653,753	3,800,492	392,920	7,324,917	141,709	19,236,023	1,188,382

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES.

BY SEINES AND GILL NETS.

Apparatus and species.	Fairfield.		Hartford.		Middlesex.		New London.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Seines:										
Alewives			39,484	$1,988	16,484	$277	800	$40	56,768	$2,305
Bullhead			60	6	300	14			360	20
Carp			9,373	1,381	12,512	1,460	6,810	806	28,695	3,647
Eels							4,440	801	4,440	801
Perch, yellow			530	44	299	27			829	71
Pickerel					109	12			109	12
Shad			18,873	4,595	26,407	4,666	5,088	1,219	50,368	10,480
Smelt	4,114	$886					293	50	4,407	936
Striped bass							600	151	600	151
Suckers			27,511	2,238	15,048	1,016			42,559	3,254
Sunfish					25	3			25	3
Total	4,114	886	95,831	10,252	71,184	7,475	18,031	3,067	189,160	21,680
Gill nets:										
Alewives					11,446	385	9,297	1,572	20,743	1,957
Bluefish					925	92			925	92
Carp					31	3	2,968	334	2,999	337
Eels							94	9	94	9
Menhaden	300	25							300	25
Shad			15,465	3,876	268,428	48,392	90,930	16,933	374,823	69,201
Squeteague					1,104	111			1,104	111
Striped bass					850	110			850	110
Sturgeon					25	5			25	5
Total	300	25	15,465	3,876	282,809	49,098	103,289	18,848	401,863	71,847

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY POUND NETS, FYKE NETS, AND LINES.

Apparatus and species.	Hartford.		Middlesex.		New Haven.		New London.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Pound nets:										
Alewives	...	...	68,073	$1,405	500	$5	26,115	$808	94,688	$2,218
Bluefish	...	...	40	3	...	...	200	32	240	35
Butterfish	...	...	50	3	...	...	18,760	2,604	18,810	2,607
Carp	...	...	5,093	571	...	...	...	...	5,093	571
Cusk	...	...	...	...	...	...	6,767	73	6,767	73
Eels	...	...	...	...	...	...	2,150	309	2,150	300
Flounders	...	...	6,350	187	...	...	20,215	1,837	26,565	2,024
Herring	...	...	...	...	...	...	3,000	71	3,000	71
Mackerel	...	...	...	...	...	...	410	67	410	67
Menhaden	...	...	18,314	1,110	102,350	350	7,200	62	127,864	1,522
Perch, yellow	...	...	736	67	...	...	50	10	786	77
Scup	...	...	...	...	...	...	1,980	202	1,980	202
Sea bass	...	...	...	...	210	60	...	...	210	60
Shad	...	...	34,994	6,251	327	83	2,070	466	37,391	6,800
Skates	...	...	...	...	...	...	400	10	400	10
Squeteague	...	...	1,617	120	...	...	18,650	2,841	20,267	2,961
Striped bass	...	...	...	...	...	...	2,349	559	2,349	559
Suckers	...	...	6,069	384	...	...	...	...	6,069	384
Tautog	...	...	809	61	500	50	9,639	925	10,948	1,036
Tomcod	...	...	...	...	...	...	455	37	455	37
Whiting	...	...	...	...	...	...	9,317	175	9,317	175
Squid	...	...	...	...	...	...	3,612	258	3,612	258
Total	...	...	142,145	10,162	103,887	548	133,339	11,337	379,371	22,047
Fyke nets:										
Alewives	677	$20	2,710	55	...	...	1,561	82	4,951	157
Bullhead	...	...	65	3	...	...	1,067	77	1,132	80
Carp	2,481	256	873	111	...	...	...	...	3,354	367
Eels	4,768	1,038	98	10	...	...	8,100	1,884	12,966	2,932
Flounders	...	...	...	...	495	28	5,740	325	6,235	353
Hake	...	...	...	...	100	2	...	...	100	2
Perch, yellow	1,904	191	178	15	...	...	2,411	241	4,493	447
Pickerel	128	20	231	23	...	...	611	88	970	131
Squeteague	...	...	...	...	808	58	111	14	919	72
Striped bass	...	...	...	...	21	5	210	39	231	44
Suckers	28,065	2,326	7,410	518	...	...	14,950	1,006	50,425	3,850
Sunfish	80	8	...	...	...	...	...	...	80	8
Tautog	...	...	...	...	...	...	390	33	390	33
Total	38,103	3,859	11,565	735	1,424	93	35,154	3,789	86,246	8,476
Lines:										
Bluefish	...	...	...	...	660	80	1,885	179	2,545	259
Bonito	...	...	...	...	...	...	6,120	912	6,120	912
Cod	...	...	...	...	...	...	2,442	100	2,442	100
Eels	...	...	...	...	515	48	2,012	357	2,527	405
Flounders	...	...	...	...	2,450	216	3,110	155	5,560	371
Haddock	...	...	...	...	...	...	350	38	350	38
Mackerel	...	...	...	...	7,400	1,572	25,051	2,994	32,451	4,566
Pollock	...	...	...	...	...	...	325	30	325	30
Sea bass	...	...	...	...	...	...	3,345	468	3,345	468
Smelt	...	...	...	...	...	...	310	45	310	45
Squeteague	...	...	...	...	...	...	786	113	786	113
Striped bass	...	...	...	...	...	...	780	195	780	195
Tautog	...	...	...	...	...	...	10,601	999	10,604	999
Tuna	...	...	...	...	...	...	5,114	550	5,114	550
Total	...	...	...	...	11,025	1,916	62,234	7,135	73,259	9,051

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS.

Apparatus and species.	Fairfield.		Hartford.		Middlesex.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls: Flounders	39,500	$1,200	...	...	177,810	$6,015
Scoop nets: Shad	...	...	621	$156	...	...
Pots:						
Eels	...	...	...	...	6,322	598
Lobsters	58,793	18,744	...	...	80,355	23,092
Total	58,793	18,744	...	...	86,677	23,690
Grand total	98,293	19,944	621	156	264,487	29,705

YIELD OF SHORE FISHERIES OF CONNECTICUT IN 1919, BY APPARATUS, COUNTIES, AND SPECIES—Continued.

BY OTTER TRAWLS, HARPOONS, SCOOP NETS, POTS, AND SPEARS—Continued.

Apparatus and species.	New Haven.		New London.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Otter trawls:						
Flounders	93,200	$4,357	1,511,535	$59,972	1,822,045	$71,544
Scallops	....	....	35,584	12,864	35,584	12,864
Total	93,200	4,357	1,547,119	72,836	1,857,629	84,408
Harpoons: Swordfish	....	....	10,120	2,210	10,120	2,210
Scoop nets:						
Shad	....	....	....	....	621	156
Smelt	....	....	20,500	3,485	20,500	3,485
Total	....	....	20,500	3,485	21,121	3,641
Pots:						
Eels	276	42	20,632	2,832	27,230	3,472
Lobsters	161,198	44,840	423,895	96,547	724,244	183,223
Total	161,474	44,882	444,527	99,379	751,471	186,695
Spears: Eels	13,362	1,870	277	50	13,639	1,920
Grand total	268,036	51,109	2,022,543	177,960	2,653,980	278,874

BY DREDGES, TONGS, RAKES, HOES, AND SHOVELS.

Species.	Fairfield.		Middlesex.		New Haven.		New London.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Clams:										
Hard	39,472	$14,589	....	....	10,504	$1,323	....	....	49,976	$18,912
Soft	8,000	725	12,200	$804	208,950	30,541	....	....	229,150	32,070
Oysters:										
Market—										
Public	17,542	2,720	4,004	810	103,208	14,600	7,000	$3,000	131,754	21,130
Private	15,036	2,391	5,614	1,001	49,714	10,654	....	....	70,364	14,046
Seed—										
Public	106,302	9,976	....	....	33,999	3,187	....	....	140,301	13,163
Private	11,200	960	....	....	....	....	....	....	11,200	960
Total	197,552	31,361	21,818	2,615	406,375	63,305	7,000	3,000	632,745	100,281

WHOLESALE FISHERY TRADE AND MENHADEN INDUSTRY.

In 1919 there were 25 establishments engaged in the wholesale fishery trade of Connecticut, employing 559 persons, to whom $338,884 were paid in wages. The value of these establishments with their equipment, etc., was $418,801 and the cash capital utilized amounted to $81,500.

There were only two factories engaged in the reduction of menhaden to oil and scrap. The statistics of these plants have been included in the fishery industries table of Massachusetts.

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ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1920.[1]

By Ward T. Bower, *Agent, Alaska Service.*

CONTENTS.

[1] Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 909.

INTRODUCTION.

The Bureau's work in Alaska was conducted along the usual lines in the calendar year 1920. Shortage of funds handicapped the work of the fisheries service early in the season before the new appropriations became available July 1. A force of temporary stream watchmen was again made use of during the active fishing season, working under the direction of the Bureau's permanent employees in the patrol of the fishing grounds for the enforcement of the laws and regulations. Vessels of the subchaser type and one mine sweeper were stationed in southeastern Alaska to aid in law enforcement.

A further study was made of the condition of the salmon fishery of the Yukon River, and an expedition was sent into the Bristol Bay region which did excellent work in the destruction of predatory fishes and gathered certain information in regard to the spawning beds and runs of red salmon in streams tributary to Bristol Bay. Five hearings were held by the Bureau at Cordova and Seattle late in the year, and further restrictions imposed on commercial fishing for salmon in Alaska.

Private salmon hatcheries were inspected as usual, and work was continued by the Bureau at its hatcheries on McDonald Lake and at Afognak. Excellent progress was made in the marking of the mouths of salmon streams, one vessel in the southeastern district being almost exclusively engaged in the work. Detailed statistics of the fishery industry of Alaska were collected and compiled as heretofore.

In accordance with the recommendation repeatedly made by the Secretary of Commerce and the Commissioner of Fisheries, the Department of Commerce has been relieved of jurisdiction over certain minor fur-bearing animals in Alaska. The act of May 31, 1920, contained a section placing the land fur-bearing animals of Alaska under the control of the Bureau of Biological Survey, of the Department of Agriculture, and transferred to the Department of Commerce jurisdiction over walruses and sea lions. The Department of Commerce retains jurisdiction over the fur seals and sea otters, and over the blue fox herds of the Pribilof Islands. The Bureau's files and all matters pertaining to the land fur-bearing animals, including the leasing of islands for fur-farming, were promptly delivered to the Bureau of Biological Survey, which assumed jurisdiction upon the approval of the act. This report, therefore, does not contain a section dealing with the protection of the so-called minor fur-bearing animals of Alaska. Employees of this Bureau in Alaska have cooperated with representatives of the Bureau of Biological Survey whenever possible in the establishment of their work.

The Bureau's activities in connection with the taking of fur-seal skins and administration of the natives' affairs on the Pribilof Islands were carried on in the usual manner. The total take of sealskins in the calendar year 1920 was 26,648, having an estimated value of about $1,000,000. The take of blue fox skins on the Pribilofs in the winter of 1920–21 was the largest for nearly 30 years, totaling 1,125 blues and 14 whites, with an estimated value of about $100,000.

Transportation of necessary food, fuel, and supplies for the natives and white employees on the Pribilof Islands, together with return of products, was afforded through the courtesy of the Navy Department and the Coast Guard.

Two sales at public auction of sealskins taken on the Pribilof Islands were held at St. Louis in 1920 by the selling agents of the Bureau. The sale of fox skins was postponed because of low prices, but was held early in 1921.

The author of this report is greatly indebted to Assistant Agent E. M. Ball for compilation of statistics of the fisheries and preparation of accompanying text. Acknowledgment is also made to C. E. Crompton for assistance in the preparation of statistics and text in regard to the fur-seal industry.

REGULAR EMPLOYEES, ALASKA SERVICE.

During the year 1920 the following regular employees have been identified with the Alaska service of the Bureau:

REGULAR EMPLOYEES IDENTIFIED WITH THE ALASKA SERVICE IN 1920.

Name.	Position.	Headquarters or chief place of duty.
Ward T. Bower	Chief agent	Washington, D. C.
Edward M. Ball	Assistant agent	Juneau.
Harry J. Christoffers	do	Seattle.
Calvin F. Townsend	Inspector	Fairbanks.
Shirley A. Baker	Assistant agent	Cordova.
Lemuel G. Wingard	do	Naknek. (Promoted Oct. 1, 1920, from warden.)
A. H. Proctor	Superintendent	St. Paul Island. (Promoted July 1, 1920, from agent and caretaker, St. Paul Island.)
Charles E. Crompton	Agent and caretaker	St. George Island.
Henry D. Aller	do	St. Paul Island. (Promoted July 1, 1920, from storekeeper, St. Paul Island.)
G. Dallas Hanna	Storekeeper	St. Paul Island. (Resigned Jan. 15, 1920.)
Edward C. Johnston	do	St. George Island. (Promoted Apr. 16, 1920, from school-teacher.)
Henry C. Scudder	do	St. Paul Island. (Resigned as warden Apr. 23, 1920. Reinstated, assistant agent, July 1, 1920. Promoted Oct. 1, 1920.)
John J. Richstein	Physician	St. Paul Island. (Resigned June 30, 1920.)
Henry H. Stromberger	do	St. Paul Island. (Reinstated July 1, 1920. Resigned Aug. 4, 1920.)
W. C. Huyler	do	St. Paul Island. (Appointed Oct. 5, 1920. Resigned Nov. 18, 1920.)
George B. Bowlby	do	St. Paul Island. (Appointed Nov. 19, 1920.)
William M. Murphy	do	St. George Island.
Herschel Silverstone	Assistant to agent	St. Paul Island. (Resigned Sept. 30, 1920.)
Henry Mygatt	do	St. Paul Island. (Appointed Oct. 1, 1920.)
George Haley	School-teacher	St. Paul Island. (Resigned July 19, 1920.)
Lois L. Proctor	do	St. Paul Island.
Richard Culbertson	do	St. Paul Island. (Appointed July 20, 1920.)
Carl E. Fletcher	do	St. George Island. (Appointed May 29, 1920. Resigned Oct. 9, 1920.)
John M. Orchard	do	St. George Island. (Appointed Oct. 12, 1920.)
Michael J. O'Connor	Warden	Juneau.
Fred H. Gray	do	Wrangell.
Philip R. Hough	do	Juneau. (Resigned June 30, 1920.)
Joseph N. Braun	do	Ikatan. (Appointed May 1, 1920.)
William E. Baumann	do	Afognak. (Appointed July 20, 1920.)
Chauncey C. Combs	do	Haines. (Appointed July 26, 1920. Resigned Sept. 30, 1920.)
James K. Nevill	do	Wrangell. (Appointed Aug. 1, 1920.)
Arthur L. Mellick	Master power vessel Eider.	Unalaska.
Edwin Hofstad	Master steamer Osprey	Wrangell.
Jesse L. Nevill	Master patrol vessel Auklet	Do.
George G. Naud	Master patrol vessel Murre.	Juneau.
Albert K. Brown	Clerk	Washington, D. C.
Mary S. Haines	do	Do.
William P. Rasin	do	Do.
Marguerite McBride	do	Washington, D. C. (Transferred to Coast and Geodetic Survey, Feb. 3, 1920.)
E. Elaine Bell	do	Seattle.
Gladys M. Gamlen	do	Seattle. (Resigned Mar. 6, 1920. Reinstated June 8, 1920.)

REGULAR EMPLOYEES AT GOVERNMENT HATCHERIES IN ALASKA IN 1920.

Location and name.	Position.
Afognak:	
Edwin Wentworth	Superintendent.
Harry J. Heuver	Foreman.
Russel Noyes	Fish-culturist. (Resigned June 30, 1920.)
Fred R. Lucas	Fish-culturist.
Thomas H. Morton	Fish-culturist. (Promoted Mar. 16, 1920 from apprentice fish-culturist at Afognak to fish-culturist at McDonald Lake. Transferred Sept. 16, 1920, to Afognak.)
Alfred Nelson	Apprentice fish-culturist.
Nicolai Boskofsky	Apprentice fish-culturist. (Appointed Oct. 6, 1920.)
Mildred I. Morton	Apprentice fish-culturist. (Appointed Nov. 4, 1920. Resigned Dec. 31, 1920.)
F. J. Stewart	Cook. (Resigned Dec. 31, 1920.)
McDonald Lake:	
C. H. Van Atta	Superintendent.
Calvin D. Ryan	Foreman.
William L. Stiles, Jr.	Fish-culturist. (Transferred Mar. 1, 1920, to Leadville, Colo.)
Thomas H. Morton	Fish-culturist. (Promoted Mar. 16, 1920, from apprentice fish-culturist, Afognak. Transferred Sept. 16, 1920, to fish-culturist, Afognak.)
Albert L. Carlton	Fish-culturist.
Everett V. Campbell	Apprentice fish-culturist. (Resigned Apr. 30, 1920.)
Lawrence T. Hopkinson	Apprentice fish-culturist. (Appointed June 5, 1920. Transferred Sept. 1, 1920, to statistical agent, Washington, D. C.)
Clarence Houts	Apprentice fish-culturist. (Resigned Aug. 14, 1920.)
Anton Hougen	Apprentice fish-culturist. (Appointed Nov. 1, 1920.)
Barney Sevisen	Do.
Casper Udstrand	Apprentice fish-culturist. (Appointed Nov. 6, 1920.)
Stella A. Campbell	Cook. (Resigned Apr. 30, 1920.)
John P. Mobley	Cook. (Appointed May 1, 1920.)

FISHERY INDUSTRIES.

As in corresponding reports for previous years, the Territory of Alaska is here considered in the three coastal geographic sections generally recognized, as follows: Southeast Alaska, embracing all that narrow strip of mainland and the numerous adjacent islands from Portland Canal northwestward to and including Yakutat Bay; central Alaska, the region on the Pacific from Yakutat Bay westward, including Prince William Sound, Cook Inlet, and the southern coast of Alaska Peninsula, to Unimak Pass; and western Alaska, the north shore of the Alaska Peninsula, including the Aleutian Islands and Bristol Bay and the Kuskokwim and Yukon Rivers.

Detailed reports and statistical tables dealing with the various fishery industries are presented herewith, and there are also given the important features of certain subjects which were the objects of special investigation or inquiry.

WATERS CLOSED TO COMMERCIAL FISHING.

Section 6 of the act approved June 26, 1906, for the protection and regulation of the fisheries of Alaska, is as follows:

SEC. 6. That the Secretary of Commerce may, in his discretion, set aside any streams or lakes as preserves for spawning grounds, in which fishing may be limited or entirely prohibited; and when, in his judgment, the results of fishing operations in any stream, or off the mouth thereof, indicate that the number of salmon taken is larger than the natural production of salmon in such stream, he is authorized to establish close seasons or to limit or prohibit fishing entirely for one year or more within such stream or within five hundred yards of the mouth thereof, so as to permit salmon to increase: *Provided, however,* That such power shall be exercised only after all persons interested shall be given a hearing, of which due notice must be given by publication; and where the interested parties are known to the Department they shall be personally notified by a notice mailed not less than thirty days previous to such hearing. No order made under this section shall be effective before the next calendar year after same is made: *And provided further,* That such limitations and prohibitions shall not apply to those engaged in catching salmon who keep such streams fully stocked with salmon by artificial propagation.

Pursuant to the provisions of this section, action was taken in 1920 in regard to waters of southeastern Alaska; waters between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, Kuskokwim River, and Yukon River.

Under date of May 22, 1920, announcement was made of a hearing to be held to consider the necessity or desirability of making changes in the regulations in regard to the Yukon River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 14, 1918, limiting or prohibiting fishing for salmon in the Yukon River, Alaska, its tributary waters, and the waters of its delta, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing, for the purpose of eliciting information as to what, if any, changes in the present Yukon River regulations are necessary or desirable, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 23, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of May 25, 1920, announcement was made of a hearing to be held in respect to fishing in the Kuskokwim River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce limit or prohibit fishing for salmon or other fishing in the prosecution of which salmon are taken or injured, in the Kuskokwim River, Alaska, its tributary waters, and within the area 500 yards outside the mouth of that river, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of limiting or prohibiting fishery operations in the waters in question will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 30, 1920, at 10 o'clock a. m., at which time and place all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of August 18, 1920, announcement was made of hearings to consider the necessity or desirability of changing the regulations regarding fishing in Copper River waters. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, Alaska, and its delta and all tributary waters, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that hearings for the purpose of eliciting information as to what, if any, changes in the present Copper River regulations are necessary or desirable will be held at Cordova, Alaska, on October 5, 1920, at 10 o'clock a. m., and at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on November 18, 1920, at 10 o'clock a. m., respectively, at which all interested persons will be heard. All persons having pertinent information are particularly invited to be present and to impart such information.

Under date of October 30, 1920, announcement was made of a hearing to be held in respect to amending the order of November 30, 1917, in regard to fishing in Bering River. The text of the announcement was as follows:

It having been recommended that the Secretary of Commerce amend the order of November 30, 1917, the provisions of which are continued in the order of December 23, 1919, prohibiting commercial fishing operations in Bering River and its tributary waters, including Bering Lake, above a line extending at right angles across Bering River from a point approximately 800 feet northwesterly from the mouth of Gandil River, Alaska, notice is hereby given under the provisions of section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," that a hearing to determine the advisability of further limiting or prohibiting fishing operations in Bering River and its tributary waters, including Bering Lake, will be held at the office of the Bureau of Fisheries, 1217 L. C. Smith Building, Seattle, Wash., on December 3, 1920, at 10 o'clock a. m., at which time and place all persons interested will be heard.

Following the hearings on October 5, November 18, 23, and 30, and December 3, the Department, under date of December 18, 1920, promulgated the following order:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all hereinafter-described waters of Alaska be and is hereby made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(*a*) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(*b*) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(*c*) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets as well as with all other apparatus is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anan Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes, and within 500 yards of the mouths of such streams, flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(*a*) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River, is prohibited.

(*b*) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(*c*) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon, is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Limitations and prohibitions upon fishing are applicable in the waters of the Yukon and Copper Rivers by virtue of previous orders of the Secretary of Commerce. Limitations have been placed upon fishing by Executive order or proclamation in the following additional waters: Afognak Reservation, Aleutian Islands Reservation, Yes Bay and Stream, and the Annette Island Fishery Reserve.

STREAM MARKING.

In order to make more effective the closing order of December 23, 1919, and to serve as a helpful guide to the fishermen, it was considered advisable to indicate by appropriate notices at suitable places on shore the protected waters off the mouth of each salmon stream in which fishing is prohibited. Though these notices in themselves could not prevent unlawful encroachments on the streams, they would serve as guides to those instinctively law-abiding and as warning to those having no respect for the fishery laws and regulations. Thus no one could plead in extenuation of a violation of the regulations that there were no visible means defining the bounds wherein operations would be illegal.

The placing of markers at the mouths of streams is therefore intended to be helpful to the fishermen in enabling them to locate the outer boundary of the protected area of each stream, and at the same time the markers serve the further purpose of making more certain to those engaged in the enforcement of the law and regulations that encroachments upon prohibited waters are not accidental.

The procedure generally followed in southeast Alaska in locating markers has been to define arbitrarily the mouths of streams at the line of mean low tide, unless physical conditions rendered such action impracticable. This is the case at some streams where considerable areas of silt have been deposited, which at low tide are exposed as comparatively extensive mud flats. Owing to the varied conditions encountered, no inflexible rule could be laid down for the determination of stream mouths, but as far as practicable the mouth of each stream was to be fixed at the line of mean low tide. Where this could not be done, authority was given to mark the mouths of such streams at the line of mean high tide.

Gratifying progress was made in the work of marking stream mouths in southeast Alaska. Signboards were erected at 189 streams. Of that number the mainland is credited with 21 streams, Chichagof Island with 60, Yakobi Island 2, Baranof Island 18, Admiralty Island 28, Kupreanof Island 5, Zarembo Island 1, Wrangell Island 2, Etolin Island 5, Mitkof Island 1, Kosciusko Island 6, and Prince of Wales Island 40. There are several hundred more salmon streams in southeast Alaska which have not been marked, but which will be given attention as funds may be available for such work.

In central Alaska markers were placed in 1920 at Eyak River, Mountain Slough, and Glacier River, all of which are streams of the delta of the Copper River, the several other outlets of the Copper having been marked in 1919. The Karluk River was also marked in 1920.

The salmon streams in western Alaska are comparatively large and few in number. Of those tributary to Bristol Bay seven were marked in 1920. They are as follows: Nushagak, Snake, Igushik, Kvichak, Naknek, Egagik, and Ugashik Rivers. The mouth of the Yukon River was marked in 1919.

STREAM WATCHMEN.

No more important work than the watching of salmon streams engages the attention of the Alaska service. The preservation of the salmon runs may depend largely upon the degree of protection afforded in this manner, for experience has shown beyond doubt that most satisfactory results are thus obtained. The duty of stream watchmen is to prevent unlawful fishing in the streams where they are stationed and within the proscribed area off the mouths thereof.

In 1920 six men were employed as stream watchmen, of whom Fred W. Dost, Eric N. Aldrich, Earl C. Nelson, and John F. Ross were assigned to the southeastern district. The other two, Kenneth C. Cole and John J. Folstad, were stationed at Abercrombie and Karluk, respectively. By consent of the governor of Alaska, Joseph A. Bourke, a Territorial officer, was detailed to fishery work in the Prince William Sound region during the fishing season.

Three other men, Chauncey C. Combs, James K. Nevill, and William E. Baumann, began work in July as stream watchmen, but they were soon appointed permanent wardens in the Alaska fisheries service, and are therefore not to be counted in this category. The regular force of the service, including these three wardens, numbered 11 men, which, with the 6 stream watchmen and the 1 special assistant previously referred to, constituted a service of 18 men actively engaged in the protection of the fisheries of Alaska. In addition there were, of course, the men engaged in operating the several vessels used in protective work.

FISHERY PATROL.

BUREAU PATROL BOATS.

Five boats, owned by the Bureau, were used in patrolling the fishing grounds of Alaska in 1920. Three of them, the steamer *Osprey* and the power boats *Auklet* and *Murre*, operated in southeastern Alaska, while the other two, the *Swan* and *Tern*, were used on the Yukon River and tributaries, cruising together during much of the season. In addition the launch *Dixie* and the power boats *Anthonette* and *Try It* were chartered in July, August, and September for patrol service in the Juneau district. The launch *Prospector* was chartered in June and July for similar service on Prince William Sound and the Copper River flats.

The *Osprey* was transferred from the central district to southeastern Alaska in July, where it was used almost entirely in the work of marking the mouths of salmon streams. While being beached near Cordova, preparatory to having her hull cleaned and copper painted, the *Osprey* settled in the gravel and turned over on May 25, falling away from the shore at low water. The boat did not right itself on the flood tide, but filled with water and remained in this partly submerged condition for about a week until assistance was rendered by the Coast Guard cutter *Algonquin*, then in the vicinity. The following extract from a report by the Commodore Commandant of the Coast Guard describes the circumstances attending the salvage of the *Osprey:*

> On May 30, while on her way to Latouche, the *Algonquin* received a dispatch from the headquarters of the Coast Guard at Washington, stating that the Bureau of Fisheries had requested her assistance in salving the steamer *Osprey*, ashore at Cordova. The cutter immediately headed for the stranded vessel and found her in Orca Inlet, 5 miles north of Cordova. She was lying

on her side, full of water. It was decided that a barge or scow was necessary to float the vessel, so the *Algonquin* proceeded to Cordova in search of one. A suitable scow, belonging to the Bering River Coal Co., was obtained, brought to the steamer *Osprey*, and hauled alongside her. On June 3 the *Osprey* was righted, floated, and made fast to a dolphin. The water was then bailed out of her.

In April the *Murre* was seriously damaged by striking a rock in Keku Strait while engaged on census work for the Bureau of Education. She was towed to Wrangell by the *Auklet* and repaired at a cost of $1,623.87.

The following statement shows the mileage made by the patrol boats owned by the Bureau in their cruises of 1920: *Auklet*, 7,616; *Murre*, 6,635; *Osprey*, 3,793; *Swan*, 3,067; *Tern*, 2,367; total mileage, 23,478. In addition to the foregoing, extensive mileage was made by chartered patrol boats, especially the *Dixie*.

NAVAL AND OTHER PUBLIC VESSELS.

In March, 1920, a rather elaborate program was arranged between the Governor of Alaska and the Navy Department, Treasury Department, and the Department of Commerce, whereby certain vessels under the direction of each department were to participate in fishery patrol work in Alaska. The original order as approved by the heads of the three departments designated the following vessels to constitute a fleet for the protection of the fisheries of the Territory:

Naval vessels: *Eagle 57*, submarine chaser *No. 294*, and submarine chaser *No. 309*. (Subchaser *No. 310* was detailed instead of *No. 309*.)

Coast Guard vessels: *Bothwell*, *Algonquin*, *Bear*, *Earp*, and *Unalga*.

Coast and Geodetic Survey vessels: *Explorer*, *Lydonia*, *Surveyor*, and *Wenonah*.

Eagle 57 and two subchasers, *No. 294* and *No. 310*, were in Alaska during the summer months. The chasers reached Alaska in May and remained until the end of the fishing season. Subchaser *No. 294*, while commanded by Lieut. Thompson, United States Navy, made an energetic patrol of the district south of Petersburg, and did much to suppress trap robberies and illegal fishing generally. Subchaser *No. 310* was similarly engaged in the district north of Petersburg, though much less actively. *Eagle 57* struck a reef at Gambier Bay July 3, en route from Bremerton to Juneau, and lost her propeller. On July 4 the vessel was towed to Juneau by the *Explorer* and several weeks later was towed to the Puget Sound Navy Yard by a naval tug. Thus *Eagle 57* performed no service in the interest of the fisheries of Alaska and was replaced on August 1 by the mine sweeper *Swallow*.

The commanding officer aboard each of these naval vessels was authorized by the Secretary of Commerce, under date of April 23, 1920, to make searches, arrests, and seizures in accordance with the provisions of the Alaska alien fisheries act of June 14, 1906. They, or other officers of the Navy assigned to this patrol, were also commissioned as deputy United States marshals, and at least one officer was appointed a United States commissioner.

The vessels of the Coast Guard were primarily in Alaskan waters to carry on the Bering Sea patrol for the protection of the fur-seal herds annually resorting to the Pribilof Islands. A statement regarding this patrol appears in the fur-seal section of this report.

The vessels of the Coast and Geodetic Survey were engaged in the vitally important work of that service in different coastal districts of Alaska and therefore could not be expected to have opportunities to do much for the fisheries.

WAR DEPARTMENT REGULATIONS.

Early in 1920 a rather general protest was registered before the Chief of Engineers of the War Department by various interests in Alaska against the location of floating fish traps in offshore positions, it being contended that such traps were a menace to navigation. After considerable inquiry into the matter, the Acting Chief of Engineers issued, on April 22, 1920, a temporary order for the regulation of floating traps, as follows:

> During the calendar year 1920 no floating pound net or fish trap in the navigable waters of Alaska shall exceed 2,400 feet in length over all nor be constructed and operated in more than 100 feet depth of water at the outer end of the net or trap at mean high tide according to the United States tide tables; with the exception that a floating pound net or fish trap may be constructed and operated in a greater depth of water, provided the extension, measured from the shore line, at mean high-tide line, does not exceed 1,000 feet over all.

At the same time announcement was made that public hearings would be held during the year to determine the advisability of continuing or modifying the order. Accordingly two hearings were held in 1920—one at Juneau on September 14 and the other at Seattle on November 19—as a result of which the War Department continued without modification the order of April 22. On January 5, 1921, new regulations were issued prescribing the conditions under which fishery operators may construct and maintain fish traps in the navigable waters of Alaska. The regulations are as follows:

War Department,
Office of the Chief of Engineers,
Washington, January 5, 1921.

Note.—It is to be understood that this authority does not give any property rights either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to private property or invasion of private rights, or any infringement of Federal, Territorial, or local laws or regulations, nor does it obviate the necessity of obtaining Territorial assent to the work authorized. It merely expresses the assent of the Federal Government so far as concerns the public rights of navigation. (See Cummings *v.* Chicago, 188 U. S., 410.)

To whom it may concern:

The attention of those fishing in the waters of the coast of the Territory of Alaska, and in the navigable waters tributary thereto, is called to the provisions of section 10 of the river and harbor act of March 3, 1899, as follows:

"Sec. 10. That the creation of any obstruction not affirmatively authorized by Congress to the navigable capacity of any of the waters of the United States is hereby prohibited; and it shall not be lawful to build or commence the building of any * * * weir * * * or other structure in any * * * navigable river or other waters of the United States, outside established harbor lines, or where no harbor lines have been established, except on plans recommended by the Chief of Engineers and authorized by the Secretary of War."

In accordance with the above provision of law, and until further notice, all fishermen who desire to operate in the waters above described, and under conditions stated as follows, but not otherwise, and whose written applications may receive the approval of the district engineer of the engineer department at large, in charge of the locality, are hereby authorized by the Secretary of War to construct and maintain fish weirs, traps, or pounds erected in the usual manner as heretofore, subject to the following conditions:

CONDITIONS.

1. All persons desiring to erect and maintain fish weirs, traps, or pounds under this authority shall make application to the District Engineer, United States Engineer Office, Seattle, Wash., giving their names, their addresses, the proposed location of their weir, trap, or pound, and evidence that the proper license has been granted by the Territory of Alaska.

2. That no floating fish trap shall exceed 2,400 feet in length over all, nor be constructed and operated in more than 100 feet depth of water at the outer end of the trap at mean high tide, according to the United States tide tables, with the exception that a floating trap may be constructed and operated in a greater depth of water, provided the extension measured from the shore line at mean high tide does not exceed 1,000 feet over all.

3. That all the apparatus used and the work herein authorized shall be subject to the supervision and approval of the aforesaid district engineer, who may temporarily suspend the work at any time if, in his judgment, the interests of navigation so require.

4. That no weir, trap, or pound shall be located or built in such place or manner as to unreasonably obstruct or interfere with navigation.

5. That on the outer end of the weir, trap, or pound the permittee or owner shall maintain a sign inscribed with the license number in numerals not less than 6 inches in height, capable of being readily read from passing vessels, and failure to keep such sign conspicuously displayed shall be sufficient reason for the cancellation of this authority and for prosecution as provided in the next paragraph. All renewals of the Territorial license shall be reported to the aforesaid district engineer when they occur, together with the Territorial license number. All changes of ownership shall also be reported to him immediately, and the permit shall be returned to him for proper notation thereon of such changes.

6. That upon the abandonment of the location or upon ceasing to use any weir, trap, or pound, as hereby authorized, the permit and the map or maps attached thereto shall be immediately returned to the aforesaid district engineer, with notice of the abandonment, and the owner shall immediately remove the structure at his own expense, including all piling, stakes, etc., to the satisfaction of the aforesaid district engineer. Failure to so remove the same shall be considered good ground for prosecution of the permittee or owner for maintaining an illegal structure endangering navigation, as set forth in sections 10 and 12 of the river and harbor act of March 3, 1899: *Provided*, That if the use of said structure is suspended temporarily it may be maintained in whole or in part if the license number is conspicuously displayed and the trap is properly lighted or otherwise marked, as may be necessary to prevent unreasonable obstruction to navigation. Any fish weir, trap, or pound allowed to go into a condition of disrepair so that it can not be readily seen, or on which the license number is not conspicuously displayed, will be regarded as abandoned, and if not promptly removed or marked as above provided will subject the permittee or owner to prosecution, and any trap not in use on which the license number is not displayed will be subject to removal by the United States at any time.

7. That if future operations by the United States require an alteration in the position of the weir, trap, or pound, or if the latter, in the opinion of the Secretary of War, shall cause unreasonable obstructions to the free navigation of the said waters, the permittee will be required, upon due notice from the Secretary of War, and within 30 days thereafter, to remove or alter the weir, trap, or pound, or obstruction caused thereby, without expense to the United States, so as to render navigation reasonably free, easy, and unobstructed. No claim shall be made against the United States on account of such removals or alterations.

8. That fishing structures and appliances in navigable waters of the United States shall be lighted for the safety of navigation, as follows:

"The lights shall be displayed between sunset and sunrise. They shall be placed at each end of the structure, excepting where the inner end terminates in such situation that there is no practicable navigation between it and the high-water line of the adjacent coast, in which case no inner light shall be displayed. The outer light shall be white and the inner light shall be red. The size, capacity, and manner of maintenance of the lights shall be such as may be specified in the War Department permit authorizing the erection of the structure or appliance.

"When several structures or appliances are placed on one line with no navigable passage between them they will be considered, for lighting purposes, as one structure."[1]

9. That there shall be installed and maintained on the weir, trap, or pound, by and at the expense of the permittee, such additional lights and signals as may be prescribed by Bureau of Lighthouses, Department of Commerce, and that provision shall be made by watchman or otherwise for proper attendance of lights and signals, so that they will at all times be in effective condition.

10. That this authority is revocable at will by the Secretary of War, and unless otherwise specified in the permit, or unless previously revoked under paragraph 7 above, shall cease and be null and void. (Date to be specified by the district engineer, not more than five years after date of issuance of permit.)

Recommended:

LANSING H. BEACH,
Major General, Chief of Engineers.

Approved:

W. R. WILLIAMS,
Assistant Secretary of War.

ALASKA FISHERY INTELLIGENCE SERVICE.

Through the cooperation of the Alaska Military Telegraph & Cable System, information was sent to and posted at frequent intervals in the telegraph offices at Wrangell, Petersburg, Craig, Sitka, Juneau, Cordova, and Seward, reporting the price of fresh halibut, sablefish, and red rockfish at Ketchikan. At less frequent intervals the price of pickled salmon and herring was also reported. In like manner the Seattle price for the same fresh and pickled fish was reported to those towns and to Ketchikan. This service is understood to have been of real value to the fishermen in enabling them to take advantage of the best market for their products, and it was continued for their benefit.

INSPECTION OF CANNERIES.

Canneries in Alaska are subject at all times to inspection by employees of the Alaska service of the bureau, but this inspection is limited chiefly to an examination of the fish with reference to the time they have been dead. The inspection also includes the wanton waste of food fish in Alaska, whether at the fishery establishments or on the fishing grounds.

There is also a cannery inspection service authorized by the National Canners' Association but supported largely if not entirely by the packing companies operating canneries in Alaska or by as many of them as contribute to the maintenance of the service. The plants of companies which do not contribute are not inspected by employees of that service. This work is somewhat in its infancy, having been started rather experimentally two years ago chiefly, it is understood, to reduce the fire risk at the canneries, to further provide for satisfactory sanitation at the plants, and to promote the general welfare and comfort of employees. The work of this service is no doubt well worth while, although it has no mandatory authority to prevent the

[1] Regulations of Department of Commerce, approved June 19, 1913.

canning of fish which in the judgment of its employees should not be canned. The superintendent of the plant is ordinarily the responsible head of affairs, with absolute control of operations, and is thus not definitely bound by the actions, recommendations, or suggestions of the inspectors.

In 1920 this private inspection service was competently conducted under the supervision of Dr. E. D. Clark, of Seattle, who for many years was identified with the U. S. Bureau of Chemistry. Its personnel was made up chiefly of students from the Fisheries College at the University of Washington. The Government has no direct connection with the inspection service thus maintained under the auspices of the National Canners' Association but approves of its general purposes and objects.

VIOLATIONS OF FISHERIES LAWS AND REGULATIONS.

Fishery work before the courts of Alaska in 1920 involved prosecutions for failure to close the tunnels and open the heart walls of traps during the weekly close season, fishing in streams and lakes closed to commercial operations, fishing within 500 yards of the mouths of salmon streams, disregard of the lateral distance interval between fixed appliances, and the wanton waste of salmon. It also covered the completion of prosecutions begun in 1919. In most cases the penalties imposed were fines, though in one case the sentence was imprisonment for one month. Fines aggregated $6,480.95, of which amount $101 was imposed in central Alaska, $158.80 in western Alaska, and $6,263.15 in the southeastern district. Costs of prosecutions, which ordinarily follow the judgments, are included in these amounts, as far as they were reported, but the record is incomplete as in several instances the costs had not been computed at the time reports were made. The total amount of penalties would therefore be increased somewhat by including these costs.

On September 13, 1919, William Strong was indicted at Juneau as an alien, having engaged in fishing in Taku River August 3, 1919. The case came to trial on March 4, 1920, at which time Strong pleaded guilty and was fined $100.

The Alaska Pacific Fisheries was indicted in 1919 for not opening the heart walls of two traps on Sunday, August 3, 1919, and tried at Ketchikan. The jury failed to agree on a verdict. On April 28, 1920, the case was again tried in the district court at Ketchikan and resulted in an acquittal of the company.

On July 17 the Alaska Pacific Fisheries was accused in a complaint filed before the United States commissioner at Juneau of failing to close the tunnel of its trap at Neck Point, Chichagof Island, during the weekly close period on July 11. The case was tried on August 6, but the jury did not agree on a verdict. Subsequently the case was dismissed on motion of the United States attorney.

The case against the Ward's Cove Packing Co., indicted in the fall of 1919 for fishing with two traps on Sunday, August 3, 1919, was called for trial at Ketchikan, April 26, 1920. The company pleaded guilty and was fined $200 and costs.

On November 23, 1920, the Ward's Cove Packing Co. was indicted at Ketchikan for illegally fishing with a trap in Clarence Strait 4 miles north of Dall Head on August 2. The case was continued to the March, 1921, term of court.

At the April term of court in Ketchikan, Gus Starkloff, who was indicted the previous fall for unlawful fishing in Staney Creek, Prince of Wales Island, September 22, 1919, was arraigned, pleaded guilty, and paid a fine of $50.

At the same term of court Jack Peratovich and five other natives were arraigned under an indictment accusing them of fishing with a seine in Staney Creek in 1919 contrary to law. They pleaded guilty and were each fined $50.

In October, 1919, T. Kato, a Japanese, was indicted as an alien for fishing with a gill net in the waters of southeastern Alaska on June 5, 1919. The case was called for trial at Ketchikan on April 30 and resulted in an instructed verdict for the defendant, it having been testified that he was not fishing, but was merely demonstrating the use of a gill net.

Jenkins & Jenkins were indicted in 1919 at Ketchikan for having driven a trap within a lateral distance of 600 yards of a floating trap then in operation. The case was tried in Ketchikan in April, 1920, resulting in an acquittal of the defendants on the ground that the floating trap was movable, and that therefore only the lateral distance interval of 100 yards was applicable in this instance.

At the September, 1919, term of the district court held at Juneau, Tony Flagas was indicted for fishing in Berners Bay during the close season on September 15, 1919. Counsel for the defendant demurred to the indictment for the reason that it did not state that Flagas was fishing for salmon. The demurrer was sustained, and the violation is therefore in the status of having been unreported.

On Sunday, May 23, Paul Rappas was found fishing with a gill net in Shoemaker Bay. On May 24 a complaint was filed against Rappas before the United States commissioner at Wrangell, whereupon he pleaded guilty and was fined $120 and costs of $8.

On September 15, 1919, Pete Knutsen and Ole Knutsen were indicted on two counts for (*a*) fishing in Petersburg Creek with a gill net covering more than one-third the width of the stream and (*b*) fishing with a gill net extending across more than one-third the width of the water of the estuary at Petersburg Creek. They were tried at Ketchikan on November 8, 1919, and convicted on the second count. On November 15 motion for a new trial was made. It was denied on November 13, 1920, and a fine of $250 and costs was imposed. Notice of an appeal was then given but was not completed, and the fine and costs of $56.65 were paid later.

The case against the Hidden Inlet Canning Co., indicted in the fall of 1919 for constructing in Peril Strait, near False Island, a fish trap within 500 yards of the mouth of a salmon stream, was tried at Juneau October 11, 1920, and resulted in an acquittal of the company, there being no satisfactory evidence presented to the jury that the stream was used by salmon.

In September two indictments were returned against the Hidden Inlet Canning Co. The first covered two counts and accused the company of not closing the tunnels of two traps on Sunday, July 18. Both traps were located on Chichagof Island, one being one-fourth of a mile south of White Rock and the other 2 miles north of Basket Bay. A plea of guilty on each count was entered when the case was called for trial in October, and a fine of $50 for each offense was imposed. The second indictment alleged that the company had not closed on Sunday, July 25, the tunnel of a trap located on Chichagof Island 3½ miles south of South Passage Point. Upon being arraigned the company pleaded guilty and was fined $100. This violation was originally reported in a complaint filed before the United States commissioner at Juneau on August 31, but it was subsequently reported to the grand jury upon dismissal of the complaint.

On September 13 complaint was made before the United States commissioner at Juneau against Libby, McNeill & Libby charging it with failure to close the tunnel of its Douglas Island trap, near Shoal Point, during the weekly close season on September 5. Arraignment was made immediately upon issuance of the complaint. The company pleaded guilty and was fined $100 and costs of $2.85. Complaint was also made against Paul Benson and John Smith, watchmen at the trap. Both men pleaded guilty and paid a fine of $25 each and costs of $2.85.

In November, F. Lloyd was indicted at Ketchikan for illegally operating a floating trap near Harry Bay, during the weekly close period on July 31, by not opening the heart walls and not closing the tunnel. On December 9 the case was called and a plea of guilty was entered. The defendant was fined $50 and paid costs of $90.65.

On August 2, a trap on the west shore of Gravina Island, 3 miles north of Dall Head, belonging to Rounsefell & Co., was found in full fishing order. Report was made to the grand jury at Ketchikan, and, on November 23, a true bill was returned. The case was called for trial in December and the company pleaded guilty. A fine of $100 and costs of $21.05 were imposed.

On Sunday, August 1, a trap of the Jensen Fish Co. located in Nichols Passage near Blanks Inlet was found with heart walls closed and tunnel only partly closed. These facts were presented to the grand jury in Ketchikan on November 23 and an indictment resulted. The company pleaded guilty on December 8, and was fined $100 and costs of $45.

On July 7 complaint was filed before the United States commissioner at Juneau, charging that the Marathon Fishing & Packing Co. had not closed on Sunday, July 4, the tunnel of a trap operated by it on Admiralty Island, 1½ miles south of Gambier Bay. The case was called for trial on August 19, when the defendant pleaded guilty and paid a fine of $200.

On July 7 the Petersburg Packing Corporation was accused in a complaint filed at Juneau before the United States commissioner of not closing, on July 4, the tunnel of its pile trap located on the south shore of Admiralty Island, one-half mile northeasterly from Deepwater point. Similar complaints were made against A. J. Young and Jesse Fowler, watchmen at the trap. The cases were called for trial on August 2. The company pleaded guilty and was fined $200 and costs of $5. The complaints against the watchmen were dismissed for the reason that they claimed it was impossible for them to close the tunnel.

On July 7 complaint was filed before the United States commissioner at Juneau, charging the Petersburg Packing Corporation with failure to close on Sunday, July 4, the tunnel of a floating trap located 1 mile southeast of Point Brightman, Admiralty Island. The case was dismissed on motion of the United States attorney.

On July 7 complaint was filed before the United States commissioner at Juneau alleging that the Washington Bay Packing Co. had not closed the tunnel of a trap on the southeast shore of Admiralty Island, one-half mile southeast of Point Brightman, supposedly owned and operated by that company, on Sunday, July 4, though at that time the trap bore no name, number, or other means of identification. The complaint was subsequently withdrawn, as the company disclaimed ownership of the trap. However, on July 23, when the trap was again inspected, it carried the name of the Washington Bay Packing Co. In view of that fact, the matter was presented, on September 17, to the grand jury at Juneau, and an indictment resulted. The case was tried October 28, and the company was acquitted.

On September 17 the Washington Bay Packing Co. was also indicted for not having closed on Sunday, July 4, the tunnel of its trap located on the south shore of Admiralty Island, $2\frac{1}{2}$ miles northeast of Woewoodsky Harbor. When the case was called for trial in October, the company pleaded guilty and was fined $100 and costs.

On July 7 the Southern Alaska Canning Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sunday, July 4, the tunnels of two of its floating traps, one of which was located at Point Napean and the other at Point Wilson, on the south and west shores, respectively, of Admiralty Island. Trial was had July 20, when a plea of guilty was entered. A fine of $400 and costs of $8.60 were paid. A similar complaint was made against Lenard Ekholm, watchman at the Point Wilson trap, but it was dismissed on condition that he should not again violate the law by leaving the tunnel open during the remainder of the close seasons of the year.

On August 31 the Southern Alaska Canning Co. was further accused in a complaint filed before the United States commissioner at Juneau of having failed to provide during the weekly close season beginning July 24 an opening for the free passage of salmon and other fish through the heart of its trap located 1 mile north of Point Gardiner, Admiralty Island. The peculiarity of this case was that the company technically complied with the law by opening the heart walls, but it had, in fact, obstructed the passage of fish through the opening thus made by extending a jigger from the heart to the pot, thus, in effect, circumventing the law. Prosecution was vigorously contested, but a conviction resulted, whereupon the company was fined $350.

On July 7 the Sanborn-Cutting Co. was accused in a complaint filed before the United States commissioner at Juneau of having violated the law in two instances, Sunday, July 4, in not closing the tunnels of two of its floating traps, located, respectively, in Herring Bay, Admiralty Island, and Frederick Sound north of Carroll Island. The case was called for trial July 17, at which time the company pleaded guilty and paid a fine of $250 and costs of $8.70. D. Simmons, watchman at the Herring Bay trap, against whom a complaint was also made, pleaded guilty and was fined $100 and costs of $35.30. There was no watchman at the other trap.

On July 7 the Fidalgo Island Packing Co. was accused in a complaint filed at Juneau before the United States commissioner of not closing on Sunday, July 4, the tunnel of a trap on the southern shore of Admiralty Island. Upon being arraigned July 26 the company pleaded guilty and paid a fine of $150 and costs of $8.

On August 31 the Fidalgo Island Packing Co. was further accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two traps on the southern shore of Admiralty Island during the weekly close season July 24. The traps were located one-third and 1¼ miles, respectively, northeast of Murder Cove. The company pleaded guilty to both offenses on September 9 and paid a fine of $200 and costs of $3.85.

On July 17 a complaint was filed before the United States commissioner at Juneau accusing the Booth Fisheries Co. of not closing the tunnel of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near Point Augusta and the other seven-eighths of a mile southeasterly from Pulizzi Island. The case was tried August 6 and resulted in an acquittal of the company. A complaint was also filed against Carl Edensword and Karl Christensen, watchmen at the Point Augusta trap, similarly charging them, but they were likewise acquitted. There was no watchman at the other trap.

On July 17 the Deep Sea Salmon Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnels of two of its traps on Sunday, July 11. Both traps were located on the northern shore of Chichagof Island, one near Whitestone Harbor and the other near Spasskaia Bay. When the case came up for trial July 19 the company pleaded guilty and was fined $100 and costs of $4.20. Complaint was also made against Theodore Thorsen, watchman at one trap. Upon being arraigned, he pleaded guilty and was fined $100 and costs of $5. No watchman was found at the other trap.

On August 31 the Wilson Fisheries Co. was accused in a complaint filed before the United States commissioner at Juneau of two violations of the law in that two of its traps were not closed on Sunday, July 25. The traps were located at or near Wilson Cove, Admiralty Island. The case was called on September 14 but was dismissed on motion of the United States attorney, as the Government had but one witness.

A complaint filed before the United States commissioner at Juneau on August 31 accused the Standard Salmon Packers (Inc.) of failing to close on Sunday, July 25, the tunnel of its trap in Tenakee Inlet, 4 miles west of South Passage Point. Upon being brought to trial September 3 the company pleaded guilty and paid a fine of $50 and costs of $3.85.

On August 27 the Auk Bay Salmon Canning Co. and Charles Smith, owner and watchman, respectively, were accused in a complaint filed before the United States commissioner at Juneau of not closing the tunnel of the company's trap at Outer Point, Douglas Island, during the weekly close season on August 7. The case was called for trial on August 28, when both defendants pleaded guilty. The company was fined $100 and costs of $2.85, and the watchman $25 and costs of $2.85.

On July 17 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of five violations of the law on Sunday, July 11, in that the tunnels of five of its traps on the western shore of Mansfield Peninsula were not closed. The trial was held on August 6 and resulted in a conviction on one count and disagreement on the other four. The company was fined $500, upon payment of which the four other counts were dismissed.

On August 31 P. E. Harris & Co. was accused in a complaint filed before the United States commissioner at Juneau of not closing on Sundays, August 1 and 8, the tunnel of one of its floating traps on the western shore of Mansfield Peninsula. The case was tried on September 3 and resulted in a conviction and fine of $350 and costs. An appeal was taken. A complaint was also made against D. A. Demick, trap watchman, but it was dismissed. Subsequently the same information was laid before the grand jury and an indictment returned. These cases were consolidated and tried before the district court on November 5 and 6, and a conviction again secured. Motion for a new trial being denied, the court imposed a fine of $350 and costs against the company and a fine of $50 and costs against Demick.

P. E. Harris & Co. and Jack Carlson, owner and watchman, respectively, of a trap located 3½ miles north of Hawk Inlet on the western shore of Mansfield Peninsula, were indicted separately by the grand jury at Juneau in September for not closing the tunnel of the trap on Sunday, August 1. The original action in respect to this violation was the filing of a complaint against the company and watchman before the commissioner at Juneau, but on motion of the United States attorney the complaints were dismissed and the matter presented to the grand jury, thus avoiding retrial in event of a conviction in the lower court and appeal to the district court. The company was tried on November 3 and 4 and acquitted. The bench warrant for Jack Carlson was returned unserved, he having left Alaska before the date of his indictment.

In September P. E. Harris & Co. was indicted for not closing on Sunday, August 8, the tunnel of its pile trap located 2¼ miles south of Hawk Inlet, Admiralty Island. This case was first taken before the United States commissioner at Juneau on a complaint filed August 31, but that action was dismissed on September 11.

At the same term of court another indictment was returned against P. E. Harris & Co., alleging that this same trap did not have its tunnel closed on Monday, August 9, during the close season on that day. The indictment contained a further count which alleged that the tunnel of a floating trap owned by this company and located one-half mile north of Hawk Inlet was not closed during the same close season. As in similar cases, complaints were first filed before the commissioner at Juneau alleging the commission of offenses as above indicated, but they were dismissed in order that the facts could be presented to the grand jury with the result as noted.

On August 31 two complaints were filed before the commissioner at Juneau accusing P. E. Harris & Co. of not closing on Sundays, August 15 and 22, the tunnel of a pile trap located 2¼ miles south of Hawk Inlet. These complaints were dismissed, and the information they contained was laid before the grand jury with the result that a true bill was returned. These three cases were tried on November 1, 3, and 4, and an acquittal secured in each one.

On August 16 Ben Fox and Bert Dennis, natives, were charged in a complaint filed before the United States commissioner at Haines with having on that day fished with a gill net in Chilkoot River. They pleaded guilty and were each fined $5.

On August 31 C. H. Gallagher was accused in a complaint filed before the United States commissioner at Juneau with not closing on Sundays, August 15 and 22, the tunnel of his trap located on the northern end of Chichagof Island between Hoonah Island and Flynn Cove. The case was called for trial September 7. Gallagher pleaded guilty and was fined $25 and costs amounting to $41.85.

On August 23 the Beegle Packing Co. was accused in a complaint filed before the United States commissioner at Ketchikan of fishing with a floating trap on the southern shore of Revillagigedo Island west of Coho Cove during the weekly close season of August 22. The company pleaded guilty when the case was called for trial and paid a fine of $100.

On August 27 the Alaska Sanitary Packing Co. was charged in a complaint filed before the United States commissioner at Wrangell with having failed to open during the close season on August 7 the heart walls of two traps located on Prince of Wales Island 4 miles north of Point Baker. The company claimed extenuating circumstances in defense, but pleaded guilty and paid a fine of $25 for each trap and total costs of $9.20.

Charles Norberg was accused in a complaint filed before the United States commissioner at Petersburg on August 30 of fishing with a purse seine within the prohibited distance of the mouth of Blind River, Mitkof Island, on August 3. He pleaded guilty and was fined $30 and costs.

By a complaint filed before the United States commissioner at Petersburg on August 30 Jack Hollingstad was also accused of fishing with a purse seine within the closed area at the mouth of Blind River on August 7. Upon arraignment he pleaded guilty and paid a fine of $40 and costs.

In September Chester Worthington, a native of Wrangell, was accused by the grand jury at Juneau of illegal fishing August 24 in a salmon stream of Port Houghton. The case was tried at Juneau, October 15, and resulted in a conviction. On October 19 Worthington was sentenced to serve one month in the Federal jail at Juneau.

The Pacific American Fisheries was indicted in September for not closing on August 14 the tunnel of one of its pile traps located on the southern shore of Pleasant Island. The case was called at Juneau on October 22, and the trial ended in a conviction of the company. Motion for a new trial being made and denied, the company, on November 13, was fined $300 and costs of $42. Notice of an appeal was entered, but upon the expiration of the period in which a bill of exception might be filed the company paid the fine, thus closing the case.

On August 7 Jack David and Patty Gonate, natives, were caught fishing with gill nets in Chilkoot Lake. They were so accused in a complaint filed that day before the United States commissioner at Haines. Both men pleaded guilty, and each paid a fine of $20 and costs of $16.

On November 23 complaint was filed in the United States commissioner's court at Ketchikan accusing the Fresh Fish Co. of fishing during the weekly close season on August 1 with a trap located on the eastern shore of Prince of Wales Island, 3½ miles north of Cape Chacon. The company pleaded guilty and paid a fine of $50 and costs of $5.50.

The Starr-Collinson Packing Co. was indicted at the November term of court in Ketchikan for not opening the heart walls of its trap No. 748, Prince of Wales Island, during the weekly close season on August 1. The case has not been tried.

On July 21 a complaint was filed before the United States commissioner at Latouche accusing the Copper River Packing Co. and Kentuck Graves and Edward Hammer, two of its fishermen, of setting a gill net in Eshamy Lagoon on July 15 a distance of 192 feet from a net of the Kenai Packing Co. Upon trial, pleas of guilty were entered and a fine of $25 and cost was imposed.

A second complaint was filed on July 21 in the same court, charging the Copper River Packing Co., Kentuck Graves, and Edward Hammer with setting another gill net a distance of 182 feet from the net of the Kenai Packing Co. Graves assumed responsibility and pleaded guilty when the case was called for trial. He was fined $25 and costs.

On July 1 a complaint was filed before the United States commissioner at Valdez, charging the Copper River Packing Co. with having set a trap within 500 yards of the mouth of a salmon stream on Chenega Island. The trial of the case began August 10 and continued until noon August 12. The defendant company was acquitted, the court holding that the mouth of the stream was above the lagoon, a distance of more than 500 yards, and, further, that the stream was not one in which salmon could spawn or would be chosen by salmon for spawning.

On July 21 a complaint was filed before the United States commissioner at Latouche, accusing the Copper River Packing Co., Kentuck Graves, and Edward Hammer of setting a net on July 15 within 500 yards of the mouth of a red salmon stream emptying into Eshamy Lagoon. When the case came up for trial, July 24, the defendants produced as witness a surveyor who disputed the measurements made by a witness for the Government. The case was finally dropped on condition that the company vacate the site, which it did.

On July 21 complaint was filed before the United States commissioner at Latouche charging that A. Gustofson and J. S. Groll had fished with two traps at the entrance of Eshamy Lagoon on Sunday, July 18. Gustofson assumed responsibility, pleaded guilty, and was fined $1 and costs for each offense.

On July 21 the King Salmon Fisheries Co. was accused in a complaint filed before the commissioner at Latouche of having set on July 14 two nets within 500 yards of the mouth of Miners River, a red salmon stream tributary to Unakwik Inlet, Prince William Sound. J. S. Groll, superintendent for the company, H. L. Neilson and W. St. Clair, fishermen, appeared as defendants in the case. Pleas of guilty were entered, and a fine of $25 and costs was imposed in each case.

During the weekly close season on Saturday, July 10, a trap at Knowles Head belonging to the Moore Packing Co. was found to be fishing. Complaint was entered before the United States commissioner at Cordova, and the case tried on August 6. The company was acquitted.

The Carlisle Packing Co. was accused in a complaint filed before the commissioner at Cordova of fishing with a trap at Porcupine Point during the weekly close season on Saturday, July 10. The case was tried August 6 at Cordova, but the jury failed to agree on a verdict. On motion of the assistant United States attorney the case was dismissed.

At the October term of the district court at Valdez the grand jury indicted the Kenai Packing Co. and the Copper River Packing Co. for the wanton waste of salmon. The Copper River Packing Co. was also indicted for not opening the heart walls of its trap in Prince of Wales Passage during the weekly close season on August 15. The cases will not be tried until 1921.

On July 27 the Bristol Bay Packing Co. was accused in a complaint made in the United States commissioner's court at Koggiung of fishing on July 5 with a gill net in Naknek River, contrary to the closing order of December 18, 1920. A plea of guilty was entered and a fine of $38.60, being the costs of the prosecution, was imposed.

On July 28 another complaint, charging that two boats belonging to the Bristol Bay Packing Co. and the Red Salmon Canning Co. were fishing in Naknek River on the night of July 12, was entered before the commissioner at Koggiung. The accused pleaded guilty and were fined the costs of the prosecution, amounting to $66.60.

On July 29 a complaint filed before the commissioner at Koggiung alleged that the Alaska Packers Association had fished with a drift gill net in Naknek River on July 5. When the case was called a plea of guilty was entered, and a fine of $10 and costs of $43.60 was imposed.

The Circuit Court of Appeals of the Ninth Circuit, sitting at San Francisco, affirmed the sentence and judgment imposed on the Canoe Pass Packing Co. and the Northwestern Fisheries Co., jointly indicted in October, 1918, and convicted in the district court at Valdez in October, 1919. These companies were indicted on four violations of the regulations affecting fishing in Copper River by having set four nets in Miles Lake, which is a part of the river, within the prohibited distance of other nets previously set. The trial court imposed a fine of $1,000 and costs against each company, or $250 for each count in the indictment.

TERRITORIAL TAX LAW UPHELD.

In October, 1919, an action was brought in the Supreme Court of the United States on writ of error from a judgment of the District Court for the District of Alaska, Division Number One, dismissing the suit of the Alaska Fish Salting & By-Products Co., plaintiff in error, against Walstein G. Smith, treasurer of Alaska, defendant in error, to recover money paid as taxes by the plaintiff to the defendant for the tax years 1917 and 1918 under chapter 74, Alaska Session Laws, 1917, enacted by the Alaska Territorial Legislature.

There were originally two suits. The first one was brought in 1918 to recover the 1917 tax of $2 per barrel on 4,112 barrels of fish oil, amounting to $8,224, and the tax of $2 per ton on 1,037 tons of fish meal, amounting to $2,074, making a total tax of $10,298, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 14, 1918. The second suit, for 1918 taxes, was filed on February 17, 1919, to recover the tax of $2 per barrel on 2,720 barrels of fish oil, amounting to $5,440, and the tax of $2 per ton on 645 tons of fish meal, amounting to $1,290, making a total tax of $6,730, for which judgment was asked, together with interest thereon at 8 per cent per annum from January 15, 1919.

Eight assignments of error were presented and based on the action of the trial court in sustaining demurrers, dismissing the complaints, denying plaintiff's motion for judgment, and rendering judgment against the plaintiff, and thus upholding the constitutionality and validity of the act of the Territorial Legislature and the taxes imposed thereby. The plaintiff company, through its attorney, filed a brief before the United States Supreme Court on December 2, 1920, setting forth at length the contention that the legislation imposing the tax, to avoid which this litigation was had, contravened and violated the Constitution of the United States, particularly the fifth and fourteenth amendments, in that the plaintiff was denied the equal protection of the law and was deprived of its liberty and property without the process of law; that the legislative classification of plaintiff's business was so arbitrary and unreasonable as to constitute class legislation, and that the tax was confiscatory and prohibitive, and that it was not laid on other businesses or industries which were essentially the same as plaintiff's business; that the legislation was a clear abuse of the Territory's legislative authority, and that it accomplished, by means of an intentionally arbitrary and confiscatory exaction imposed under the guise of a tax, the unauthorized destruction and confiscation of a lawful pursuit; that the legislation was a clear, arbitrary discrimination against the manufacture of fish oil and fish meal from herring in whole or in part, although there was no reasonable distinction between that business and other businesses in all essentials similar thereto carried on in Alaska upon which no tax whatsoever was laid; that the legislation, if deemed to be a police regulation, was unreasonable and unauthorized, as Congress had expressly reserved police supervision and control of the fisheries to itself; that the legislation was extortionate, unfair, and prohibitive, and so confiscatory as to result in a tax of 113.64 per cent of the net profits for one year; and that the legislation and the taxes imposed thereby violated the Alaska Organic Act in that they were not uniform on all occupations or businesses, nor were they uniform on all businesses of the same class; that the tax exceeded 1 per cent of the actual value of plaintiff's property, and that it was not levied or assessed on the actual value of the property, but was purely an arbitrary imposition in utter violation of the constitutional limitations of the Alaska Organic Act.

On January 31, 1921, the Supreme Court handed down a decision affirming the judgment of the trial court. In view of its interest to the fishery industry of Alaska the opinion is here quoted in full, as follows:

This is an action to recover the amount of taxes levied under statutes of Alaska which the plaintiff alleges to be contrary to the act of Congress of August 24, 1912, c. 387, § 3, 37 Stat. 512, creating a legislative assembly in the Territory of Alaska, and to the Constitution of the United States. Judgment was given for the defendant upon demurrer to the complaint, the parties agreeing that the foregoing grounds of recovery were the only matters in dispute. The statutes attacked, viz: May 1, 1913, April 29, 1915, and May 3, 1917, levy license taxes of two dollars a barrel and two dollars a ton respectively, upon persons manufacturing fish oil, fertilizer and fish meal in whole or in part from herring. The Act of Congress after giving effect to the Constitution and laws of the United States in the Territory provides that the authority therein granted to the legislature "to alter, amend, modify, and repeal laws in force in Alaska shall not extend to the * * * fish * * * laws * * * of the United States applicable to Alaska, or to the laws of the United States providing for taxes on business and trade * * * *Provided further*, that this provision shall not operate to prevent the legislature from imposing other and additional taxes or licenses." Some reliance is placed also upon § 9 that all taxes shall be uniform upon the same class of subjects, &c., and that no tax shall be levied for territorial purposes in excess of one per centum upon the assessed valuation of property therein in any one year.

The complainant alleges that the tax will prohibit and confiscate the plaintiff's business, which is that of manufacturing fish oil, fertilizer, fish meal and by-products from herring either in whole or in part; that the tax unreasonably discriminates against the plaintiff, as it levies no tax upon the producers of fish oil, &c., from other fish, and is otherwise extortionate; and that it contravenes the Act of Congress in lack of uniformity and in exceeding one per centum of the actual value of the plaintiff's property. The prophecies of destruction and the allegations of discrimination as compared with similar manufactures from salmon are denied by the Attorney General for Alaska, the latter denial being based upon a comparison of the statutes which of course is open. We are content however to assume for the purposes of decision that, not to speak of other licenses, the questioned Acts do bear more heavily upon the use of herring for oil and fertilizer than they do upon the use of other fish. But there is nothing in the Constitution to hinder that. If Alaska deems it for its welfare to discourage the destruction of herring for manure and to preserve them for food for man or for salmon, and to that end imposes a greater tax upon that part of the plaintiff's industry than upon similar use of other fish or of the offal of salmon, it hardly can be said to be contravening a Constitution that has known protective tariffs for a hundred years. *Rast* v. *Van Deman & Lewis Co.*, 240 U. S. 342, 357. Even if the tax should destroy a business it would not be made invalid or require compensation upon that ground alone. Those who enter upon a business take that risk. *McCray* v. *United States*, 195 U. S. 27. See *Quong Wing* v. *Kirkendall*, 223 U. S. 59; *Mugler* v. *Kansas*, 123 U. S. 623; *Louisville & Nashville R. R. Co.* v. *Mottley*, 219 U. S. 467, 482. We need not consider whether abuses of the power might go to such a point as to transcend it, for we have not such a case before us. The Acts must be judged by their contents not by the allegations as to their purpose in the complaint. We know of no objection to exacting a discouraging rate as the alternative to giving up a business, when the legislature has the full power of taxation. The case is different from those where the power to tax is limited to inspection fees and the like, as in *Postal Telegraph & Cable Co.* v. *Taylor*, 192 U. S. 64, 72.

But it is said that however it may be with regard to the Constitution taken by itself, the statutes brought into question are contrary to the Act of Congress from which the local legislature derives its power. In the first place they are said to be an attempt to modify or repeal the fish laws of the United States. The Act of Congress of June 6, 1900, c. 786, § 29; 31 Stat. 321, 331; Alaska Compiled Laws, § 2569; imposes a tax on fish oil works of ten cents per barrel and on fertilizer works of twenty cents per ton, repeated in slightly different words by the Act of June 26, 1906, c. 3547; 34 Stat. 478; Alaska Compiled Laws, § 259. But these are not fish laws as we understand the phrase. It is argued, however, that at least they import a license, *License Tax Cases*, 5 Wall. 462, 470, and that a tax alleged to be prohibitory flies in their teeth. It would be going far to say that a tax on fish oil works in general terms imported a license to a specific kind of works deemed undesirable by the local powers, and when we take into account the express and unlimited authority to impose additional taxes and licenses we are satisfied that the objection should not prevail. We confine our decision to the statutes before us, repeating in this connection that they must be judged by their contents not by the characterization of them in the complaint.

The requirement of uniformity in § 9 is disposed of by what we have said of the classification when considered with reference to the Constitution. The legislature was warranted in treating the making of oil and fertilizer from herring as a different class of subjects from the making of the same from salmon offal. The provisions against taxing in excess of one per centum of the assessed valuation of property does not apply to a license tax like this. This is not a property tax, *Alaska Pacific Fisheries* v. *Territory of Alaska*, 236 Fed. Rep. 52, 61. The objection that the plaintiff in error is doubly taxed, first by the United States and then by the Territory, is answered by the express authority to levy additional taxes to which we have referred heretofore. Without going into more detail we are of opinion that the tax must be sustained.

ROBBERY OF FISH TRAPS.

The fishing season of 1920 was marked by a renewal in southeast Alaska of the piratical operations of 1919, which caused the packers considerable loss of salmon. The regions chiefly affected were the Cape Fox district, Craig and vicinity, Icy Strait, and the northern part of Chatham Strait. The first robberies were reported in June, and from that time until the middle of August depredations occurred at short intervals. Calls for assistance in putting down the disorder were made to officials of the district court and to the governor of Alaska, who was instrumental in securing the presence in Alaskan waters of certain vessels of the Navy, supposedly for the better enforcement of all laws and especially the suppression of this particular form of lawlessness.

Subchaser *No. 294* was almost constantly engaged in patrolling the southern districts while subchaser *No. 310* made infrequent cruises into the northern localities. But with all these activities the unlawful taking of salmon was not stopped thereby. In September information was presented by one packing company to the grand jury at Juneau which indicted four men who had operated in the Icy and Chatham Straits region, but when the case came on for trial it was dismissed against three of them for lack of sufficient evidence while the other one was tried and acquitted.

Investigation has shown that much of this so-called piracy was the purchase of salmon from dishonest trap watchmen. Negotiations were unsuccessful when they were undertaken with faithful, upright watchmen. In some instances salmon were taken from unwatched traps, but the number so secured must have been small, as all traps making even fair catches of salmon were watched by one or more men.

Of further interest in this connection is the fact that salmon were taken chiefly from floating traps, owing to the ease with which fish could be removed from such apparatus, there being no material change of conditions at any stage of the tide. With but occasional exceptions, it is improbable that more than a few hundred salmon were taken or purchased at any one time, for the boats engaged in the business were small and manned by very few men. Most reports of large losses of salmon from this cause must be regarded as exaggerated, for in view of the scarcity of salmon many traps making even moderate catches were carefully guarded by reliable employees, who in some instances are said to have easily frightened away would-be thieves by the discharge of firearms.

In the last analysis, the suppression of this business appears to be almost wholly in the hands of the cannerymen and the operators of traps themselves. It seems reasonable to conclude that refusal to purchase salmon from suspicious sources and the employment of honest watchmen will make it unprofitable and cause the entire cessation of the reprehensible practice.

TERRITORIAL FISH COMMISSION.

The Alaska Territorial Fish Commission was created by the legislature at its session early in 1919, and at the same time the sum of $80,000 was appropriated for its work during the ensuing biennium. The efforts of the commission have been devoted chiefly to fish-cultural work, the removal of natural barriers in salmon streams, and the destruction of predatory trout. The commission has issued two printed reports covering its activities during each of the two years ending March 31. According to the report for the biennium ending March 31, 1921, there was expended in the first year $27,901.24, and in the second year $40,143.66, thus leaving an unexpended balance of $11,955.10. Of the $27,901.24 expended in the first year, $12,072.08 was spent for fish-cultural work, $6,373.98 for stream improvement, and the balance for general expenses, permanent improvements, etc. Of the $40,143.66 spent in the second half of the biennium, $16,573.71 was chargeable to propagation and $19,695.90 to stream improvement and the destruction of predatory fish, the balance going for general expenses.

According to the reports of the commission, stream improvement work in 1919 was accomplished as follows: Juneau district, seven streams; Ketchikan district, eight; Cordova district, three; and Seward district, three. In 1920 this work was upon a more extensive scale, being reported as follows: Juneau district, seven streams; Ketchikan district, various streams south of Wrangell Narrows, number not stated; Cordova district, five; and Seward district, eight. It is reported also that in the Juneau district 10,000 predatory fish were destroyed, and in the Cordova district 13,648 were destroyed. Mention is made also of the destruction of a considerable number of predatory fish in the Bristol Bay district. Figures in respect to this, however, are covered by the report by Dennis Winn, field superintendent of fish-cultural work for the Bureau, appearing on page 31. The Territory contributed $2,000 toward the fund for conducting this work in Bristol Bay.

Details as to the fish-cultural and hatchery work of the commission will be found in the section of this report devoted to hatcheries.

TERRITORIAL LICENSE TAX.

Under the laws of Alaska a tax is levied on certain fishery products and apparatus, and it is payable annually to the treasurer of Alaska. On May 11, 1921, the treasurer furnished a statement showing the collections as made to that date for the fiscal year ending December 31, 1920. As compared with collections for 1919, the revenues of the Territory fell off $51,901.14, which amount is almost covered, however, by delinquent taxes for 1920.

FISHERY LICENSE TAXES COLLECTED BY TERRITORY FOR FISCAL YEAR ENDED DEC. 31, 1920.

Schedule.	Division No. 1.	Division No. 2.	Division No. 3.	Total.
Salmon canneries	$52,460.26	$1,260.94	$88,474.61	$142,195.81
Herring canneries	71.95		.10	72.05
Clam canneries	3.58		58.48	62.06
Salteries and mild-cure plants	923.73	123.25	4,625.14	5,672.12
Fish traps	55,800.00		23,500.00	79,300.00
Fish-oil works and fertilizer and fish-meal plants	18,199.73		1,168.00	19,287.73
Cold-storage plants	1,500.00		510.00	2,010.00
Whale-oil plants			100.00	100.00
Total	128,879.25	1,384.19	118,436.33	248,699.77
Additional tax [1]				700.66
Delinquent whale products tax				21,696.00
Estimated delinquent canned salmon tax				30,000.00
Grand total				301,096.43

[1] Additional tax of 1 per cent of their annual net incomes collected from salmon canneries (not possible to segregate by divisions).

DESTRUCTION OF PREDATORY FISHES IN BRISTOL BAY REGION.

During the season of 1920 the Bureau cooperated with salmon packers in the Bristol Bay region by organizing a force for the destruction of predatory fishes in certain waters of the district. Part of the expenses of the expedition were paid from a fund made up by the fishery companies and the governor of Alaska. Field Superintendent Dennis Winn, of the Bureau's fish-cultural service, was in charge of the work. Mr. Winn's report is as follows:

In Seattle equipment was purchased and the services secured of J. W. Gardner, a practical fish-culturist, of the Bureau of Fisheries; A. T. Looff, of the College of Fisheries, University of Washington, who has had considerable experience in commercial fishing; and Harry Savage, a practical fisherman. All proved excellent men for the work to which they were assigned. Men and equipment were transported from Seattle on the *Libby Maine*, which vessel arrived at Bristol Bay on May 25, and we were put ashore at Libbyville the same evening.

Our equipment was taken ashore at the cannery of the Naknek Packing Co. the evening of June 4, and the following morning we moved the entire equipment with supplies to the cannery of the Alaska-Portland Packers' Association farther up the Naknek River, where it was divided into three lots, one for each location to be operated. Camps were established on the Upper Naknek River, Lake Aleknagik, and Iliamna Lake. Mr. Looff was in charge of the crew at Naknek, Mr. Savage at Aleknagik, and Mr. Gardner at Iliamna. Each camp was moved several times in order to facilitate the work, as local conditions and possibilities were recognized.

NAKNEK SECTION.

Mr. Looff, taking with him his portion of the equipment, one white man and two Indians, was immediately transferred upriver, where camp was established that evening about 2 miles below the foot of the rapids. His operations extended from the rapids to about 5 miles below the camp, near the mouth of Ralph River. But few trout were observed below that point. A spoon troll was used en route to the camp site, and several steelheads and one lake trout were caught, all above Ralph River.

In making a survey of the vicinity we found we were late for the migrating salmon, arriving at the latter end of the period, which extended only through the month of May and early June. Good numbers of lake trout, however, were taken in the vicinity of our camp, these weighing from 6 to 12 pounds, and all had fish in their stomachs—young salmon, smelts, and whitefish. It is safe to say that this species is as detrimental to the salmon industry as is the Dolly Varden, if not more so. One specimen was taken with two whitefish over 12 inches in length in its stomach without distending it. The trout follow the migrating salmon to tidewater and gradually work back into the lake when the young salmon have passed. We found this species distributed through the entire main river above Ralph River and up through the rapids into the lake, but not in extremely large numbers. Steelhead trout were more abundant in the river, as were also grayling and whitefish, the latter, especially, appearing in great numbers.

After the river was thoroughly cleared in the vicinity of our operations camp was moved to the lake outlet, where fair numbers were taken, but, owing to the difficulties of seining and to the salmon ascending, a survey was made of the entire lake with a view to finding more suitable operating points. Camp was finally located at the mouth of Kidawik Creek, on the south side of the lake near the entrance to the east arm, where good numbers of lake trout and some Dolly Vardens were taken. The lake entrance would be an excellent location when the young salmon are descending early in the season, but none were in evidence at that date, June 17.

Practically all the fish entering Naknek Lake either pass up Kidawik Creek or Simenoffsky River at the extreme head of the east arm. The lake shore, with the exception of a few miles along the south shore, offers no inducement for spawning fish owing to the amount of ashes accumulated from the eruption of 1912 distributed along the shore line. All other tributaries are thickly impregnated with ashes. While our arrival was late and help of little account, about 16,600 pounds were destroyed, mostly lake trout.

Kidawik Creek is an ideal salmon stream with fine spawning bottom its entire length of about 2 miles. It connects Naknek Lake with Toms Lake, which is 12 by 4 miles in extent, the greater portion being clear and suitable for spawning grounds. About midway between the two lakes there is a waterfall from 5 to 8 feet high, over which it would be impossible for fish to ascend during low-water stage. It is a stone shelf of volcanic formation extending clear across the river, and, having no powder, we felt that a cut could be made with steel bars, etc. We therefore secured several stone-cutting gads, a steel bar, top maul, hammer and pick, and, after diverting the flow of water near one side of the stream, a cut was made 10 feet in width, sloping back about 15 feet, through which the fish could easily pass.

The salmon made their appearance in the mouth of the creek July 8, the number increasing gradually. A good run entered July 15, which was the date the cut was complete. There were fair numbers that found and passed through the cut, but the majority worked continuously at the center of the fall, many being injured and floating downstream. As the water rose, some of the fish were noticed passing over the top of the dam, and with high water they had no trouble in passing over. The cut makes it possible for them to ascend at any time. Fishing at this point was conducted in conjunction with the work of making a passageway through the dam. The trout taken were chopped fine and used to bait certain suitable seining points, where the fish gathered in numbers, and a seine was slipped around them.

As this point was the only one where the fish could be observed, owing to the murky water, we endeavored to keep a check on the new arrivals from day to day in order to estimate the approximate escapement. From such observations it is estimated that about 150,000 fish entered the lake. This estimate must of necessity be rough, as the water was so badly discolored. There was no way by which we could intelligently estimate the number entering Simenoffsky River, as the water at that point was thick with ashes, but indications were of less fish than at Kidawik, and an average was accepted of from one-half to two-thirds. This would place the total escapement at the figure mentioned, which we consider as near an average as could be secured with our opportunities.

On two occasions the camp was visited by bears, when all the crew were absent, and the tent was slashed down the side. While bears were observed from time to time in the vicinity, none of the men was ever threatened.

WOOD RIVER SECTION.

On the evening of June 8, accompanied by Mr. Savage and another white man, I left on the Alaska-Portland Packers' Association boat *North King*, en route to Lake Aleknagik. We arrived at Dillingham the morning of the 9th, where supplies were purchased and the services engaged of two natives to assist Mr. Savage. However, we were forced to discharge these men after three days' service. One native was later secured who qualified and remained to the completion of the work at that point.

Men and equipment were transferred from Dillingham on the Alaska-Portland Packers' Association power boat *Ekuk* to Lake Aleknagik, where camp was established June 10 at the lake outlet. A survey was made of this lake to determine its possibilities for trout operations. It was learned that the only suitable places lay at the lake outlet and the mouth of the river between Aleknagik and Nerka lakes.

Set and drift gill nets, in connection with seine and troll lines, were used and the early work centered at the lake outlet, where a considerable number of Dolly Vardens were taken, weighing from two to seven pounds each. The stomachs of these fish were all well filled with migrating salmon, Nos. 2½ and 3 in size, 25 or more young salmon being counted in a stomach. The habits of the trout were observed closely. It was noticed that they met the salmon schools at the inlet and outlet of the lake, where the bar drops off into deep water, a certain number of trout accompanying and feeding on the salmon.

In connection with the Dolly Vardens working on the young salmon in deep water, the terns are almost equally severe at the surface. The salmon migrate in enormous schools, making them easy prey for trout, and the work of the latter forces the young salmon to the surface, where the terns take their toll. Large flocks of from 500 to 1,000 were noticed actively feeding whenever a school passed certain points. After several days' operations at the lake outlet the catch of trout became almost negligible, and it was noticed that while the terns were present in large numbers and would become excited and active on sighting a school of young salmon, their success in catching was materially lessened, the fish not coming close enough to the surface. No trout other than Dolly Vardens were taken in this section, and very few under 2 pounds were captured. All averaged 3 and 4 pounds, and specimens weighing 7 pounds were common.

Through the courtesy of Capt. Williams, of the Alaska Packers Association, we were supplied with a tally scow, and, with the assistance of Mr. Daly, of the Alaska-Portland Packers' Association, this scow was towed into the lake. We were comfortably housed and easily moved. When the trout became scarce at the lake outlet the camp was moved to the upper end of the lake, where the scow was placed in the mouth of the river connecting with Nerka Lake. At this point good results were secured, and it was here that the bulk of the trout was taken. It is estimated that from 35,000 to 40,000 pounds of trout were destroyed. Many were diseased, wormy, and emaciated, but always ready to feed.

The migrating season of salmon in this district extends over a period of about three months, and, figuring an average of 15 to 20 migrating salmon for each trout per day—which represents but one feed for the average trout taken—the number of trout destroyed would mean a saving of more yearling salmon than could be handled in any of our hatcheries during a season, not to mention the expense of feeding, etc., and this without taking into consideration the serious depredations of the terns.

Our point of vantage in the scow enabled us to keep a close tally on the adult salmon ascending to the spawning grounds, together with the proportion of loss from fungus growth, due to gill-net injuries. No large run of salmon was ever observed ascending, but a steady line was noticed from July 5 to July 20, gradually tapering off to small numbers at the date of our departure, July 28. Some were noted ascending prior to July 5, but in negligible numbers. As consistent a check as possible was kept on the ascending fish. The salmon came along the shore of the lake, entered the river, and passed into the strong river current in the rear of our scow, where the current and scow created smooth water. Dolly Varden trout as large as the salmon were noticed passing upstream with the latter in a ratio of about 2 to 4 per cent. As no small trout were taken throughout the season it is believed that all spawn in the upper lakes. Those taken by us were principally sea-run fish. It was impossible to use gill nets without injury to the salmon, and the trout operating in deep water made it necessary to devise some other means of capture. Mr. Savage devised a mold in the shape of a fish, and this was poured full of lead over the stem of a large, long-shank fishhook, which was used as a troll and fished among the migrating salmon. With this crude device two men succeeded in taking 1½ tons of trout in one day. As fishing continued the numbers taken gradually decreased several hundred pounds each day to the time of our departure, when the best capture possible was from 300 to 1,000 pounds per day.

A check was made from time to time, in 5-minute periods, on the numbers of salmon ascending during the height of the run, and it was estimated that about 400,000 fish passed upstream during the period of 20 days. This constituted the run, figuring a steady escapement during the whole 24-hour day. This figure, while not absolutely correct, we feel is as close an estimate as can be made under the circumstances.

The salmon afflicted with fungus were closely checked by myself and each employee individually, and we estimated that 5 per cent unable to swim the current in the river would die in the lower lake in a very short time. A wound caused by gill nets in salt water rapidly becomes covered with fungus after the fish enters fresh water. When the fish is badly cut the wound putrefies rapidly, and on arrival at the head of the first lake there will be a circle of fungus one-half inch or more in depth and several inches wide around the body of the fish. Another 5 per cent were noticed with numerous gill-net marks around the body, but in these the fungus was not in an advanced stage. However, while these fish have strength to ascend the river, I am positive that few, if any, ever reach the spawning stage.

KVICHAK AND ILIAMNA SECTION.

It was planned to operate early on the Kvichak River, but owing to the impossibility of securing help and an accident to one of our boats en route, which was repaired at the cannery of the Alaska-Portland Packers' Association, that plan was necessarily abandoned.

For various reasons it was impossible for Mr. Gardner, who had his equipment assembled at Naknek, to reach the Iliamna district before June 27, and at that date the water was extremely high in the streams with occasional floods overflowing the banks. Very little help was possible, but every effort was made with gill nets; seines could not be used owing to the high water. Good work was accomplished by Mr. Gardner under discouraging conditions.

The writer divided his time between the Wood River and Naknek fields until it was necessary for employees at those points to discontinue work, owing to the departure of cannery boats on which they had passage to the States; then he proceeded to Iliamna, arriving August 10. On the Iliamna River, where our first camp was established, but few large trout were taken, and those mostly at the mouth of the river in the lake. All taken here were Dolly Vardens, with the exception of a few steelhead trout and whitefish. The high water had the effect of scattering the schools and but small numbers were noticed gathering in the pools. The trout, unlike those captured in other localities, were long and slender, which made it impossible to gill many in our nets, and, moreover, the ascent of the salmon necessitated the removal of the nets from the water so as to prevent injuring the ascending salmon.

As the water receded the trout were noticed schooling in the eddies. Traps were improvised, about 5 feet long and 2 feet in diameter, from wooden hoops covered with chicken wire, with an opening in one end similar to the opening in lobster pots. These traps were baited and set in the pools where they caught many thousand fish. In the first one set we took 150 fish in two hours. Many worked through the wire mesh, necessitating doubling the wire screen, thus making the mesh smaller, and no further trouble was experienced. These bait traps have the advantage of catching the predatory fish without in any way attracting or interfering with the salmon. They can also be fished in any water and are efficient up to the time of active spawning.

The people in the vicinity were impressed with these traps and wished to use this method in their own fishing. Therefore, on our departure, we distributed the traps on hand and supplied the other residents with material to make one or two each.

After the pools in the vicinity were cleared of trout, which work was accomplished in short order without interfering with the salmon, it became necessary to seek new locations for operations, and the near-by creeks and rivers were examined with this end in view, and also to obtain all salmon data possible.

In accordance with previous plans, we arranged to proceed to Lake Clark, arriving at the portage between Iliamna Lake and Newhalen River on August

21, where we were storm bound for several days. Supplies and equipment were packed over the portage mainly by myself and assistants, as the Indian packers who perform this kind of work are absolutely undependable, especially as they had considerable money from the summer's work at the canneries, and most of their time was occupied in celebrating. We proceeded upriver en route to Lake Clark on August 28. We learned from natives and prospectors that no Dolly Varden trout are ever taken in Lake Clark, and that there is but one stream in that locality which is inhabited by this species, namely, Kegik Creek.

A thorough survey was made of the entire lake and tributaries, our party passing up the east shore and returning on the opposite side. No trout in quantities were observed, and the possibilities of stream spawning were found to be very limited. It was noticed that the salmon spawn earliest near the outlet of the lake and later as they proceed up the lake. The prospectors and natives were fishing the mouths of the creeks and also directly on the spawning grounds preparing dog feed. Streams were visited in the following order:

Tazimina River is an ideal salmon stream with suitable sloughs for spawning red salmon, but not more than 50 were noticed. A high waterfall about 5 miles from the mouth blocks the ascent of fish.

Tarnalia River is a good stream but contained no salmon. We were advised by prospectors living at its mouth that few salmon ever enter, even in good years. There are falls about 4 miles up and no fish above.

Current Creek is a good spawning stream for the first mile, but unsuitable farther up. It contained no fish.

A small creek at the head of Little Lake Clark could accommodate fair numbers, which are in evidence in good years, but none have appeared for the last two seasons.

Big River, at the junction of Big and Little Lake Clark, is the largest stream tributary to the lake. It is glacial fed and few salmon ever enter.

Portage Creek is small, with no possibilities.

Kegik Creek is a fair-sized stream with good possibilities. It has a lake at its head and is recognized as the best salmon stream in that locality, the fish ascending into the lake. A trip was made to the lake and but few salmon noticed, none being found in the small tributaries at its head which are thoroughly suitable for spawning. I was advised by prospectors in the vicinity that some spawning red salmon were noticed in the lake in December and spawned-out fish still active in January of some years, which would indicate an extremely late run.

Chulitna River has no salmon possibilities. It is a shallow river and heads in a marsh containing large numbers of pike.

Practically all the salmon spawn along the shore of the lake and nearly the entire shore is suitable. Many miles of ideal spawning grounds were noticed along the lake shore. The Indian fish villages, now deserted, scattered along gave positive evidence as to the best spawning locations in former years. Lake trout, especially during the spring months, are numerous and easily taken; specimens reported weighing 40 pounds or more were common. Very little use is ever made of them by the natives, and only in emergency cases are they ever considered. As our time was limited and lake trout were not abundant, we continued back to Iliamna and finished the season with a survey of that lake, with the exception of the west shore, which was too dangerous at that time of year to undertake in a small boat.

The Newhalen River, which connects Iliamna Lake and Lake Clark, has a series of falls and rapids about 2 miles from its mouth, but these are not of sufficient size to hinder the ascent of the fish. The formation, however, renders it easy for the Indians to catch their supply with large hooks on the end of long poles, as the fish must of necessity pass through certain small channels between the rocks. The rapids are about 500 yards long, passing through narrow channels at the upper end and widening to about 300 feet in rapids below, which end in a further widening of the river to about one-half mile. This portion of the river is shallow for about one-quarter of a mile, with ideal spawning bottom, on which some fish were spawning. The major portion of the fish taken by the natives in this locality were captured either in the rapids or on these spawning grounds.

The channel between the river and Iliamna Lake is about 200 yards wide and broadens immediately on entering the river to about one-half mile. This channel would be an ideal place for the capture of trout with any kind of gear through the spring months.

A good run of salmon was found in Kokhonak Creek, with the usual native family catching them on the spawning beds and drying them as food for the family and dogs. Here we captured a number of steelhead trout in nets, and great numbers were noticed on the beds with salmon, feeding on their eggs. No Dolly Vardens were taken or seen. A trip was made to the lake at the head of the stream, a distance of 6 miles, and it was observed that the stream was well seeded the entire way. The stomachs of the fish taken at this point were filled with decomposed salmon and spawn, and on account of the unlimited supply our bait traps did not appeal.

All streams in Kokhonak Bay were visited, but no fish were noticed in any streams other than Kokhonak Creek and Kokhonak River. A fall 20 feet high in the mouth of Kokhonak River prevents the ascent of fish. From 400 to 500 red salmon were observed endeavoring to pass over this obstruction, but they could not proceed over halfway. It was believed that after being unsuccessful in negotiating the falls they would drop back and spawn. After careful search they were located spawning about 100 feet from the falls, close to a straight rock bluff, in 9 feet of water, and between large bowlders where there were suitable gravel spots. Some lingcod and steelhead trout were observed working in the beds for eggs, and each specimen taken had salmon eggs in its stomach. An efficient fishway can be installed at small expense, providing it is undertaken in the spring, when the water is low. Its installation would open miles of perfect spawning area in the river, and would also permit the fish to pass up as far as Kokhonak Lake. This river is one of the best streams for salmon tributary to Iliamna Lake.

On the Iliamna River trips of observation were made about 12 miles upstream, the first on August 14, when not over 1,000 salmon were seen on the beds; on the second trip, September 17, no salmon were noticed in localities visited in August, but about 500 were found spawning 4 miles from camp. These represented the entire run in Iliamna River for the season. There was always a sprinkling of Dolly Vardens with the salmon, some of them spawning, but they were so scattered as to render capture in any numbers impossible.

Pile River was not visited, but the natives reported no fish there.

A fair run of fish entered Chekok River, from which the majority of the natives in the Iliamna River district obtained most of their fish supply.

The last few days in the field were spent at Iliamna, where we set bait traps and caught several hundred Dolly Vardens, thereby again clearing the pools.

SUMMARY.

Our work was severely handicapped owing to late arrival, the impossibility of securing suitable help, and the necessity of familiarizing ourselves with conditions, each locality having a distinct problem to solve in the capture of trout. We were compelled to pay top wages for native help, and most of the natives were worthless, necessitating their discharge at the earliest moment possible without embarrassment to the work. At no time was suitable help available, except at Iliamna late in the season after the canneries had closed. Our equipment, too, was inadequate; while we expected that gill nets of 3-inch and 3½-inch mesh would be suitable, we found the trout usually too large to gill.

Our experience this year will enable us to wage an extensive and aggressive campaign another season. At Naknek the work can be best accomplished in the early spring months, or up to the time salmon enter the stream. After this, if desirable, some of the operators could be used as stream watchmen through the cannery season. In the Aleknagik Lake section excellent results could be obtained throughout the entire season, or until the canneries close, necessitating departure. Good work can be accomplished in the Iliamna district up to the period of spawning, or the middle of August.

The salmon run was spasmodic in all but the Wood River section, but at no time were there indications of an abundance of salmon in any portion of the districts operated. While the escapement into Wood and Naknek Rivers was greater than that of the previous year, a greatly insufficient number reached the spawning grounds to insure a normal pack and allow sufficient escapement for the future. Our judgment would indicate a totally inadequate supply for even a small year, to say nothing of normal.

In the Kvichak and Iliamna sections the spawning beds were nearly destitute of spawning salmon. I am positive that the storms, which interfered somewhat with the commercial catch, were the salvation of the situation, for if but a slightly increased pack had been made the escapement would have been practically nil and the beds would have been left nearly or wholly bare, with an absolutely discouraging outlook for the future.

We are thoroughly convinced that the predatory fishes, together with the terns mentioned heretofore, constitute one of the most serious menaces facing the salmon industry. In small years, such as 1919 and 1920, they will practically eliminate the cycle runs by their depredations, first on the eggs on the spawning beds, next on the young fish in the first year or two spent in the lakes, and last, but not least, on the migrating fish descending to the ocean. The only hope of curtailing this loss is by waging a constant, aggressive and extensive campaign against these marauders. In the performance of this work a close tally can be kept on the escapement and spawning grounds, which is the only method by which the industry can be advised with any degree of assurance and safety. Our work of extermination this year will surely be of invaluable aid to the future, and its continuance with an enlarged scope will show its value within the next cycle. We also feel at this time that it is one of the greatest hopes for the industrial future of the salmon industry.

RECOMMENDATIONS.

I would respectfully recommend that this work be continued on as extensive a scale as possible for the elimination of predatory fishes and birds.

I recommend the purchase of three power boats of Columbia River type, one for each section operated, with living quarters aboard for three or four people. They would facilitate the work of transferring crews to different localities, and it would not then be necessary to embarrass the different cannery superintendents with requests for the use of a launch when same is needed for cannery work. It would also insure comfortable living and sleeping quarters for the crew and thus eliminate the discomforts of tents and sleeping on the ground, which is nearly impossible in that section during heavy rains. With such a boat many localities could be profitably operated with seines, set and gill nets, and bait traps, necessitating but a small crew at any point of operation. Such a boat would also be of special value to stream watchmen. As efficient work at the different points would cease at about the time the commercial season began, I would suggest that the boats be utilized by some of our men who would be employed as stream watchmen.

Good work can be effectively continued with jigger trolls and bait traps during the period the salmon are running. A small crew can profitably operate as much of this gear as can be efficiently utilized, thus releasing a portion of the crew with the power boats for stream police duty without detriment to the predatory fish work.

Three new 20-foot fishing skiffs are needed, together with several gill nets of large mesh, and material for making a number of bait traps, and three larger and deeper seines, one for each locality. These added to our present equipment will meet any emergency pertaining to our work as outlined.

I would further recommend that employees be engaged in the States and that they reach the different localities in Bristol Bay as early as possible in the spring months. They should be on the first boats reaching the region. Employees should go to the Upper Iliamna by the regular steamship line to Cook Inlet, thence to Iliamna Bay and Iliamna village, arriving about May 1. At that time the water is low and the trout schooling in large numbers. Seines can then be used to advantage, also the bait traps and gill nets. The necessity of reaching Iliamna by Cook Inlet is due to the fact that passage can not be made from Bristol Bay through the lower end of Iliamna Lake before late in the season owing to the ice in that locality.

A fishway should be installed in Kokhonak River.

These recommendations are made to meet conditions as they exist in the sections operated this season, but they can be enlarged in accordance with any plan formulated to broaden the scope of the work.

AFOGNAK RESERVATION.

Historical data have been published year after year showing the establishment of the Afognak Fishery Reservation by presidential proclamation in 1892 and the object that was hoped to be attained by its creation. From the date of the establishment of the reserve until the spring of 1912 all commercial fishing in Afognak waters was prohibited, but the order was not obeyed and no attempt was made to enforce it. Though those waters were nominally closed to all commercial fishing and the two canneries on Litnik Bay suspended operations and were dismantled and sold, pickling operations were carried on by local parties at the most important streams of the island until 1912, when by departmental order the reservation was opened to the native inhabitants of the region under such terms and conditions as seemed necessary to safeguard the runs of salmon. Although the fishery resources of Afognak were well known, the mere fact that fishing was authorized coincident with the opening of a salmon cannery at Kodiak was sufficient inducement for the entire native population of the island to seek and secure fishing privileges. The legalization of fishing did not, however, increase the supply of salmon in those waters, though on the face of returns that might appear to have been the case. The catch in 1912 was larger than any year since 1892, but it was so for no other reason than that more fishing was done. Yet, on the whole, results were disappointing, and it was early apparent that the island fisheries alone could not support the natives of Afognak. It was further evident, after a few seasons had passed, that the salmon runs would suffer serious depletion if the original scale of operations was allowed to continue. Accordingly a limit was placed on the number of fishermen, who were divided into small gangs, to each of which certain fishing grounds were assigned. Experience taught that where unnecessary numbers of fishermen congregate at one place fishing is much more intensive. This evil was easily corrected by limiting the number of men who might operate at each place and by shortening the fishing season. Authority was therefore given that not to exceed 55 natives were to be licensed to fish in Afognak waters in 1920.

The issuance of licenses was placed in the hands of the superintendent of the fish-cultural station at Afognak until July 10, when William E. Baumann was put in charge of patrol work about the island. He took over the licensing of fishermen for the remainder of the season.

Fishing began May 11 and continued until September 9. Salmon were taken at seven localities, the total catch being 125,538, all species except kings being taken. This catch was sold to the Kadiak Fisheries Co., at Kodiak.

The following table shows the total take of salmon for commercial uses in the Afognak Reservation:

Commercial Catch of Salmon in Waters of Afognak Reservation in 1920.

Locality.	Coho.	Chum.	Humpback.	Red.	Total.
Little Afognak	5,128		34,374	8,556	48,058
Danger Bay	840				840
Litnik Bay	6,194			7	6,201
Paramanoff Bay		35	15,385	18,009	33,429
Seal Bay			190	11,733	11,923
Malina Bay			10,995	10,728	21,723
Izhut Bay				3,364	3,364
Total.	12,162	35	60,944	52,397	125,538

As compared with the catch in 1919, cohos increased approximately 16.7 per cent, humpbacks increased 164.2 per cent, and reds declined 50.9 per cent. Chum salmon were taken in negligible quantities, while no kings were obtained.

ALEUTIAN ISLANDS RESERVATION.

The report in regard to permits for fishery operations in the Aleutian Islands Reservation in 1919 stated that at the end of the calendar year 1919 there were 20 permits remaining in effect. Permit No. 18, granted June 22, 1917, to Andrew C. Smith for salmon and cod operations at Unalaska Island, was canceled late in the year. During 1920 the following permits were canceled: No. 21, granted September 19, 1917, to Paul Buckley for whaling operations; No. 35, granted November 6, 1918, to Samuel Applegate for commercial fishery operations at Umnak Island; and No. 41, granted September 6, 1919, to Lars Mikkelsen for cod operations on Unalaska, Akun, and Tigalda Islands. These four permits were canceled upon request of the holders for reissuance in other names. Four additional permits were granted during 1920, which with the 16 remaining in effect made a total of 20 outstanding at the end of the calendar year 1920.

PERMITS FOR FISHERY OPERATIONS IN ALEUTIAN ISLANDS RESERVATION GRANTED DURING CALENDAR YEAR 1920.

No.	Date.	Grantee.	Location and scope of operations.
42	Apr. 9	American Whale Products Co.	Whaling plant. Udagak Bay, Unalaska Islands.
43	Sept. 16	American Fishing & Packing Co.	Biorki, Rootok, Avatanak, Ugamak, Unalga, and Unalaska Islands. Cod stations.
44	Oct. 11	A. C. Goss	Umnak Island. Commercial fishery operations; erection of salmon cannery prohibited.
45	Oct. 23	Bering Sea Fisheries Co.	Six locations on Unalaska Island, Akun Island, and Tigalda Island. Cod stations.

Two permits were granted jointly by the Departments of Agriculture and Commerce in connection with certain stock-raising and mining activities within the reservation. Four grazing permits previously granted remained effective.

JOINT PERMITS IN ALEUTIAN ISLANDS RESERVATION GRANTED IN CALENDAR YEAR 1920.

Date.	Grantee.	Purpose and location.
Jan. 14	L. A. Lavigne	To raise sheep and cattle on Unalga Island.
Oct. 29	Alaska Sulphur Co.	For construction of an aerial tramway for mining operations on Akun Island.

ANNETTE ISLAND FISHERY RESERVE.

By presidential proclamation of April 28, 1916, Annette Island and neighboring small islands were made a fishery reserve for the exclusive benefit of the Metlakatla Indians then living thereon, and for such other Indians of Alaska as might desire to establish their homes in the reservation. The Bureau of Education, Department of the Interior, administers the affairs of the reserve for the Indians residing therein.

In 1918 fishing privileges in the reserve were leased to the Annette Island Packing Co. under a five-year contract, which provided that the company should pay to the Metlakatlans a royalty of 1 cent per fish for all salmon taken by traps in the coastal waters of Annette Island and a fee of $100 for each trap operated, and that all labor in connection with the catching and canning of salmon, except that of a few skilled mechanics, should be performed by the Indians. The company was also to employ the Indians at all common labor required in the maintenance and upkeep of the cannery. The season of 1920 was the third year of operations by the company in accordance with the terms of the contract.

Seven traps were operated by the company, for which a fee of $700 was paid. The catch of salmon by traps was 967,600, for which the Indians received $9,676; contract labor in the cannery brought them a return of $36,298.88, while payments for 75,268 salmon taken by purse seines and for labor on buildings and docks, including material, such as lumber and piling, further increased the income of the Metlakatlans by $24,391.86. The total disbursement of money to the Indians by the Annette Island Packing Co. was $71,066.74, or $18,966.14 less than in 1919.

COPPER RIVER FISHERY.

The importance and peculiar geographical conditions of the Copper River fishery again warrant special mention. In 1920 this fishery produced 946,452 salmon of all species as compared with a catch of 1,307,401 in 1919 and of 869,350 in 1916, the year in which the progenitors of the 1920 run made their appearance.

In all, nine packing companies took salmon from the Copper River in 1920, eight of which carried on fishing in the delta district, while one operated exclusively in the lake and canyon sections. Those operating on the delta were the Canoe Pass Packing Co., Carlisle Packing Co., Eyak River Packing Co., Alaska Sea Food Co., Hoonah Packing Co., Pioneer Packing Co., Hillery-Scott Co., and Hayes-Graham Fish Co. The only operator in the up-river district was F. H. Madden, who packed at the cannery formerly listed under the name of the Abercrombie Packing Co. It is of interest also to record that the Hayes-Graham Fish Co. operated a floating cannery on the delta at the entrance to Pete Dahl Slough.

There were 46,000 fathoms of gill nets used in the delta fishery and 4,227 fathoms in Miles Lake, a total of 50,427 fathoms for the river as a whole. This is a decrease in nets at the delta of 18,800 fathoms, or approximately 28.8 per cent, and an increase at the lake of 977 fathoms of nets, or approximately 30 per cent. Practically no change in the number of dip nets was noted between 1919 and 1920.

The following table shows the catch of salmon by districts and species during the five years from 1916 to 1920, inclusive:

CATCH OF SALMON IN COPPER RIVER FROM 1916 TO 1920, INCLUSIVE.

District and species.	1916	1917	1918	1919	1920
Delta district:					
Cohos	79,396	55,564	36,247	24,872	55,484
Kings	5,440	5,134	4,292	8,972	15,086
Reds	300,157	455,001	745,522	1,096,090	700,342
Humpbacks	31,578				
Total	416,571	515,699	786,061	1,129,934	770,912
Lake and Canyon district:					
Cohos	36,034	36,839	25,509	15,778	18,440
Kings	8,765	8,050	14,806	4,092	6,315
Reds	407,980	309,324	484,607	157,597	150,755
Total	452,779	354,213	524,922	177,467	175,540
Grand total	869,350	869,912	1,310,983	1,307,401	946,452

On October 5, 1920, a preliminary hearing was held at Cordova, Alaska, to consider the advisability of amending the order of December 20, 1918, limiting or prohibiting fishing in the Copper River, and a further hearing on the same matter was held at Seattle, Wash., on November 18, 1920. As a result of these hearings the order of December 20, 1918, was continued in force until September 1, 1921, on and after which date all commercial fishing in the Copper River, its lakes and tributaries, and within 500 yards of the mouth of its outlets is prohibited. The closing order is given in full on page 11 of this report.

YUKON RIVER FISHERY.

The Carlisle Packing Co. carried on practically all the commercial fishing for salmon for export from the Yukon River in 1920. The cannery was located at Kwiguk Slough, and operations were restricted to the south mouth of the river below the junction of the Clear River, and to the waters of Bering Sea more than 500 yards off the mouth of the Yukon.

The total catch of salmon by this company was 214,122, of which 155,655 were chums and 58,467 were kings. Of these, 105,218 chums and 40,493 kings, or approximately 68 per cent, were taken in outside waters beyond the jurisdiction of the Department. The catch in the river was 50,437 chums and 17,974 kings. The pack consisted of 12,876 cases of chums, 15,961 cases of kings, and 145 tierces and 20 barrels of mild-cured and pickled king salmon. These operations gave employment to 176 whites, 53 natives, and 41 Japanese, or a total of 270 persons. The investment was $534,000; the value of all products was $349,356. Fishing apparatus consisted of 2 fish wheels and 12,000 fathoms of gill nets.

During the summer of 1920 the Yukon River was visited by Dr. Charles H. Gilbert, of Stanford University, and Henry O'Malley, field assistant of the Bureau, who made an examination of the river from Dawson, Yukon Territory, to the delta. They collected much information and data regarding the runs of salmon and the number of fish used by the residents of the Yukon Valley. They were accompanied by Inspector Calvin F. Townsend, who gave particular attention to the enforcement of the fishery laws and regulations in that region from the middle of June to the end of July. The Bureau's boats *Swan* and *Tern* were used in cruising the Yukon and some tributaries. The report by Dr. Gilbert and Mr. O'Malley is published in full elsewhere in this document.

In line with the recommendation in their report that all commercial fishing in the Yukon be suspended, a public hearing was held in Seattle, Wash., on November 23, 1920, to consider the advisability of such action. Satisfactory information was presented at that hearing in support of the opinion generally expressed that commercial fishing for export could not be continued without seriously depleting the runs of salmon and jeopardizing the lives of the native inhabitants of the region and their indispensable dogs. Accordingly the Secretary of Commerce issued an order on December 18, 1920, prohibiting the taking of salmon for other than local use from the Yukon River, its tributaries, and the waters within 500 yards of the mouth thereof after August 31, 1921.

HATCHERIES.

EXTENT OF OPERATIONS.

The two Federal salmon hatcheries in Alaska, one on McDonald Lake, in the southeast district, and the other on Afognak Lake, in the central district, were operated in 1920, except that at the station first named no eggs were collected during the year. In addition, two private hatcheries were operated in southeast Alaska, one a few miles from Loring, owned by the Alaska Packers Association, and the other at Quadra, owned by the Northwestern Fisheries Co. All of these hatcheries were engaged chiefly in the propagation of red salmon.

The Territorial Fish Commission of Alaska also operated a hatchery at Juneau, the collection of eggs being made at two field stations, one of which was on the mainland of Alaska, a few miles north of Juneau, while the other was at Auk Cove, on the north shore of Admiralty Island, about 25 miles southwest of Juneau.

Exclusive of the number collected by the Territorial commission, the total take of red-salmon eggs by the Federal and privately owned hatcheries hereinbefore mentioned was 99,990,000, or 19,070,000 less than the number collected in 1919. This smaller collection is accounted for by the total suspension of operations at the McDonald Lake station, where important repairs to the plant were being made, and also by the washout of retaining racks at the Afognak station during the spawning season.

OPERATIONS OF FEDERAL AND PRIVATE HATCHERIES IN ALASKA IN 1920.

Station.	Red or sockeye salmon eggs taken in 1919.	Red or sockeye salmon liberated in 1919-20.	Red or sockeye salmon eggs taken in 1920.
McDonald Lake	9,752,000	9,387,000	....
Afognak Lake	[1]79,178,000	61,524,000	62,300,000
Fortmann	18,420,000	17,070,000	18,240,000
Quadra	11,710,000	11,357,000	19,450,000
Total	119,060,000	99,338,000	99,990,000

[1] 7,000,000 eyed eggs transferred to the Federal hatchery at Quinault, Wash., and 3,000,000 to the State hatchery at Bonneville, Oreg.

HATCHERY REBATES.

Under the law of 1906 for the protection and regulation of the fisheries of Alaska, the owners of privately operated hatcheries in Alaska are exempt from the payment of all taxes and license fees on their catch and pack of salmon at the rate of 40 cents per 1,000 red or king salmon fry liberated, which is equivalent to the tax of 4 cents per case on 10 cases of canned salmon. This rebate is obtained by the operators filing with the clerk of the district court of the judicial division of Alaska in which the hatchery is located an affidavit showing the number of red and king salmon fry planted in the waters of Alaska in the year covered by the affidavit. The clerk of the court then issues certificates to the owners of the hatcheries for the number of fry liberated, and these in turn are accepted by the Government in payment of taxes and licenses as aforesaid.

Rebates due private hatchery operators are shown in the following table:

REBATES CREDITED TO PRIVATE SALMON HATCHERIES DURING FISCAL YEAR ENDED JUNE 30, 1920.

Owner.	Location.	Red-salmon fry liberated.	Rebate due.
Alaska Packers Association	Naha Stream	17,070,000	$6,828.00
Northwestern Fisheries Co	Hugh Smith Lake	11,357,000	4,542.80
Total		28,427,000	11,370.80

HATCHERY OPERATIONS.

M'DONALD LAKE.

In 1919 a collection of 9,752,000 red-salmon eggs was made at the McDonald Lake station, from which 9,387,000 fry were hatched and planted in contiguous waters. There was a loss of 365,000 eggs and fry, or approximately 3.8 per cent.

No eggs were collected at that station in 1920, owing to the fact that the water-supply pipe line had to be renewed, an entire complement of new hatching troughs provided, and a new foundation put under the hatchery building. As this work could be done satisfactorily only in the summer months, it was necessary to suspend fish-cultural work for the season.

AFOGNAK.

Out of the 79,178,000 red-salmon eggs taken at the Afognak station in 1919, a shipment of 7,000,000 eyed eggs was made to the Bureau's station at Quinault, Wash., and another of 3,000,000 to the Oregon State hatchery at Bonneville. From the eggs remaining there were hatched and liberated in Afognak Lake 61,524,000 fry. The loss was 7,654,000 eggs and fry, or approximately 9.6 per cent.

In 1920 a total of 62,300,000 red-salmon eggs was collected by September 24. Spawn taking was stopped at that time by high water, which damaged the retaining racks and allowed the escape of all unspawned salmon, thus materialy affecting the possible take of eggs. The run of salmon was reported as being equal to that of 1919, or sufficient to have yielded a quantity of eggs far in excess of the capacity of the hatchery.

FORTMANN.

The Alaska Packers Association operated the hatchery at Heckman Lake, on Revillagigedo Island, as heretofore. In 1919 a collection of 18,420,000 red-salmon eggs was made, from which 17,070,000 fry were hatched and planted in the Naha stream system. The loss during incubation was 1,350,000, or approximately 7.3 per cent.

Egg collecting in 1920 began September 4 and ended November 11. In that time 18,240,000 red-salmon eggs were obtained. In addition 360,000 humpback-salmon eggs were also taken.

QUADRA.

The Quadra hatchery on Hugh Smith Lake is owned by the Northwestern Fisheries Co. Out of the 11,710,000 red-salmon eggs taken in 1919, there were hatched and liberated 11,357,000 fry, the loss being 353,000, or 3 per cent.

Egg taking in 1920 began August 5 and ended October 28, resulting in a collection of 19,450,000, an increase of more than 71 per cent over 1919.

JUNEAU.

The Alaska Territorial Fish Commission operates a hatchery in a rented building at Juneau. The plant appears to be modern and is equipped with concrete troughs. No ponds, however, are available for rearing purposes. The commission began this work in 1919, and in 1920 the capacity of the hatchery was enlarged to handle 10,000,000 salmon eggs.

In 1919 the commission reported the collection of salmon eggs as follows: Cohos, 10,540,000; chums, 3,425,000; and humpback, 890,000—a total of 14,855,000. Of the resulting product, 6,815,000 were distributed as eyed eggs and 5,250,000 as fertilized eggs, while 2,110,000 were distributed as fry. The loss in eyeing and hatching was 680,000. The distributions occurred in waters on Admiralty and Baranof Islands and streams on the mainland in the Juneau region.

In 1920 the commission reported a collection of 17,020,000 salmon eggs, of which 6,460,000 were cohos, 5,250,000 chums, 4,640,000 humpbacks, and 670,000 reds. Of these, irrespective of species, 4,885,000 were planted as eyed eggs, 6,500,000 as fertilized eggs, and 2,919,000 were distributed as fry. The loss of eggs held through the period of incubation was 846,000, or a little more than 8 per cent. By species, these distributions were cohos, 5,730,000; chums, 5,000,000; humpbacks, 3,410,000; and reds, 134,000. The fry remaining in the hatchery totaled 1,900,000.

GENERAL STATISTICS OF THE FISHERIES IN 1920.

The total investment in the fisheries of Alaska in 1920 was $70,986.221, or $3,195.339 less than in 1919. Approximately 89 per cent of this amount was invested in the salmon industry. Employment was given to 27,482 persons or 1,052 less than in 1919. The total value of the products in 1920 was $41,492,124, a decrease of $8,789,940, or approximately 17½ per cent. The important factor in this reduced production was the smaller pack of salmon in southeast Alaska.

SUMMARY OF INVESTMENTS IN THE FISHERIES OF ALASKA IN 1920.

Industries.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Salmon canning	$30,153,798	$14,058,952	$18,337,977	$62,550,727
Salmon mild-curing	213,632			213,632
Salmon pickling	9,800	560	288,321	298,681
Salmon dry salting			45,232	45,232
Salmon by-products	375,127			375,127
Halibut fishery	2,270,722			2,270,722
Herring fishery	443,346	949,006	4,260	1,396,612
Cod fishery		1,639,453	418,275	2,057,728
Whale fishery	535,709	88,904	1,076,297	1,700,910
Crab fishery	550	200		750
Shrimp fishery	76,100			76,100
Total	34,078,784	16,737,075	20,170,362	70,986,221

SUMMARY OF PERSONS ENGAGED IN THE FISHERIES OF ALASKA IN 1920.

Races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Whites	6,629	3,648	5,775	16,052
Natives	2,442	874	417	3,733
Chinese	1,115	563	691	2,369
Japanese	1,071	273	101	1,445
Filipinos	862	358	367	1,587
Mexicans	278	174	1,227	1,679
Negroes	24	53	230	307
Miscellaneous	184	19	107	310
Total	12,605	5,962	8,915	27,482

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920.

Products.		Quantity.	Value.
Salmon:			
Canned	cases	4,429,463	$35,602,800
Mild-cured	pounds	1,857,800	364,219
Pickled	do	964,400	104,873
Frozen	do	1,916,595	161,143
Fresh	do	3,248,081	263,264
Dry salted	do	224,840	37,535
Dried and smoked	do	20,000	3,250
By-products, oil	gallons	39,052	16,370
By-products, fertilizer	pounds	1,778,000	88,382
Halibut:			
Fresh	do	7,506,763	1,034,380
Frozen	do	7,788,017	692,343
Canned	do	720	75
Herring:			
Canned, 1-pound cans	cases	3,602	28,980
Fresh for food	pounds	2,400	105
Fresh for bait	do	1,559,100	21,167
Frozen for bait	do	2,525,700	20,027
Pickled, Scotch cure	do	8,223,490	490,485
Pickled, spiced	do	8,000	400
Pickled, Norwegian cure	do	314,619	22,199
Fertilizer	do	6,078,000	316,161
Oil	gallons	681,067	404,090

SUMMARY OF PRODUCTS OF THE ALASKAN FISHERIES IN 1920—Continued.

Products.	Quantity.	Value.
Cod:		
Dry salted ... pounds..	10,837,321	$932,110
Pickled ... do....	1,895,638	181,647
Fresh ... do....	565	23
Stockfish ... do....	12,775	2,300
Tongues ... do....	17,600	1,384
Whales:		
Oil ... gallons..	765,309	304,256
Sperm oil ... do....	343,611	131,783
Fertilizer, meat ... pounds..	2,436,000	101,105
Fertilizer, bone ... do....	754,000	18,815
Bone ... do....	17,484	6,118
Ivory ... do....	750	225
Clams ... cases..	6,833	46,812
Trout:		
Canned ... do....	470	2,384
Fresh and frozen ... pounds..	74,470	11,128
Pickled ... do....	2,000	150
Sablefish ... do....	584,251	28,544
Crabs:		
Canned ... cases..	70	1,050
Fresh ... pounds..	6,350	690
Shrimps ... do....	112,045	49,123
Miscellaneous fresh fish ... do....	11,073	229
Total	....	[1] 41,492,124

[1] These figures represent the value of the manufactured product. It is estimated that the value of the catch to the fishermen is approximately $12,000,000.

SALMON INDUSTRY.

The most prominent features of the salmon industry growing out of the operations of 1920 are (1) the continued falling off in the catch of salmon in southeast Alaska and (2) the increase in production in both central and western Alaska. But the catch of salmon in any district may not be a sufficient indicator of the condition of the fisheries therein unless considered in connection with the character of fishing activities, the amount of gear used, length of season, and the intensiveness of operations. Nor can an accurate analysis of the condition of the fisheries be made until the position and influence of these factors are determined; and even then there are other factors of less prominence which may have an important bearing on the question, as, for instance, the application of restrictive measures designed to afford more protection to the runs of salmon.

Consideration of certain pack figures in the southeastern district for a number of years back may be of interest. From 1912 to and including 1920 the pack of canned salmon in southeast Alaska did not vary markedly, except from 1916 to 1917 and from 1919 to 1920. The first of these movements was upward, with an increase of more than 1,000,000 cases in 1917; the second marked change occured in 1920, when there was a decrease of almost 900,000 cases from the previous year. In the three seasons of 1917, 1918, and 1919 the production of salmon in southeast Alaska reached its peak. In 1920 the production may be considered as normal, upon the basis of the general average pack for a series of years, and was not exceeded in the period from 1910 to 1916, inclusive, except in 1915.

In central Alaska there was an increase in the pack of all species of salmon except chums, and the total catch of salmon in that district in 1920 has been exceeded but once, and then in 1918, when the necessities of war seemed to demand the largest possible output.

Results in the Bristol Bay district of western Alaska show an improvement over 1919. To a large extent the increased pack was due to a much larger run of salmon in the Port Moller region than for several years. The pack in other parts of western Alaska, particularly the Yukon and Kuskokwim Rivers, was less than in 1919.

SALMON CATCH AND FORMS OF GEAR.

Approximately 99 per cent of the commercial catch of salmon in Alaska in 1920 was made by seines, gill nets, and pound nets, while less than 1 per cent was taken with dip nets, lines, and wheels. Records show that 712 seines were used in 1920, the total length of which was 117,111 fathoms. This is 88 less than the number operated in 1919, and a decrease of 20,173 fathoms in the total length of seines. Of the number used, southeast Alaska was credited with 510, central Alaska with 189, and western Alaska with 13. There were 88,013 fathoms of seine webbing used in southeast Alaska, and the average length of each seine was 172 fathoms; in central Alaska 25,698 fathoms were used, the average per seine being 136 fathoms; in western Alaska 3,400 fathoms were operated, with an average of 261 fathoms per seine.

Statistics show that 4,597 gill nets, having a total length of 475,214 fathoms, were used in the salmon fisheries of Alaska in 1920. Of this number, 351 nets, or 41,780 fathoms of webbing, were used in southeast Alaska; 1,469 nets, or 89,217 fathoms, were used in central Alaska; and 2,777 nets, or 344,217 fathoms, were operated in western Alaska. This is an increase of 477 gill nets, or 15,277 fathoms, over the number used in 1919, when 4,120 nets, or 459,937 fathoms of webbing, were operated.

Statistics also show that 653 pound nets were operated in the salmon industry in 1920, as compared with 630 in 1919. There were 445 driven traps, a decrease of 39, and 208 floating traps, an increase of 62. Southeast Alaska leads with 287 driven traps, 14 less than in 1919, and 197 floating traps, an increase of 54 over the number used in the preceding season; central Alaska had 150 driven and 11 floating traps, which was, respectively, 22 less and 8 more than the number used in 1919; western Alaska had 8 driven traps, or 3 less than in 1919. The rapidly increasing use of floating traps in southeast and central Alaska and the decreasing use of pile traps in all districts are noteworthy developments of the year.

Considering Alaska as a whole, the number of fathoms of seines used in 1920 was approximately 15 per cent less than in 1919; there was an increase of 3 per cent in the number of fathoms of gill nets and $3\frac{2}{3}$ per cent increase in the number of pound nets operated in 1920 over that of 1919.

Of the total catch of salmon in 1920, seines took $26\frac{2}{3}$ per cent, gill nets approximately 20 per cent, and pound nets approximately 53 per cent. In 1919 the catch by apparatus was: Seines 36 per cent, gill nets 19 per cent, and pound nets 42 per cent. The change in 1920 was a decrease in catch by seines of $9\frac{1}{3}$ per cent and an increase by gill nets of 1 per cent and by pound nets of 11 per cent. The following table shows the proportionate catch by districts according to the principal kinds of apparatus:

PERCENTAGE OF SALMON CAUGHT IN EACH ALASKA DISTRICT, BY PRINCIPAL FORMS OF APPARATUS.

Apparatus.	Southeast Alaska.		Central Alaska.		Western Alaska.	
	1919	1920	1919	1920	1919	1920
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Seines	46	30	31	34	3	6
Pound nets	49	66	50	59	4	8
Gill nets	2	2	18	7	92	86

In 1920 the production of salmon in Alaska was 65,080,539 as compared with 58,172,665 in 1919, an increase of approximately 12 per cent. The decrease in southeastern Alaska was 6,446,220, or a little more than 16 per cent. In central Alaska there was an increase of 9,836,712, or approximately 101 per cent; in the western district the increase was 3,517,382, or approximately 40 per cent. The striking development of the season was the large catch of salmon in central Alaska, it being next to the largest ever recorded for that district, the catch of 1918 alone exceeding it. Considering Alaska as a whole, the 1920 catch shows that in comparison with that of 1919, cohos decreased 538,987, chums decreased 2,065,483, humpbacks increased 6,217,635, kings decreased 192,525, and reds increased 3,487,194.

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Seines:				
Coho, or silver	284, 106	85, 014	2, 790	371, 910
Chum, or keta	4, 264, 032	308, 537	3, 622	4, 576, 191
Humpback, or pink	4, 618, 516	4, 362, 069	....	8, 980, 585
King, or spring	6, 540	2, 187	8, 257	16, 984
Red, or sockeye	795, 631	1, 864, 565	761, 682	3, 421, 878
Total	9, 968, 825	6, 622, 372	776, 351	17, 367, 548
Gill nets:				
Coho, or silver	163, 521	130, 211	160, 125	453, 857
Chum, or keta	60, 243	6, 002	581, 470	647, 715
Humpback, or pink	73, 898	74, 940	937, 335	1, 086, 173
King, or spring	60, 295	22, 320	189, 252	271, 867
Red, or sockeye	392, 882	1, 113, 349	8, 787, 947	10, 294, 178
Total	750, 839	1, 346, 822	10, 656, 129	12, 753, 790
Pound nets:				
Coho, or silver	552, 972	445, 828	6, 380	1, 005, 180
Chum, or keta	3, 684, 559	1, 163, 062	42, 110	4, 889, 731
Humpback, or pink	16, 232, 881	5, 546, 058	266, 914	22, 045, 853
King, or spring	54, 080	48, 550	11, 816	114, 446
Red, or sockeye	1, 441, 224	4, 268, 363	649, 867	6, 359, 454
Total	21, 965, 716	11, 471, 861	977, 087	34, 414, 664
Lines:				
Coho, or silver	44, 710	....	....	44, 710
King, or spring	366, 510	....	....	366, 510
Total	411, 220	....	....	411, 220

SALMON TAKEN IN 1920, BY APPARATUS AND SPECIES, FOR EACH GEOGRAPHIC SECTION OF ALASKA—Continued.

Apparatus and species.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Dip nets:				
Coho, or silver		15,202		15,202
King, or spring		5,660		5,660
Red, or sockeye		112,415		112,415
Total		133,277		133,277
Wheels: Chum, or keta	40			40
Total:				
Coho, or silver	1,045,309	676,255	169,295	1,890,859
Chum, or keta	8,008,874	1,477,601	627,202	10,113,677
Humpback, or pink	20,925,295	9,983,067	1,204,249	32,112,611
King, or spring	487,425	78,717	209,325	775,467
Red, or sockeye	2,629,737	7,358,692	10,199,496	20,187,925
Grand total	33,096,640	19,574,332	12,409,567	65,080,539

SALMON CANNING.

CHANGES IN CANNERIES.

Three changes occurred in the ownership of canneries in Alaska in 1920. The plant of the Tee Harbor Packing Co., at Tee Harbor, was purchased by the Alaska Pacific Fisheries; the Pavlof Harbor Packing Co. acquired the cannery of the Alaska Packing & Navigation Co. at Pavlof Harbor; the Tenakee Fisheries Co. transferred its plant at Tenakee to the Standard Salmon Packers (Inc.); and the Sockeye Salmon Co. leased its cannery on Isanotski Strait to P. E. Harris & Co. The Everett Packing Co. operated its cannery at Herendeen Bay in the interest of the Herendeen Bay Consolidated Canneries. The Thlinket Packing Co. changed its name to the Thlinket Packing Corporation.

NEW CANNERIES.[1]

There were 16 new salmon canneries in Alaska in 1920, 8 of which were opened and operated in southeast Alaska.

In the central district seven new canneries were operated in 1920.

In western Alaska one new cannery, which had been constructed by the Alaska Packers Association in 1919, was put in operation in 1920.

In addition to these plants Robert J. Peratovich put up a small pack by hand at Bayview, Prince of Wales Island, and W. J. O'Connor packed a few cases on the Yukon River delta.

CANNERIES NOT OPERATED.

There were 10 idle canneries in Alaska in 1920, of which 5 were in southeast Alaska, 2 in central, and 3 in western Alaska. The cannery of the Fidalgo Island Packing Co., at Herendeen Bay, was

[1] New canneries are indicated by an asterisk (*) in the table on page 50.

dismantled and will not be operated again. The inactive plants were owned and located as follows:

Alaska Fish Co	Waterfall.
Cape Fanshaw Fish & Packing Co. (Inc.)	Cape Fanshaw.
Columbia Salmon Co	Craig.
Southern Alaska Canning Co	Quadra Bay.
Northwestern Fisheries Co	Hunter Bay. Orca. Seldovia.
Nelson Lagoon Packing Co	Nelson Lagoon.
Phoenix Packing Co	Herendeen Bay.
Midnight Sun Packing Co	Kotzebue Sound.

TOTAL CANNERIES OPERATED.

There were 146 salmon canneries operated in Alaska in 1920, as compared with 134 in 1919, of which 82 were located in southeast Alaska, 36 in central Alaska, and 28 in western Alaska. This is an increase of six in both the southeastern and central districts, while the number in western Alaska remains unchanged.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920.

[New canneries indicated by (*).]

Company.	Canneries. Number.	Canneries. Location.	Pound nets.
Southeast Alaska:			
Ainsworth-Dunn Co	1	Floating *	
Alaska Herring & Sardine Co	1	Port Walter	[1] 20
Alaska Pacific Fisheries	3	Chomley	[2] 9
		Tee Harbor	[3] 16
		Yes Bay	[4] 13
Alaska Packers Association	2	Loring	[5] 11
		Wrangell	[6] 8
Alaska Salmon & Herring Packers	1	Tyee	
Alaska Sanitary Packing Co	2	Cape Fanshaw	
		Wrangell	5
Alaska Union Fisheries (Inc.)	1	Port Conclusion *	
American Packing Co	1	Juneau	[7] 2
Anacortes Fisheries Co	2	Kasaan	[7] 8
		Shakan	3
Annette Island Packing Co	1	Metlakatla	7
Astoria & Puget Sound Canning Co	1	Excursion Inlet	[3] 12
Auk Bay Salmon Canning Co	1	Auk Bay	6
Baranof Packing Co	1	Red Bluff Bay	
F. C. Barnes Co	1	Lake Bay	1
Beauclaire Packing Co	1	Port Beauclerc	2
Beegle Packing Co	1	Ketchikan	[8] 5
Burnett Inlet Packing Co	1	Burnett Inlet	[9] 6
Cape Flattery Fisheries Co	1	Floating *	
John L. Carlson & Co	1	Auk Bay	[9] 5
Chilkat Packing Co	1	Haines *	[9] 1
Columbia Salmon Co	1	Tenakee Inlet	[8] 8
Deep Sea Salmon Co	2	Ford Arm	[9] 8
		Port Althorp	[9] 25
Douglas Island Packing Co	1	Douglas	
Fidalgo Island Packing Co	2	Ketchikan	[7] 12
		Pillar Bay	
George Inlet Packing Co	1	George Inlet	2
Haines Packing Co	1	Letinkof Cove	
P. E. Harris & Co	1	Hawk Inlet	[10] 19
Hidden Inlet Canning Co	2	Hidden Inlet	[3] 5
		Hood Bay	4
Hood Bay Packing Co	1	Hood Bay	

[1] Seventeen floating.
[2] Four floating.
[3] Three floating
[4] Eight floating.
[5] Six floating.
[6] Seven floating.
[7] One floating.
[8] Two floating.
[9] All floating.
[10] Nine floating.

Companies Canning Salmon in Alaska, Number and Location of Canneries Operated, and Number of Pound Nets Owned by Each, 1920—Continued.

Company.	Canneries.		Pound nets.
	Number.	Location.	
Southeast Alaska—Continued.			
Hoonah Packing Co	2	Gambier Bay	[1] 15
		Hoonah	[2] 13
G. W. Hume Co	2	Nakat Harbor	6
		Scow Bay	3
Karheen Packing Co	1	Karheen	5
Ketchikan Packing Co	1	Ketchikan	2
Libby, McNeill & Libby	2	Taku Harbor	18
		Yakutat	....
Marathon Fishing & Packing Co	1	Cape Fanshaw	3
Mount Baker Packing Co	1	Floating *	....
Mountain Point Packing Co	1	Wrangell Narrows	....
Mutual Packing Co	1	Floating *	....
Geo. T. Myers & Co	1	Chatham	[4] 10
Northern Packing Co. (Inc.)	1	Juneau	....
North Pacific Trading & Packing Co	1	Klawak	[3] 1
Northwestern Fisheries Co	4	Dundas Bay	[5] 9
		Quadra	7
		Roe Point	[4] 7
		Santa Ana	....
Noyes Island Packing Co	1	Steamboat Bay	....
Olympic Fisheries Co	1	Floating	....
Pacific American Fisheries	1	Excursion Inlet	[6] 13
Pavlof Harbor Packing Co	1	Pavlof Harbor	....
Petersburg Packing Corporation	2	Petersburg	[6] 13
		Washington Bay	[6] 9
Point Warde Packing Co	1	Point Warde	....
Pure Food Fish Co	1	Ketchikan	[1] 5
Pybus Bay Fish & Packing Co	1	Pybus Bay	....
Pyramid Packing Co	1	Sitka	[7] 3
Revilla Packing Co	1	Ketchikan *	....
Sanborn-Cutting Co	1	Kake	[3] 14
Sitka Packing Co	1	Sitka	....
J. L. Smiley & Co	1	Ketchikan	[6] 8
Southern Alaska Canning Co	2	Big Port Walter	....
		Rose Inlet	[5] 10
Standard Salmon Packers (Inc.)	1	Tenakee Inlet	[1] 5
Starr Collinson Packing Co	1	Moira Sound	[3] 2
Straits Packing Co	1	Skowl Arm	....
E. R. Strand	1	Wrangell Narrows*	....
Sunny Point Packing Co	1	Ketchikan	8
Swift Arthur Crosby Co	1	Heceta Island	[1] 3
Thlinket Packing Corporation	1	Funter Bay	[8] 21
Todd Packing Co	1	Todd	[7] 5
Union Bay Fisheries Co	1	Union Bay	5
Ward's Cove Packing Co	1	Ward Cove	3
Central Alaska:			
Alaska Packers Association	4	Alitak	[1] 6
		Chignik	4
		Kasilof	14
		Larsen Bay	....
Alaska Sea Food Co	1	Point Whitshed	[7] 4
Alitak Packing Co	1	Lazy Bay	4
Arctic Packing Co	1	English Bay *	....
Bainbridge Fisheries Co	1	Evans Island *	1
Canoe Pass Packing Co	1	Shepard Point	[7] 5
Carlisle Packing Co	1	Cordova	8
Central Alaska Fisheries	1	Drier Bay*	1
Columbia River Packers' Association	1	Chignik	4
Copper River Packing Co	1	McClure Bay	7
Eyak River Packing Co	1	Eyak River	....
Fidalgo Island Packing Co	1	Port Graham	7
P. E. Harris & Co	1	Isanotski Strait	3
Hayes-Graham Fish Co	1	Floating*	....
Hillery-Scott Co	1	Cordova	1
Hoonah Packing Co	1	Bering River	4
Kadiak Fisheries Co	1	Kodiak	1
Kenai Packing Co	1	Drier Bay	2
King Salmon Fisheries Co	1	Unakwik Inlet*	[7] 4
Libby, McNeill & Libby	1	Kenai	13
F. H. Madden	1	Abercrombie	....
Moore Packing Co	1	Orca Inlet	3

[1] One floating.
[2] Five floating.
[3] All floating.
[4] Four floating.
[5] Six floating.
[6] Three floating.
[7] Two floating.
[8] Twelve floating.

COMPANIES CANNING SALMON IN ALASKA, NUMBER AND LOCATION OF CANNERIES OPERATED, AND NUMBER OF POUND NETS OWNED BY EACH, 1920—Continued.

Company.	Canneries. Number.	Canneries. Location.	Pound nets.
Central Alaska—Continued.			
Northwestern Fisheries Co	3	Chignik	4
		Kenai	14
		Uyak	
Pacific American Fisheries	2	Ikatan	7
		King Cove	9
Pioneer Packing Co	1	Cordova	7
San Juan Fishing & Packing Co	1	Seward	2
Shumagin Packing Co	1	Squaw Harbor*	6
Surf Packing Co	1	Chisik Island	2
Valdez Packing Co	1	Valdez	[1] 5
Seldovia Canning Co	1	Seldovia*	3
Western Alaska:			
Alaska Packers Association	9	Kvichak River (2)	
		Naknek River (3)	
		Nushagak River (2)	1
		Ugaguk River	
		Ugashik River*	
Alaska-Portland Packers' Association	2	Naknek	
		Nushagak Bay	2
Alaska Salmon Co	1	Wood River	
Bristol Bay Packing Co	1	Kvichak River	
Carlisle Packing Co	1	Kwiguk Slough	
Columbia River Packers' Association	1	Nushagak Bay	
Everett Packing Co	1	Herendeen Bay	
Libby, McNeill & Libby	6	Ekuk	
		Kvichak Bay	
		Libbyville	
		Lockanok	
		Nushagak	
		Ugaguk River	
Naknek Packing Co	1	Naknek River	
Northwestern Fisheries Co	2	Naknek River	
		Nushagak	
Pacific American Fisheries	1	Port Moller	5
Red Salmon Canning Co	2	Naknek River	
		Ugashik River	

[1] One floating.

LOSSES AND DISASTERS IN THE SALMON-CANNING INDUSTRY.

The loss of property by those interested in the salmon industry of Alaska in 1920 was unusually heavy. Four disastrous fires occurred in the southeastern district. The first fire occurred on May 25, before canning had commenced, and it destroyed the cannery of the Mountain Point Packing Co., on Wrangell Narrows, which with the machinery, fishing gear, and floating equipment was valued at $60,998. The plant was not rebuilt during the season.

The other three fires occurred in August, and entailed considerably heavier losses, being the cause of the destruction of much larger plants at each of which several thousand cases of salmon had been packed and were stored. All of these canneries were located in the southern part of the southeastern district, and were burned in the same month.

The cannery of the Straits Packing Co., at Skowl Arm, including warehouse and equipment, fishing gear in stock, all other stock, and 4,000 cases of canned salmon, was burned on August 6. The total loss was reported as being $150,000.

On August 20 practically the entire plant of the Hidden Inlet Canning Co. at Hidden Inlet was destroyed by fire, entailing a loss in buildings, supplies, equipment, and canned salmon of $217,823.

The burning of the Nakat Inlet cannery of the G. W. Hume Co. occurred on August 28. Buildings and fishing gear valued at $75,000 were lost.

The Chinese quarters at the Roe Point cannery of the Northwestern Fisheries Co. were burned, at a loss of $4,635.

The vessel losses in southeastern Alaska aggregated $35,660, chief of which was that of the barge *Dashing Wave*, owned by Libby, McNeill & Libby, and valued at $15,000.

A rather heavy loss of fishing apparatus was also reported, which in the aggregate was valued at $80,288. Of this amount, $67,238 represented the value of traps that were destroyed.

Property losses in central Alaska amounted to $22,544, the major part of which consisted of fishing apparatus. In western Alaska losses of property having a total value of $126,966 were reported, of which $88,802 was charged under vessels and floating equipment, $31,664 to fishing apparatus, and $6,500 to buildings and wharves. The notable item in these losses was that of the ship *Chas. E. Moody*, owned by the Northwestern Fisheries Co., and valued at $80,000.

In 1920 the total loss of property in the salmon industry throughout Alaska was reported as $773,914, of which approximately 81 per cent was sustained by operators in the southeastern district. The loss of life in this industry was considerably greater than in 1919. In southeastern Alaska 1 fisherman, 3 shoresmen, and 1 transporter met accidental death; in central Alaska 2 shoresmen and 1 transporter were killed and 2 transporters were drowned; in western Alaska 11 fishermen and 2 shoresmen were drowned and 2 shoresmen were killed.

STATISTICS.

There were operated in Alaska in 1920 a total of 146 salmon canneries, 12 more than in 1919. Several of them were small floating plants. The investment in the salmon-canning industry was $62,550,727, a decrease of $3,944,444. There as a decline of $3,588,093 in southeast Alaska and $1,517,356 in western Alaska. In central Alaska the investment increased $1,161,005.

The canning industry gave employment to 24,423 persons, or 1,076 less than in 1919. Whites decreased 345, natives 126, Chinese 401, Japanese 39, and Mexicans 214. Filipinos increased 10, and miscellaneous, including Negroes, 39.

The pack of canned salmon was 4,429,463 cases, valued at $35,602,800, a decrease of 154,225 cases in the pack and of $7,662,549 in value of the products of 1920 as compared with those of 1919. This is a decline of approximately 3⅓ per cent in production and 17⅔ per cent in value from 1919. These decreases in quantity and value of products are directly and entirely due to the smaller pack in southeast Alaska, as in both the other districts the pack was larger than in 1919. A comparison of the pack in 1920 with that in 1919, by districts, shows that southeast Alaska dropped from 3,119,260 cases to 2,225,011, a decrease of 894,249 cases; central Alaska increased from 771,907 to 1,337,448, a gain of 565,541 cases; and western Alaska increased from 692,521 to 867,004, an advance of 174,483 cases. A further comparison of the pack by species for 1919 and 1920 in Alaska as a whole shows that cohos decreased from 232,870 to 192,085 cases, a decline of 40,785 cases; chums decreased from 1,365,563 to 1,033,517, a drop of 332,046 cases; humpbacks decreased from 1,611,608 to 1,593,120, a drop of 18,488 cases; kings increased from 95,986 to 110,003, a gain of 14,017 cases; and reds advanced from 1,277,661 to 1,500,738, a gain of 223,077 cases.

INVESTMENT IN THE SALMON-CANNING INDUSTRY IN 1920.

Item.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Canneries operated	82	$6,914,906	36	$2,832,902	28	$4,885,074	146	$14,632,882
Working capital	...	10,350,339	...	4,702,152	...	3,764,804	...	18,817,295
Wages paid	...	5,635,911	...	3,337,521	...	4,567,020	...	13,540,452
Vessels:								
Power vessels over 5 tons	382	2,801,915	110	1,023,750	75	1,939,076	567	5,764,741
Net tonnage	7,405	...	2,613	...	7,664	...	17,682	...
Sailing	2	65,000	7	325,199	32	1,295,300	41	1,685,499
Net tonnage	3,004	...	10,788	...	47,220	...	61,012	...
Barges	1	6,377	...	...	...	...	1	6,377
Net tonnage	1,354	...	...	...	...	...	1,354	...
Launches, under tonnage	131	157,919	171	180,874	42	146,801	344	485,594
Boats, row and sail	1,234	106,135	915	128,720	1,538	651,074	3,687	885,929
Lighters, scows, and houseboats	430	420,389	270	288,417	197	445,910	897	1,154,716
Pile drivers and pile pullers	68	505,491	44	212,715	25	85,905	137	804,111
Apparatus:								
Beach seines	107	50,954	115	47,043	...	...	222	97,997
Fathoms	11,643	...	14,959	...	...	...	26,602	...
Purse seines	402	332,824	73	40,543	13	22,700	488	396,067
Fathoms	76,295	...	10,689	...	3,400	...	90,384	...
Gill nets	343	65,492	1,469	140,163	2,616	499,313	4,428	704,968
Fathoms	39,455	...	89,217	...	332,275	...	460,947	...
Pound nets, driven	285	2,157,806	150	767,083	8	35,000	443	2,959,889
Pound nets, floating	197	582,340	11	28,511	...	...	208	610,851
Dip nets	...	...	184	603	...	...	184	603
Lines	...	...	...	2,756	...	...	...	2,756
Total	...	30,153,798	...	14,058,952	...	18,337,977	...	62,550,727

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Fishermen:				
Whites	1,832	1,283	2,862	5,977
Natives	1,249	292	75	1,616
Miscellaneous [1]	74	...	...	74
Total	3,155	1,575	2,937	7,667
Shoresmen:				
Whites	2,628	1,156	2,251	6,035
Natives	1,085	539	227	1,851
Chinese	1,115	563	691	2,369
Japanese	1,018	273	101	1,392
Filipinos	862	358	367	1,587
Mexicans	264	174	1,214	1,652
Negroes	24	53	230	307
Miscellaneous [1]	59	18	106	183
Total	7,055	3,134	5,187	15,376

[1] Koreans, Porto Ricans, Kanakas, etc.

PERSONS ENGAGED IN THE SALMON-CANNING INDUSTRY IN 1920—Continued.

Occupations and races.	Southeast Alaska.	Central Alaska.	Western Alaska.	Total.
Transporters:				
Whites	812	295	204	1,311
Natives	17	18	6	41
Miscellaneous [1]	26	1	1	28
Total	855	314	211	1,380
Grand total:				
Whites	5,272	2,734	5,317	13,323
Natives	2,351	849	308	3,508
Chinese	1,115	563	691	2,369
Japanese	1,018	273	101	1,392
Filipinos	862	358	367	1,587
Mexicans	264	174	1,214	1,652
Negroes	24	53	230	307
Miscellaneous [1]	159	19	107	285
Total	11,065	5,023	8,335	24,423

[1] Koreans, Porto Ricans, Kanakas, etc.

OUTPUT OF CANNED SALMON IN 1920.[1]

Product.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Cases.	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*	*Cases.*	*Value.*
Coho, or silver:								
½-pound flat	7,602	$91,541	1,267	$14,733	46	$55	8,915	$106,832
1-pound flat	8,395	80,295	1,314	14,454	1,037	10,997	10,746	105,746
1-pound tall	95,951	831,599	64,660	595,230	11,813	114,463	172,424	1,541,292
Total	111,948	1,003,435	67,241	624,417	12,896	126,018	192,085	1,753,870
Chum, or keta:								
½-pound flat	53	394					53	394
1-pound flat	44,582	154,353	1,585	7,291			46,167	161,644
1-pound tall	792,480	3,298,390	141,715	620,692	53,102	255,531	987,297	4,174,613
Total	837,115	3,453,137	143,300	627,983	53,102	255,531	1,033,517	4,336,651
Humpback, or pink:								
½-pound flat	18,277	145,749	693	5,900			18,970	151,649
1-pound flat	58,265	324,353	17,752	81,659			76,017	406,012
1-pound tall	931,095	5,112,406	498,532	2,662,343	68,506	386,640	1,498,133	8,161,389
Total	1,007,637	5,582,508	516,977	2,749,902	68,506	386,640	1,593,120	8,719,050
King, or spring:								
½-pound flat	5,203	85,533	1,922	32,942	3,071	52,812	10,196	171,287
1-pound flat	3,611	45,344	1,887	21,677	12,821	194,872	18,319	261,893
1-pound tall	37,316	313,552	18,769	158,435	25,403	302,061	81,488	774,048
Total	46,130	444,429	22,578	213,054	41,295	549,775	110,003	1,207,228
Red, or sockeye:								
½-pound flat	46,031	847,564	43,867	773,138	11,818	226,040	101,716	1,846,742
1-pound flat	21,378	277,802	51,497	693,054	47,272	630,700	120,147	1,601,556
1-pound tall	154,772	1,776,092	491,988	6,280,839	632,115	8,080,772	1,278,875	16,137,703
Total	222,181	2,901,458	587,352	7,747,031	691,205	8,937,512	1,500,738	19,586,001
Grand total	2,225,011	13,384,967	1,337,448	11,962,387	867,004	10,255,446	4,429,463	35,602,800

[1] Cases containing ½-pound cans have been reduced one-half in number, and thus, for the purpose of affording fair comparison, all are put upon the basis of 48 1-pound cans per case.

OUTPUT OF CANNED SALMON IN ALASKA, 1914 TO 1920.[1]

Product.	1914	1915	1916	1917	1918	1919	1920	Total.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Coho, or silver:								
½-pound flat	4,579	2,050	13,145	30,412	26,238	9,719	8,915	95,058
1-pound flat	285	2,338	8,191	362	12,786	10,438	10,746	45,146
1-pound tall	152,199	119,880	240,573	162,457	179,934	212,713	172,424	1,240,180
Total	157,063	124,268	261,909	193,231	218,958	232,870	192,085	1,380,384
Chum, or keta:								
½-pound flat	373	....	1,423	26,760	3,559	3,981	53	36,149
1-pound flat	5,568	317	....	2,530	2,996	....	46,167	57,578
1-pound tall	657,918	479,629	722,692	877,457	1,358,405	1,361,582	987,297	6,444,980
Total	663,859	479,946	724,115	906,747	1,364,960	1,365,563	1,033,517	6,538,707
Humpback, or pink:								
½-pound flat	2,103	4,325	41,491	91,403	63,557	28,185	18,970	250,034
1-pound flat	9,286	3,508	14,796	6,014	20,215	7,553	76,017	137,389
1-pound tall	974,660	1,867,683	1,681,506	2,199,559	2,355,182	1,575,870	1,498,133	12,152,593
Total	986,049	1,875,516	1,737,793	2,296,976	2,438,954	1,611,608	1,593,120	12,540,016
King, or spring:								
½-pound flat	3,143	2,404	2,617	12,973	6,000	7,584	10,196	44,917
1-pound flat	4,804	3,755	3,804	5,133	5,267	11,532	18,319	52,614
1-pound tall	40,092	82,092	59,452	43,845	37,959	76,870	81,488	421,798
Total	48,039	88,251	65,873	61,951	49,226	95,986	110,003	519,329
Red, or sockeye:								
½-pound flat	53,825	52,033	81,565	124,309	137,008	122,236	101,716	672,692
1-pound flat	64,671	112,847	86,395	89,612	151,864	110,491	120,147	736,027
1-pound tall	2,083,147	1,765,139	1,936,971	2,274,460	2,244,865	1,044,934	1,278,875	12,628,391
1½-pound nominals	....	2,293	....	....	....	....	....	2,293
2-pound nominals	....	....	6,006	....	....	....	....	6,006
Total	2,201,643	1,932,312	2,110,937	2,488,381	2,533,737	1,277,661	1,500,738	14,045,409
Grand total	4,056,653	4,500,293	4,900,627	5,947,286	6,605,835	4,583,688	4,429,463	35,023,845

[1] The number of cases shown has been put upon the common basis of 48 1-pound cans per case.

AVERAGE ANNUAL PRICE PER CASE OF FORTY-EIGHT 1-POUND CANS OF SALMON, 1910 TO 1920.

Product.	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
Coho, or silver	$4.89	$5.67	$4.44	$3.45	$4.39	$4.31	$5.34	$8.76	$9.15	$11.27	$9.13
Chum, or keta	3.04	3.72	2.37	2.21	3.37	2.59	3.34	6.14	6.27	6.82	4.19
Humpback, or pink	3.15	3.94	2.55	2.58	3.50	2.78	3.64	6.44	6.58	8.35	5.47
King, or spring	5.34	6.48	5.37	4.04	5.01	4.63	5.36	10.40	9.85	13.13	10.97
Red, or sockeye	5.30	6.33	5.45	4.54	5.58	5.82	6.04	9.48	9.44	12.98	13.05

MILD CURING OF SALMON.

The business of mild curing salmon in Alaska fell off materially in 1920, evidence of which is found not only in the smaller pack but also in the withdrawal of six of the largest operators in 1919. Conspicuous among those who withdrew were the Pacific Mild Cure Co., with eight plants, the Columbia & Northern Fishing & Packing Co., Vendsyssel Packing Co., Columbia Salmon Co., and M. B. Dahl & Co. H. R. Thompson, of Ketchikan, was the only important mild curer of last year who continued operations in 1920. The mild curers of 1920 who packed more than 100 tierces each are shown in the following list:

Wrangell Cooperative Association ---------- Wrangell.
Atlantic & Pacific Fisheries Co ---------- Port Alexander.
Alaska Union Fisheries (Inc.) ---------- Port Alexander.

H. R. Thompson	Ketchikan.
Karl Hansen	Port Alexander.
Carlisle Packing Co	Yukon River.

The total investment in the mild-cure salmon industry was $213,632. Employment was given to 357 persons. The mild-cure products were 2,295 tierces of king salmon, valued at $364,219, of which 2,120 tierces were prepared in southeastern Alaska, 26 in central, and 149 in the western district.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON MILD-CURING INDUSTRY IN 1920.

Items.	Tierces.	Number.	Value.
INVESTMENT.			
Plants (all floating)		4	$5,600
Operating capital			149,677
Vessels:			
Power, over 5 tons		7	28,200
Net tonnage		86	
Launches under 5 tons		4	5,700
Other boats and skiffs		12	5,850
Lighters		1	1,500
Apparatus:			
Lines		657	1,405
Gill nets		8	3,700
Fathoms		2,325	
Pound nets		2	12,000
Total			213,632
PERSONS ENGAGED.[1]			
Fishermen:			
Whites		306	
Natives		10	
Total		316	
Shoresmen: Whites		28	
Transporters: Whites		13	
Grand total		357	
PRODUCTS.		*Pounds.*	
Southeast Alaska: King salmon	2,120	1,717,800	341,429
Central Alaska: King salmon	26	20,800	5,000
Western Alaska: King salmon	149	119,200	17,790
Total	2,295	1,857,800	364,219

[1] Southeast Alaska only.

SALMON PICKLING.

The pickling of salmon as a branch of the salmon industry is rapidly losing its importance. Since 1918 there has been a shrinkage in investment of $1,064,836, or 78 per cent, and in production from 56,890 barrels of salmon to 4,822 barrels, or 91.6 per cent. As compared with the situation in 1919, the investment fell off approximately 50 per cent, or from $590,422 to $298,681, and production 41 per cent, from 8,110 barrels valued at $195,447 to 4,822 barrels valued at $104,873. From an industry employing 815 men in 1918 and 267 in 1919, it has shrunk until only 157 were employed in 1920, all but 2 of whom were credited to western Alaska. The most noticeable changes occurred in central Alaska. In 1919 that district showed approximately 40 per cent of the capital invested in this industry, whereas in 1920 no salteries were operated and no investment reported. Of the two companies listed in that district a year ago, the

Shumagin Packing Co. changed to the canning business, while the Universal By-Products Co. did not operate. Western Alaska produced 85 per cent of the pack of pickled salmon in 1920, the most conspicuous operators being Libby, McNeill & Libby, Bering Sea Salmon Packing Co., Golden Gate Salmon Co., Peter M. Nelson, and Alaska Salmon Co.

Statistics regarding the salmon-pickling industry in 1920 appear in the following table:

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SALMON-PICKLING INDUSTRY IN 1920.

Items.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
INVESTMENT.	*No.*		*No.*		*No.*		*No.*	
Salteries	1	$8,000			6	$70,547	7	$78,547
Operating capital						106,336		106,336
Vessels:								
Sailing					2	50,000	2	50,000
Net tonnage					719		719	
Launches	1	1,500	1	$500	11	34,056	13	36,056
Gill net boats					33	10,175	33	10,175
Rowboats and skiffs					8	615	8	615
Lighters and scows					5	3,900	5	3,900
Pile drivers					1	250	1	250
Apparatus:								
Haul seines	1	300	1	60			2	360
Fathoms	75		50				125	
Gill nets					161	11,942	161	11,942
Fathoms					9,620		9,620	
Wheels					2	500	2	500
Total		9,800		560		288,321		298,681
PERSONS ENGAGED.								
Fishermen:								
Whites			2		60		62	
Natives					3		3	
Total			2		63		65	
Shoresmen:								
Whites					43		43	
Natives					26		26	
Mexicans					13		13	
Total					82		82	
Transporters: Whites					10		10	
Grand total			2		155		157	
PRODUCTS.[1]	*Barrels.*		*Barrels.*		*Barrels.*		*Barrels.*	
Coho, or silver	110	2,160	183	3,880	109	2,090	402	8,130
Chum, or keta	105	1,400			119	2,360	224	3,760
Humpback, or pink	61	882			135	1,400	196	2,282
King, or spring	100	2,000	8	160	144	3,201	252	5,361
Red, or sockeye	164	3,280	6	150	3,578	81,910	3,748	85,340
Total	540	9,722	197	4,190	4,085	90,961	4,822	104,873

[1] Each barrel holds 200 pounds of fish.

SALMON FREEZING.

The freezing of salmon in 1920 was carried on as a business of secondary importance by six companies primarily engaged in other branches of the fishery industry of Alaska. These companies, operating seven plants, reported an output of frozen salmon of 1,916,595 pounds, valued at $161,143, an increase of 364,115 pounds in production and $30.788 in value over corresponding quantities and values for 1919. This business represents no investment as distinguishable from that of the major activities of the companies concerned.

The output of frozen salmon was prepared by the following companies: Libby, McNeill & Libby, Sunny Point Packing Co., National Independent Fisheries Co., New England Fish Co., San Juan Fishing & Packing Co., and Booth Fisheries Co.

QUANTITY AND VALUE OF SALMON FROZEN IN ALASKA IN 1920, BY SPECIES.

Species.	Pounds.	Value.
Coho, or silver	134,134	$10,624
Chum, or keta	448,634	19,049
Humpback, or pink	105,816	7,276
King, or spring	1,143,765	115,770
Red, or sockeye	84,246	8,424
Total	1,916,595	161,143

FRESH SALMON.

The trade in fresh salmon in Alaska declined markedly in 1920 as compared with 1919, a condition doubtless due to the shortened supply and the greater demand for salmon by the canneries. As heretofore, this business was carried on almost wholly in southeastern Alaska and by operators more particularly engaged in other branches of the fishery industry. The bulk of the trade was represented by the business of the firms listed below:

Hoonah Packing Co	Hoonah.
Wrangell Cooperative Association	Wrangell.
Annette Island Packing Co	Metlakatla.
National Independent Fisheries Co	Juneau. Ketchikan.
H. Bergman	Ketchikan.
Atlantic & Pacific Fisheries Co	Port Alexander. Douglas.
Petersburg Cooperative Association	Petersburg.
Ripley Fish Co	Wrangell. Petersburg. Ketchikan.
H. R. Thompson	Ketchikan.
Juneau Cold Storage Co	Juneau.
San Juan Fishing & Packing Co	Ketchikan.
Karl Hansen	Port Alexander.

The total quantity of salmon sold fresh was 3,248,081 pounds, valued at $263,264. This is 38 per cent less than the production in 1919.

PRODUCTS OF ALASKA FRESH-SALMON TRADE IN 1920.

Species.	Pounds.	Value.
Coho, or silver	273,020	$11,784
Chum, or keta	242,444	9,052
Humpback, or pink	203,444	3,122
King, or spring	2,474,733	234,474
Red, or sockeye	54,440	4,832
Total	3,248,081	263,264

DRY SALTING OF SALMON.

The Kuskokwim Salmon Co., which was formed as a consolidation of the interests of the Kuskokwim Fishing & Transportation Co. and the Northern Fisheries (Inc.), on the Kuskokwim River, was engaged in the packing of dry-salted salmon in Alaska in 1920. The investment in miscellaneous supplies, small boats, fishing apparatus, and wages amounted to $45,232. Employment was given to 28 whites and 15 natives. The products were as follows:

Products of the Dry-Salting Salmon Business in Alaska in 1920.

Species.	Pounds.	Value.
Coho, or silver	42,200	$4,642
Chum, or keta	7,800	881
King, or spring	152,640	28,440
Red, or sockeye	22,200	3,572
Total	224,840	37,535

There was an increase in production over 1919 of 12,596 pounds of dry-salted salmon, and in value of $19,934.

DRYING AND SMOKING OF SALMON.

As a commercial undertaking the drying and smoking of salmon in 1920 was unimportant; the only reported products of that kind were 15,000 pounds of kippered salmon, valued at $3,000, prepared by the Juneau Cold Storage Co., at Juneau, and 5,000 pounds of humpback salmon, valued at $250, dried at Uyak by Peter Petrovsky.

Whites and natives living along the larger rivers of Alaska dry or smoke considerable quantities of salmon annually for local uses, but reliable figures of the number so used were not obtainable. These methods of preparing salmon were practiced chiefly in the Yukon Valley, where the inhabitants depend largely on such products for human needs and for dog food. In the coastal regions of Alaska, particularly those localities where winter temperatures are comparatively moderate, very limited quantities of salmon are dried or smoked. The possibility of taking cod and other sea foods at practically any time of the year obviates the necessity of preparing other fishery products for winter use.

SALMON BY-PRODUCTS.

The utilization of offal and waste material at the salmon canneries in Alaska in the manufacture of oil and fertilizer as a branch of the salmon industry revived somewhat in 1920, and was centered wholly in the southeastern district. Three companies were engaged exclusively in this business, while four were primarily concerned in the canning of salmon. In the first category are the Fish Canners' By-Products Co., which resumed operations at Ward Cove; the Alaska Reduction Co., which established a plant at Hawk Inlet; and the Petersburg By-Products Co., which operated at Scow Bay; in the other class were the Alaska Herring & Sardine Co., at Port

Walter; John L. Carlson & Co., at Auk Bay; Hoonah Packing Co., at Hoonah; and the Pacific American Fisheries, at Excursion Inlet and Ikatan.

The investment in this industry amounted to $375,127. Employment was given to 90 whites, 23 natives, 13 Mexicans, and 13 others, or a total of 139 men.

In 1920 there were produced as salmon by-products 889 tons of fertilizer, valued at $88,382, and 39,052 gallons of oil, valued at $16,370. The total value of these products was $104,752, an increase of $85,106 over the value of similar products in 1919.

HALIBUT FISHERY.

Halibut are taken on banks of the North Pacific Ocean by vessels from ports of Washington, British Columbia, and Alaska. American vessels deliver their fares indiscriminately in those regions, controlling factors in the selection of a port of delivery being the market price of halibut and the cost of supplies. As the bulk of the catch of halibut in 1920 from Pacific waters was made on the high seas, beyond the jurisdiction of any country, Alaska is credited only with so much of the catch as was landed at her ports. Ordinarily this apportionment of the catch would tend to reduce the amount shown as the product of Alaska, for in recent years there was a marked diversion of fares to the more southerly ports, but in 1920 this condition was not so evident, there being a notable increase in the quantity of halibut handled through Alaskan ports. Deliveries in 1920 exceeded those of 1919 by 1,016,709 pounds.

STATISTICAL SUMMARY.

In arriving at the investment in the halibut industry as credited to Alaska an estimate was made of the value of all vessels, including apparatus, which made one or more landings of fares at ports in Alaska. In the same manner an estimate was made of the number of persons employed in this industry. On this basis the investment is given as $2,270,722, an increase of $291,265. The number of persons employed in the halibut fishery was 768, as against 867 in 1919. The production in 1920 was 15,295,500 pounds, valued at $1,726,798, as compared with 14,278,791 pounds, valued at $1,550,605, in 1919.

The companies which handled the bulk of the halibut exported from Alaska were the National Independent Fisheries Co., at Juneau and Ketchikan; Jack Bailey, Pacific Sea Products Association (Inc.), New England Fish Co., and the Ripley Fish Co., at Ketchikan; San Juan Fishing & Packing Co., at Seward and Ketchikan; and the Booth Fisheries Co., at Sitka.

Investment, Persons Engaged, and Products of Alaska Halibut Fishery in 1920.

Item.	Quantity.	Value.	Item.	Quantity.	Value.
INVESTMENT.			PERSONS ENGAGED.		
Fishing vessels:	*Number.*			*Number.*	
Steam and gas	102	$1,281,246	Whites	744	
Net tonnage	1,954		Natives	24	
Launches	35	53,400	Total	768	
Dories and scows	155	11,700			
Fishing apparatus		86,124	PRODUCTS.		
Shore property		357,833		*Pounds.*	
Cash capital		480,419	Fresh (including local)	7,506,763	$1,034,380
			Frozen	7,788,017	692,343
Total		2,270,722	Canned (15 cases)	720	75
			Total	15,295,500	1,726,798

HERRING FISHERY.

In the aggregate, the production of herring in Alaska in 1920 was greater than ever before, but there was a wide variation in the quantity of certain products as compared with the previous year. In 1919 approximately 52 per cent of the catch of herring was used in the preparation of pickled and canned herring and other food products. In 1920 almost 80 per cent of the catch of herring was used as bait or in the manufacture of fertilizer and oil. Of 15 companies handling herring in southeast Alaska, 7 were primarily operators of reduction plants, 6 were handling herring exclusively for bait, and 2, the smallest operators of all, were engaged wholly in the preparation of food products. In central Alaska the situation was decidedly different. There were 13 operators, all of whom were chiefly engaged in the preparation of food products, while 2 operated reduction works in connection with or supplemental to the packing of pickled herring. All herring taken in western Alaska were pickled; the limited output resulted from the operations of three packers at Golovin Bay.

STATISTICAL SUMMARY.

The herring industry shows an investment in Alaska of $1,396,612, an increase of 55 per cent over the investment in 1919. Employment was given to 376 persons, as compared with 427 in 1919. Products were valued at $1,303,614, as against $1,676,170 in 1919, a decrease of $372,556. Out of a total of 8,751,405 pounds of food products, approximately 94 per cent was prepared as Scotch-cured herring. This was an increase from 7,718,985 pounds in 1919 to 8,223,490 pounds in 1920, or 6½ per cent.

In the same period the Norwegian-cured product decreased from 2,216,120 pounds to 344,619 pounds, or approximately 84½ per cent.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA HERRING FISHERY IN 1920.

Item.	Southeast Alaska.		Central Alaska.		Western Alaska.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.	Number.	Value.
INVESTMENT.								
Plants operated	5	$139,670	7	$284,828	2		14	$424,498
Operating capital		243,694		549,443		$3,050		796,187
Vessels:								
Power vessels over 5 tons.	8	35,433	11	63,500			19	98,933
Net tonnage	195		233				428	
Launches under 5 tons	1	2,000	6	8,300			7	10,300
Boats, row and seine	15	1,400	36	2,835	1	80	52	4,315
Lighters and scows	3	4,900	8	9,100			11	14,000
Pile drivers	1	1,500	1	3,000			2	4,500
Apparatus:								
Beach seines	4	2,300	9	7,050			13	9,350
Fathoms	215		1,135				1,350	
Purse seines	8	12,449	9	18,500	1	350	18	31,299
Fathoms	1,510		1,770		100		3,380	
Gill nets			17	2,450	24	780	41	3,230
Fathoms			850		400		1,250	
Total		443,346		949,006		4,260		1,396,612
PERSONS ENGAGED.								
Fishermen:								
Whites	52		67				119	
Natives	2				1		3	
Others	4						4	
Total	58		67		1		126	
Shoresmen:								
Whites	42		166				208	
Natives	27		1		2		30	
Others	8						8	
Total	77		167		2		246	
Transporters: Whites			4				4	
Grand total	135		238		3		376	
PRODUCTS.								
Canned (1-pound cans)							[1] 3,602	28,980
Fresh for food							[2] 2,400	105
Fresh for bait							[2] 1,559,100	21,167
Frozen for bait							[2] 2,525,700	20,027
Pickled for food, Scotch cure							[2] 8,223,490	490,485
Pickled for food, spiced							[2] 8,000	400
Pickled for food, Norwegian cure							[2] 344,619	22,199
Fertilizer							[2] 6,078,000	316,161
Oil							[3] 681,067	404,090
Total								1,303,614

[1] Cases. [2] Pounds. [3] Gallons.

COD FISHERY.

The changes of note in the cod industry of Alaska in 1920 were increases in production of 17 per cent, 14 per cent in number of persons employed, and 60 per cent in investment. These expansions are recorded notwithstanding the withdrawal of J. A. Matheson, of Anacortes, Wash., who for many years was listed as an important operator in the vessel fishery of western Alaska. The Bering Sea Fisheries Co. appears as a new concern in this industry, but in reality it is understood to be only an organization of the interests previously shown under the name of Lars Mikkelsen. Operations by the Pacific American Fisheries in the vicinity of Unimak Island and W. J. Erskine Co. in the Kodiak region account largely for the increased production of cod in 1920 over that of 1919. It is noteworthy that approximately 28 per cent of the cod taken in Alaskan waters was reported as of shore-station catch. Generally the smaller producers of cod are the operators of shore stations only.

The Alaska cod industry is facing a decline of serious proportions in view of the active competition which has developed rather recently through deliveries of cod by Japanese vessels. Under present conditions this competition bids fair to increase to the great disadvantage of the Alaska cod industry.

VESSEL FISHERY.

Owing to the withdrawal of J. A. Matheson, the schooner *Fanny Dutard* does not appear in the list of vessels forming the cod fleet of 1920. The *Chas. R. Wilson*, a schooner heretofore listed as one of the vessels of the Pacific Coast Codfish Co., was also withdrawn from the Alaska field. Offsetting these withdrawals are two notable additions to the list of vessels in the fleet of 1920. One was that of the schooner *S. N. Castle*, belonging to the Alaska Codfish Co., and the other that of the schooner *Carolyn Frances*, owned by the Union Fish Co., which company further increased its fleet by adding the schooners *Eunice*, *Mary E*, *Chas. E. Brown*, and the power schooner *Progress*. The W. J. Erskine Co. reported nine small vessels engaged in cod fishing at Kodiak, two of which were listed in 1919. The Alaska Codfish Co. added the *Alasco IV* to its fleet of small power vessels in Alaska.

The fleet in 1920 was composed of 36 vessels, 16 of which were schooners of more than 100 tons register. This is an increase of 11 over the number listed in 1919. The total tonnage of the fleet in 1920 was 5.171 net tons, as compared with 4.234 net tons in 1919.

SHORE STATIONS.

The important shore stations of Alaska were operated and located as follows: O. Kraft & Son at Kodiak; the Union Fish Co. and the Alaska Codfish Co. at several stations in the Shumagin and Sanak Islands; the Bering Sea Fisheries Co. at Unga; and four stations in the Aleutian Islands Reservation.

ALASKA COD FLEET IN 1920.

Name.	Rig.	Net tonnage.	Operators.
City of Papeete	Schooner	370	Alaska Codfish Co., San Francisco, Calif.
Glendale	do	281	Do.
Maweema	do	392	Do.
S. N. Castle	do	464	Do.
Alasco	Power schooner	23	Do.
Alasco II	do	5	Do.
Alasco III	do	8	Do.
Alasco IV	do	14	Do.
Trio	do	9	Alaska Ocean Food Co., Seattle, Wash.
Dora	Steamer	217	Bering Sea Fisheries Co., Seattle, Wash.
Lister	Power schooner	15	W. J. Erskine Co., Kodiak, Alaska.
Pilgrim	do	8	Do.
Northern King	do	8	Do.
Patmos	do	17	Do.

ALASKA COD FLEET IN 1920—Continued.

Name.	Rig.	Net tonnage.	Operators.
Edith	Power schooner	7	W. J. Erskine Co., Kodiak, Alaska.
Buffalo	....do	15	Do.
Flossie	....do	6	Do.
Nimrod	....do	8	Do.
North Star	....do	15	Do.
John A	Schooner	235	Pacific Coast Codfish Co., Seattle, Wash.
Maid of Orleans	....do	171	Do.
Alice	....do	220	Robinson Fisheries Co., Anacortes, Wash.
Wawona	....do	413	Do.
Golden State	Power schooner	223	Union Fish Co., San Francisco, Calif.
Eunice	Schooner	35	Do.
Progress	Power schooner	115	Do.
Mary E	....do	21	Do.
Chas. E. Brown	Schooner	64	Do.
Carolyn Frances	....do	422	Do.
Sequoia	....do	324	Do.
Galilee	....do	328	Do.
Beulah	....do	339	Do.
Louise	....do	328	Do.
Martha	....do	14	Do.
Pirate	Power schooner	30	Do.
Union Flag	....do	7	Do.

STATISTICAL SUMMARY.

The total investment in the cod industry of Alaska in 1920 was $2,057,728, as compared with $1,286,075 in 1919, an increase of $771,653. Employment was given to 803 men, as against 702 in 1919. The production of cod in 1920 was 12,763,899 pounds, valued at $1,117,464, being an increase over the output of 1919 by 1,870,587 pounds and $291,474 in value.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA COD FISHERY IN 1920.

Item.	Quantity.	Value.
INVESTMENT.	*Number.*	
Value of shore stations		$405,583
Cost of operations		490,229
Wages paid		440,384
Vessels:		
Power vessels over 5 tons	20	232,912
Net tonnage	767	
Sailing	16	380,074
Net tonnage	4,400	
Launches	115	67,373
Dories	371	17,761
Pile drivers	3	3,603
Apparatus:		
Seines (75 fathoms)	1	250
Gill nets (75 fathoms)	1	195
Lines	472	19,364
Total		2,057,728
PERSONS ENGAGED.		
Fishermen:		
Whites	695	
Natives	38	
Total	733	
Shoresmen:		
Whites	27	
Natives	2	
Total	29	
PERSONS ENGAGED—contd.	*Number.*	
Transporters: Whites	41	
Grand total	803	
PRODUCTS.		
Vessel catch:	*Pounds.*	
Dry-salted cod	8,887,339	$712,948
Pickled cod	168,730	10,123
Fresh cod	565	23
Tongues	16,600	1,244
Total	9,073,234	724,338
Shore-station catch:		
Dry-salted cod	1,949,982	219,162
Pickled cod	1,726,908	171,524
Stockfish	12,775	2,300
Tongues	1,000	140
Total	3,690,665	393,126
Total:		
Dry-salted cod	10,837,321	932,110
Pickled cod	1,895,638	181,647
Fresh cod	565	23
Stockfish	12,775	2,300
Tongues	17,600	1,384
Grand total	12,763,899	1,117,464

The known losses in the cod industry were comparatively small. Three fishermen were drowned and one shoresman was accidentally killed. The loss of small boats and fishing tackle, valued at $10,461. and the loss of the steamer *Dora*, owned by the Bering Sea Fisheries Co., and valued at $50,000, were reported. The *Dora* was wrecked on December 20, 1920, at Hardy Bay, on the northeast coast of Vancouver Island, B. C., and thus, after 40 years of almost continuous service, at times under very trying conditions, there was lost the most historic vessel plying Alaskan waters.

WHALE FISHERY.

SHORE STATIONS.

Whaling operations in Alaska in 1920 were carried on by four companies, namely, United States Whaling Co., at Port Armstrong; North Pacific Sea Products Co., at Akutan; J. A. Magill & Co., at Beluga River, on Cook Inlet; and the Arctic Whaling & Fishing Co., at Golovin Bay.

The North Pacific Sea Products Co. operated four steam whaling vessels, the *Kodiak* and *Unimak* (each 99 tons net), *Tanginak* (71 tons net), and the *Paterson* (77 tons net). It also used the barge *Fresno* (1,149 tons net) and the steamer *Elihu Thomson* (449 tons net) as transporting vessels. Its operations were carried on in the waters of the Pacific Ocean and Bering Sea contiguous to the Aleutian Islands. Four species of whales were taken—the finback, humpback, sulphur-bottom, and sperm—almost half of the catch being finbacks. A total of 290 whales was taken by this company.

The United States Whaling Co. operated in the coastal waters of southeastern Alaska from Dixon Entrance to Cross Sound, the important hunting ground paralleling the coast at an approximate distance of 25 miles. Three steam whaling vessels were engaged in the hunting of whales. They were *Star I* (133 tons net) and *Star II* and *Star III* (each 97 tons net). A total of 139 whales was taken. Five species were represented, the sei whale being secured in addition to the four species taken in western Alaska.

J. A. Magill & Co. operated the plant on Beluga River, formerly controlled by the Beluga Whaling Co. This company captured 100 belugas or white whales, this being by far the most successful season experienced at that station.

The Arctic Whaling & Fishing Co. operated in the vicinity of Nome and succeeded in capturing 136 belugas.

STATISTICAL SUMMARY.

The whaling industry of Alaska shows an investment of $1,700,910 in 1920, a decrease of $89,957 from 1919. It gave employment to 318 men, or 7 more than in 1919. Whale products were valued at $562,302, as compared with $1,027,200 in 1919. The total number of whales taken was 665, or 85 more than in the preceeding season.

INVESTMENT, PERSONS ENGAGED, AND PRODUCTS OF ALASKA SHORE WHALING OPERATIONS IN 1919.

Items.	Number.	Value.	Items.	Number.	Value.
INVESTMENT.			PRODUCTS.		
Vessels:			Whales:		
Steam and gas	9	$471,000	Finback	179	
Net tonnage	1,121		Humpback	75	
Barge	1	30,000	Sulphur-bottom	81	
Net tonnage	1,149		Sperm	90	
Launches under 5 tons	5	6,400	Sei	4	
Row boats	19	1,360	Beluga	236	
Scows	5	2,800			
Pile driver	1	150	Total	665	
Value of plants		366,246			
Cash capital		546,946	Whale oil	[1] 765,309	$304,256
Wages paid		276,008	Sperm oil	[1] 343,611	131,783
			Fertilizer, meat	[2] 1,218	101,105
Total		1,700,910	Fertilizer, bone	[2] 377	18,815
			Whalebone	[3] 17,484	6,118
PERSONS ENGAGED.			Ivory, sperm	[3] 750	225
Whites	239		Total		562,302
Natives	46				
Japanese	33				
Total	318				

[1] Gallons. [2] Tons. [3] Pounds.

CLAM CANNING.

A few years ago the canning of clams in Alaska gave promise of becoming an industry of some consequence, as it was then generally held that the areas occupied by clams were reasonably extensive, fairly accessible, and that they might support an independent industry for some time to come; but to date almost no attempt has been made to develop clam fisheries at any other locality than the Cordova district. Production in that field began to decline in 1919. The results of operations in 1920, with only one company packing clams at Cordova as against three in 1918, show that this decline is still in progress. In addition to the exhaustion of the clam beds it was also apparent that the increasing cost of the raw product to the packers was a vital factor in the life of the industry. Owing to the diminution in the supply of clams the diggers encountered greater difficulty in making wages, which necessitated a demand from them for a higher rate per pound for clams.

Clam canning was carried on by the Pioneer Packing Co., at Cordova; Surf Packing Co., at Chisik Island, Cook Inlet; and the Douglas Island Packing Co., at Douglas. These companies were also engaged in canning salmon, for which reason the plant investment is credited to that industry. There were employed 57 diggers, to whom wages amounting to $9,387 were paid. A total of 6,833 cases of clams and clam juice was prepared, the value of which was $46,812.

Products of Alaska Clam-Canning Industry in 1920.

Items.	Cases.	Value.
Minced clams:		
½-pound cans (48 per case)	424	$3,384
No. 1 eastern oyster cans (48 per case)	5,876	41,132
1-pound cans (48 per case)	17	136
2-pound cans	380	1,748
Clam juice, 8-pound cans	136	412
Total	6,833	46,812

MINOR FISHERIES.

TROUT.

The output of trout in Alaska in 1920 was practically equal in quantity and value to that of 1919, when it was valued at $13,155 as against $13,662 in the past year. Southeastern Alaska led in production, as approximately but 20 per cent of the catch came from central and western Alaska, as compared with 27 per cent from those districts in 1919 and 79 per cent in 1918. The chief factor contributing to this result was the continued closure of the cannery of the Midnight Sun Packing Co., at Kotzebue Sound, where a few thousand cases of Dolly Vardens were canned annually prior to 1919.

The bulk of the catch of both steelhead and Dolly Varden trout was handled as fresh or frozen fish by the Ripley Fish Co., and Libby, McNeill & Libby, in southeastern Alaska. All canned trout came from central and western Alaska. No investment is credited to this business, as all operations were incidental to halibut and salmon industries.

Products of Alaska Trout Fishery in 1920.

Section and species.	Fresh.		Frozen.		Pickled.		Canned.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Barrels.*	*Value.*	*Cases.*	*Value.*
Southeast Alaska:								
Steelhead	26,751	$1,414	17,344	$2,601				
Dolly Varden	26,326	6,726	250	25	5	$75		
Total	53,077	8,140	17,594	2,626	5	75		
Central:								
Steelhead							427	$2,126
Dolly Varden	3,420	342	379	20	5	75		
Total	3,420	342	379	20	5	75	427	2,126
Western Alaska: Dolly Varden							43	258
Grand total	56,497	8,482	17,973	2,646	10	150	470	2,384

SABLEFISH.

As may be generally known, the catch of sablefish each year is made almost wholly by halibut fishermen operating in the offshore waters of Alaska, and the quantity reported annually fluctuates with market demands and the willingness of the fishermen to utilize space in their boats for sablefish which might be filled more profitably with halibut. In 1920 the production of sablefish reached a total of 584,251 pounds, valued at $28,544. There was an increase of 74,882 pounds in products but a decline of $6,941 in value from the corresponding figures reported in 1919. Statistics show that 565,926 pounds, valued at $27,770, were frozen; 3,000 pounds, valued at $140, were pickled; and 15,325 pounds, valued at $634, were shipped fresh to the States.

CRABS.

Some change was noted in 1920 with respect to the utilization of crabs in Alaska. The Arctic Packing Co. and Eda O. Kitzman canned experimentally a few cases of crabs at Seldovia, in central Alaska. John Murphy, at Tenakee, was the only operator engaged in crab fishing in southeastern Alaska. The investment in the crab fishery was $750. The products were 70 cases of canned crabs, valued at $1,050, and 6,350 pounds of crabs sold fresh for $690. The total value of all crab products was $1,740.

SHRIMPS.

Encouraging interest in the shrimp fishery of southeastern Alaska was manifested in 1920 by the Alaskan Glacier Sea Food Co., at Petersburg. The investment in the shrimp industry was reported as $76,100, of which amount $24,500 was paid in wages to 14 whites, 5 natives, 20 Japanese, and 1 Mexican. Four boats and six trawls, valued at $29,600, were operated in this fishery. The total production of shrimp was 112,045 pounds, valued at $49,123. The products of this fishery were more than double those of 1919, and it would therefore seem that the competition of the southern shrimp fisheries had not seriously affected operations in Alaska.

MISCELLANEOUS FISHERY PRODUCTS.

This classification of products includes red rockfish, flatfish, and smelts. Products aggregated 11,073 pounds, valued at $229, practically all of which were frozen.

FUR-SEAL INDUSTRY.

PRIBILOF ISLANDS.

GENERAL ADMINISTRATIVE WORK.

In 1920 the work of the Bureau at the Pribilof Islands was carried on in the usual manner. Sealing operations were upon practically the same scale as in the previous year, but a more extensive study of experimental methods in taking and curing skins was made, the results of which will be applied upon a commercial scale in succeeding seasons. The take of pelts from the blue fox herds was the largest for many years. Progress was made in construction work, additional housing facilities being provided for natives on St. Paul Island and increased salt house and workshop space on both islands to handle larger takes of fur-seal and fox skins. The census of the fur-seal herd was taken as usual. The annual supplies for the islands were transported chiefly by the Navy Department, but considerable assistance was given by Coast Guard vessels, and the Bureau's vessel *Eider* rendered valuable service between Unalaska and the Pribilofs.

PERSONNEL.

Effective July 1, Agent and Caretaker A. H. Proctor, of St. Paul Island, was appointed to the new position of superintendent, Pribilof Islands, to have general direction of the work on the two islands. Storekeeper H. D. Aller, who had been detailed to the Washington office during the previous winter, was appointed agent and caretaker of St. Paul Island, arriving there October 26 on the U. S. S. *Saturn*. When Agent and Caretaker Charles E. Crompton left for the States September 9 on the *Saturn*, St. George Island was placed in charge of Storekeeper E. C. Johnston. After taking leave of absence, Mr. Crompton proceeded east via St. Louis, arriving at the Washington office January 5, 1921, for duty through the winter. School-teacher E. C. Johnston, of St. George Island, was appointed storekeeper, effective April 27; he was succeeded by Carl E. Fletcher, who reached the island on the *Saturn* June 16, and, having tendered his resignation, left on the same vessel in October. John M. Orchard was then appointed school-teacher of St. George Island and arrived there on the *Saturn* October 29. Herschel Silverstone, assistant to the agent on St. Paul Island, tendered his resignation and left by the Coast Guard cutter *Bear* in October. Mr. Silverstone was succeeded by Henry Mygatt, who arrived on the *Saturn* October 26. Assistant Agent H. C. Scudder was appointed storekeeper on St. Paul Island, arriving there October 26. George Haley resigned as school-teacher on St. Paul Island and left the islands on the *Saturn* in June. Mr. Haley was succeeded by Richard Culbertson, who arrived at St. Paul Island on the *Saturn* June 17. Dr. Washington C. Huyler was appointed physician for St. Paul Island, but resigned soon after his arrival and returned on the *Saturn* in November. Dr. J. J. Richstein, resigned, left St. Paul Island at the same time. Dr. G. B. Bowlby was appointed to succeed Dr. Huyler and was en route to the island via Kodiak at the close of the year. Warden Joseph N. Braun arrived at St. George Island on the *Algonquin* September 19, having been detailed for general duty there during the winter.

In the list of temporary employees was Dr. G. Dallas Hanna, curator of invertebrate paleontology at the California Academy of Sciences and formerly in the Alaska service of the Bureau, who arrived at the islands on the *Saturn* June 16 and left on the same vessel September 9; in the interim he was engaged in taking the annual census of fur seals, making several trips between the islands. Dr. H. A. Swanson was employed as a dentist for several months, spending part of his time on each island. W. C. Allis, special assistant on St. Paul Island, left there in October for a winter in the south, having been on the island since early in 1919. H. A. Peterson, sealing assistant, arrived on the *Saturn* in June and remained for the winter. Messrs. W. P. Zschorna, F. L. Milligan, O. E. Klockenbrink, M. Syron, and J. H. Quatmann, employees of Funsten Bros. & Co., of St. Louis, spent the summer on the island in connection with experimental work in improving methods of handling and salting sealskins. Mr. Milligan spent part of his time on St. George Island. Andrew Pearson and Ole Holum, carpenters, were on hand from May until November; the former was continuously on St. Paul Island but the latter was sent to St. George Island for a few weeks.

Ward T. Bower, of the Washington office, visited the islands during the summer for the purpose of getting in closer contact with the activities there, reaching the islands July 1 and leaving July 18. Passage between the islands and King Cove was furnished by the Bureau's vessel *Eider*, and between King Cove and Seattle by commercial vessels.

PURCHASE AND TRANSPORTATION OF SUPPLIES.

As in previous seasons, printed schedules of annual supplies of general merchandise required for the Pribilof Islands were prepared and competitive bids received for the sale and delivery of the goods at Seattle, Wash. Through the courtesy of the Navy Department the radio tender *Saturn* was made available for the transportation of the annual supplies, the vessel making two trips to the islands to complete the work.

On the first trip the *Saturn* had considerable cargo for the radio stations, hence only part of the Bureau's supplies could be taken. On this voyage the vessel sailed from Seattle August 8, carrying 260 tons of general supplies, 77,000 feet of lumber, and 225 tons of coal for St. George Island; and a shipment of empty barrels, 80 tons of coal, and a few tons of general merchandise for St. Paul Island. Owing to unusually severe weather conditions, however, but very little of this cargo was discharged at the Pribilofs, the major portion being unloaded at Dutch Harbor. The vessel then returned to Bremerton and Seattle, leaving the latter place October 13 with the balance of the supplies. This cargo, and a part of that which had been left at Dutch Harbor, was landed at the islands under adverse conditions. The lumber and some of the coal purchased for St. George Island remained at Dutch Harbor.

During the summer and fall the vessels *Unalga* and *Algonquin* of the Coast Guard very courteously assisted the islands in the transportation of coal and much-needed supplies from Unalaska and Dutch Harbor.

The Bureau's tender *Eider* made a trip to the islands in the month of September and again in October, carrying staple foodstuffs and coal to relieve the shortage which existed until the arrival of the *Saturn* on her second trip.

POWER SCHOONER "EIDER."

The Bureau's power schooner *Eider*, which was purchased and sent to Alaska late in 1919 as a tender for the Pribilof Islands, thoroughly demonstrated its value in the calendar year 1920, making in all 11 round trips between Unalaska and the islands and 2 trips to King Cove from Unalaska before it became necessary in November for the vessel to proceed to Kodiak for certain urgent repairs. All told, 7,959 miles were covered during the year. As Bering Sea is not generally navigated during the winter months and a vessel operating there would be unable to secure assistance in distress, all precautions possible were taken for the safety of the craft during periods of severe weather. Trips to the islands were made as follows: One in January, two in April, one in May, one in June, three in July, one in August, one in September, and one in October. Trips to King Cove were made in June and July.

Early in April the *Eider* transported a special shipment of 1,312 fur-seal skins and 938 fox skins from the islands to Unalaska, from which place they were taken by the commercial steamer *Victoria* to Seattle. The second trip in April from Unalaska to the islands was chiefly to deliver fuel oil for the naval radio stations. During the season the vessel transported general cargo and carried passengers for the radio stations as well as white employees and native workmen of the Bureau's service between Unalaska and the islands, and was also used at St. Paul Island to transfer salted sealskins from Northeast Point to the village. Naval stores were carried on a number of trips by the vessel. The better mail service between the islands and Unalaska, the nearest post office, was of special value.

On October 18 the *Eider* was placed under quarantine for smallpox, of which there was a rather serious outbreak at Unalaska. After the quarantine was lifted the vessel aided in landing cargo from the *Saturn* and otherwise acted as tender for that vessel until again quarantined when a case of smallpox developed aboard the *Eider* November 10. After clearing the second quarantine the *Eider* left for Kodiak November 28 for repairs and to furnish transportation to a physician for St. Paul Island on the return trip. The vessel was at Kodiak at the end of the year.

The officers and crew of the *Eider* deserve commendation for making hazardous trips to the islands during the winter season and at times of the year when no vessel ever before was at the Pribilofs.

DEPARTMENTAL ORDER REGARDING VISITING OF FUR-SEAL ROOKERIES.

For the purpose of definitely regulating the movements of persons temporarily or otherwise present at the Pribilof Islands, the following order was issued by the Secretary of Commerce on March 2, 1920, and the regulations therein were put into effect at the islands during the summer of 1920:

> Section 293, Compiled Laws of Alaska, 1913, provides that it shall be unlawful for any person to land or remain on any of the Pribilof Islands, except through stress of weather or like unavoidable cause or by authority of the Secretary of Commerce.
>
> In order that the interests of the Government may be properly served in the matter of protecting the fur-seal rookeries from unnecessary disturbance and in the matter of avoiding the driving of hauling-ground seals into the water, the following regulations are hereby promulgated:
>
> 1. Persons lawfully landing, whether to remain temporarily or otherwise, must confine themselves to their lawful activities, and any visiting of rookeries or hauling grounds of seals or sea lions must first be authorized by the Department's agents in charge.
>
> 2. In order that persons authorized or permitted to land may have an opportunity to observe seal life, the Department's agents in charge will provide escorts, when practicable, to accompany interested persons to proper observation points. No side digressions from the designated observation points will be permitted. There will be no visiting of rookeries except under such escorts. On St. Paul Island the usual observation point for persons temporarily present shall be what are commonly known as "Observation Rocks" at Gorbatch rookery.
>
> 3. Persons authorized to land at St. Paul Island, whether to remain temporarily or otherwise, are required, except under circumstances specifically authorized by the Department's agent in charge, to remain on that portion of the island in and about the village of St. Paul which is bounded by the shore line, including that of the salt lagoon and its outlet, and two straight lines running approximately as follows: The first from the shore at Black Bluffs to the southerly portion of the salt lagoon, passing to the eastward of the natives' cemetery, the natives' wells, and the by-products plant; the second to cut across the isthmus at Zolotoi Sands. The land lines as described will be indicated by notices posted at suitable intervals.
>
> 4. Any person willfully violating these regulations will be regarded as a trespasser and will be required to leave the islands at the first opportunity, or will be subject to such other action as may be deemed appropriate.

The above rules have become necessary primarily because of the great importance of nondisturbance of hauling ground seals during the few weeks of active commercial sealing when a thoughtless intrusion upon the seals of that class might mean a large financial loss to the United States. The unnecessary disturbance of seals on their breeding areas is also quite undesirable. Signs designating the limits of the unrestricted district in the vicinity of the village were posted on St. Paul Island, and on St. George Island a definite observation point was selected and marked where visitors, under escort, might see the rookery life without disturbing seals of any class.

CONSTRUCTION WORK.

Considerable construction work has been accomplished at the Pribilofs during the year. On St. Paul Island a new salt house was completed, a concrete native dwelling was built, and two frame houses for natives were completed. Some of this work had been started the previous year. A garage to house the four tractors on St. Paul Island was built. A concrete extension to the wharf was completed. There is more work to be done along this line as soon as time and funds permit. Various repairs to native dwellings, improvements at the by-products plant, the construction of outhouses, and minor matters were given attention. A road grader was sent to St. Paul Island and some work in improving roads was undertaken.

On St. George Island an extension to the wharf was completed and the landing slip was enlarged, thus facilitating the discharge of small boats lightering cargo ashore. Also some blasting was done at East Landing, thus making possible the construction of a short roadway for handling boats. Preliminary work, including completion of excavation, was done toward the construction of a combined shop and warehouse urgently necessary to provide storage and handling space for the increased take of fox skins. The kenches in the old salt house were transferred to the new salt house, thus bringing sealskin work into a single building. Alterations were made at the fox house to allow trapping, regardless of the direction of the wind.

USE OF TRACTORS.

The four tractors which were forwarded to St. Paul Island on the supply vessel late in 1919 were used during the season of 1920 with satisfactory results. They were employed, with trailers, for general hauling in and about the village, hauling sealskins from the killing fields to the salt houses and moving carcasses to the by-products plant. Also they were found to be of great value in handling the large quantities of lumber, coal, and general cargo landed from the supply ship, and which, owing to the uncertainty of weather conditions in Bering Sea, must be landed and stored as rapidly as possible. In conjunction with a road grader and trailers the tractors rendered good service in the construction of roads.

BY-PRODUCTS PLANT.

The by-products plant on St. Paul Island was operated during a part of the summer of 1920. A shortage of coal made it necessary to close the plant much earlier than had been originally intended. During the period the plant was in operation it produced approximately 19,000 pounds of fertilizer meal and 1,853 gallons of oil, of which 361 gallons were No. 1, 1,299 gallons No. 2, and 193 gallons No. 3. A shipment of 15,393 pounds of meal produced this season was sold at Seattle for $68 per ton, bringing a total of $523.36; the remainder of the meal is still at the island. The oil is in storage at Seattle pending decision as to its most advantageous disposition; the market for this product was very poor at the close of the year.

During the summer of 1920 an experiment was conducted to determine the comparative values of oil rendered from the carcasses of seals which had been dead for different lengths of time. It was considered possible that in the cool climate of the Pribilofs the factor of decomposition might be of less consequence than is the case where animal oils are handled in warmer regions. Accordingly samples were taken of oil rendered from carcasses of seals which had been dead 1, 2, 3, 4, 5, 6, 7, 10, 11, and 12 days, and these were later forwarded to the Bureau of Standards.

The report on the analyses showed that with seal blubber, as in other animal fats, a decided increase in free fatty acids takes place within a very few days. The acid number of the seal oil samples ranged from a minimum of 2.8 for the first two days to a maximum of 13.3 on the tenth day after killing. Reference to the New York market quotations at the end of the year showed a price of 45 cents per gallon for herring oil containing less than 5 per cent of acids, while only 28 cents per gallon was offered for the same oil containing between 5 and 10 per cent of acids. The seal-oil samples taken 10, 11, and 12 days after killing showed an average acid number of 11.2, and the samples for the third, fourth, fifth, sixth, and seventh days had an average acid number of well over 5. In view of the great depreciation in value of oils having a high acid content, it is of primary importance that the oil be rendered from the animal tissues as early as practicable. Other features of the analyses did not show progressive changes on which sound conclusions could be based.

IMPROVED SEALING METHODS.

With a view to securing improvement in the quality of the sealskins prior to the dressing and dyeing processes, the study of sealing methods at the islands was continued in 1920. W. P. Zschorna, who carried on preliminary work in 1919 for the Bureau, was in charge of experimental work this year for Funsten Bros. & Co. Four other employees of the company, namely, Michael Syron, Oliver E. Klockenbrink, Frank L. Milligan, and J. H. Quatmann, were detailed for duty at the Pribilofs during the active sealing season and assisted in this special work. Particular attention was given the features of blubbering and washing the raw pelts before salting, and of salting the skins only once instead of twice, as formerly. While this work was of an experimental character, it was on a scale sufficiently large to warrant its being used as the basis for making changes if any were found to be desirable.

The method of handling raw sealskins in effect for many years was to allow them to lose their natural heat while lying on the killing field. They were then taken to the salt houses, and at the end of five days were removed, examined for faulty curing, and returned to the salt to await shipment, usually at least five or six weeks later. In the summer of 1920, however, 1,000 skins were given different treatment on St. Paul Island. Immediately after killing, or as soon as they could be hauled in from the killing fields, these skins were cooled in a tank of running sea water; all blubber and meat was carefully removed, they were again washed, and then were stretched and placed in salt to remain until removed for shipment. Advance reports on these skins indicate that they are of such an improved quality as to warrant the extension of the washing, blubbering, and stretching of the pelts to the whole take of skins.

A feature of the new plan is the taking of sealskins by the so-called rough method, which consists in leaving considerable quantities of blubber and meat on the pelt when it is removed from the animal. In addition to securing more evenly cured skins, the new method does away with the chances for cutting or flaying the skins on the killing field as the subsequent removal of the blubber and meat makes it unnecessary for the skinner to cut close to the pelt. The following comments by the Gibbins & Lohn Dressing & Dyeing Co., of St. Louis, in regard to the blubbered and washed skins of 1920, show some of the practical advantages of the new treatment:

> The benefit of the better curing and more uniform condition of the pelts is apparent throughout the various dressing processes. The washing is rendered easier, more efficacious, and safer than on ordinary skins. The better condition of the pelts is also felt in the unhairing process. The hair on the yellow spots is always quite difficult to remove. It is generally necessary on such pelts to loosen the hair by a slight and controlled sweating action, which can not be advantageous, for it has a tendency to loosen fur as well as hair. It was found that in the white-blubbered pelts the hair could be loosened by the unhairing process and the fur left firmer and set tighter when the process was finished. In other words, the hair was easier to remove because the fur held firm. Another result is that more of the fine hair is removed during the unhairing. While this fine hair can be clipped out during the subsequent machining process, a better finished product is obtained if it is removed during the unhairing.

In addition to the skins which were washed and blubbered, a portion of the catch was handled in the usual manner and then cooled by washing before salting; others were given no special treatment beyond a stretching at the time of salting. Various small lots of skins were treated in different ways, the entire effort being toward developing improved methods.

It is probable that the blubbering, washing, stretching, and single salting will be conducted on a larger scale in the season of 1921, as there is every reason to believe that the new methods result in a superior finished product.

NATIVES.

HEALTH CONDITIONS.

The maintenance of good health among the natives on the Pribilof Islands is not only one of the responsibilities resting upon the Bureau in its administration of affairs there, but it is greatly to the interest of the Government to give the best of care to the communities which perform the bulk of the manual labor incidental to the valuable and remunerative industries centering on the islands.

A resident physician is stationed on each of the two islands primarily for the purpose of attending to the health of the natives. Well-stocked dispensaries are provided and a small hospital is available on St. Paul Island. A building to contain hospital facilities is to be constructed on St. George Island in the near future.

During the summer and fall of 1920 a dentist was employed to give attention to the needs of the natives and others on the Pribilofs and he was fully occupied during his entire stay. Another dentist will be secured for the coming year to continue this important work.

It is especially noteworthy that on St. George Island, with a population of about 135 persons, no deaths occurred for a period of 15 months ending June 19, 1920. This is unprecedented in the history of the Pribilofs.

SCHOOLS.

St. Paul Island.—The senior school on St. Paul Island, under the direction of George Haley, was opened on September 22, 1919, and continued until May 28, 1920. The enrollment consisted of 66 pupils. The usual methods were followed in the teaching of the children, particular stress being placed upon subjects which would tend to bring about the increased use of the English language. In resigning at the close of the session, Mr. Haley terminated a period of service in the island schools extending over six years.

St. George Island.—On St. George Island the senior school was opened on October 7, 1919, and closed May 14, 1920, with an enrollment of 34 pupils. The percentages of attendance and punctuality were 99.45 and 99.52, respectively. In discussing the methods of instruction and administration used in the school, Mr. Johnston states:

The pupils were divided into five general classes and again subdivided where necessary. These subdivisions varied with the different subjects of instruction, but were determined more by the intelligence and capabilities of the pupils.

The use of English was always required in the schoolroom. Several days sometimes passed without a word of Aleut being spoken. At recess and at home the pupils were encouraged to speak English.

When the Aleut children can understand English with more ease and quickness, especially as it is spoken, they will advance in their other studies at a surprisingly rapid rate. This inability to understand many explanations given by the teachers, no matter how simple they are, makes such studies as arithmetic difficult. In every recitation the study and use of English was of paramount importance.

In the fourth and fifth reading classes the text was discussed and commented upon by the pupils so that they would understand the English phraseology The lower classes were given drills in vocabulary and pronunciation. Compositions on stories in the readers were rather poor, as it seemed hard for most of the children to grasp the important points of a story. The following will illustrate: In the geography textbook a paragraph would describe a river system. The final sentence of the description would be: "This is called a river system." The pupils, in spite of continuous instruction, would give the sentence quoted above as the definition of a river system.

Compositions were frequently called for, the subjects being chosen by the pupils or by the teacher. Letters were written to friends at other places. All written work was corrected and handed back to be rewritten or discussed in class.

During the second half of the term the fifth class kept individual diaries. They understood the purpose of the diary easily, and noted many details which most children would not remember The diaries were examined once a week and individual instruction was given to the writer on his mistakes in grammar, spelling, etc.

It was not necessary to inflict corporal punishment at any time. Standing up in front of the school, staying in at recess, etc., proved sufficient. Strange to say, the pupils did not like to be sent home from school, a fact used to advantage in inflicting punishment.

In addition to the senior school, classes for small children were conducted by Mrs. Ella J. Johnston. This junior school was carried on between the dates given above for the session of the larger school. The enrollment was made up of six girls and five boys. Simple work, similar to that given in kindergarten classes, forms the basis of the work in the junior school. These classes are very valuable in preparing the children for entrance into the senior school and enabling them to take up their work to greater advantage than would otherwise be the case. Mr. Johnston's report comments upon the work of the junior school as follows:

The value of this preparatory course can be realized best by those who take up the child's instruction in the senior school. Last term one of the boys coming to the junior school for the first time was so frightened that he cried lustily until one of his sisters stood beside him. He continued to do this for six weeks. At the end of that time he became interested, and it was hard to persuade him to go home at the end of the period. Without this experience in the junior school, the boy would have caused considerable trouble in the senior school, besides delaying his own advancement.

Sewing classes were also conducted for the larger girls by Mrs. Johnston, various practical stitches being taught. Useful articles, such as sewing bags, needlecases, and aprons were made, and interest was stimulated by the fact that the girls were allowed to keep the articles made.

ATTENDANCE AT SALEM INDIAN TRAINING SCHOOL, CHEMAWA, OREG.

Several native students from the Pribilof Islands are at the Salem Indian Training School at Chemawa, Oreg. None of the pupils returned to the islands, nor were any enrolled during the year; the list of pupils, therefore, remains the same as at the close of 1919.

PRIBILOF ISLANDS NATIVES AT SALEM INDIAN TRAINING SCHOOL, DEC. 31, 1920.

Fratis, Akalina [1]	Resident of St. Paul Island.
Fratis, Ouliana	Do.
Stepetin, Nicolai	Do.
Stepetin, Vasilii	Do.
Lekanof, George	Resident of St. George Island.
Merculief, Laurence	Do.

Ouliana Fratis has completed a course of study at the school and has since been given the responsibilities of acting as matron in one of the buildings for the smaller girls. It is doubtful whether she or her mother will ever return to the Pribilof Islands.

On November 18, 1920, Agent Crompton made an official visit to Chemawa for the purpose of later making recommendations regarding the policy of sending natives from the Pribilof Islands to that school. The following is extracted from his report:

Rumors had reached the island that the natives who were at Chemawa were not receiving good care, that their food was not plentiful and was of poor quality, and that the sleeping quarters were poorly heated. At first but little attention was paid to these reports, but they became quite persistent and resulted in my request for authority to investigate the matter. In addition there was a question regarding the general policy of sending natives to the States for their schooling.

I arrived at Chemawa late in the evening of November 17, 1920, and spent the entire following day at the school.

The superintendent, Mr. Harwood Hall, showed me through the classrooms of the institution during the forenoon, and the remainder of the day was spent in the various workshops and other buildings.

During the day all of the Pribilof boys were separately questioned regarding their comforts and treatment. They were informed that my visit was for the purpose of hearing their grievances if they had any, but they were unanimous in praise of their treatment, and in addition seemed to have a strong "school spirit" of pride in the institution. The boys were told that if they ever had any real grievances the agents at the Pribilof Islands wished to know of them, but that they should not worry their parents by writing about petty matters. Though I observed closely, nothing seemed to indicate that they were not well cared for in all respects. The food was inspected and the dormitories seen, and all was on an equality with conditions in first-class boarding schools.

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[1] Mother of Ouliana Fratis and employed at the school.

The question of sending natives from the Pribilofs to Chemawa, then, becomes one of policy rather than one of doubt regarding the care they might receive while there. In the writer's opinion it is not to the interest of the United States to send them to outside schools, and there is doubt that it adds to the ultimate happiness of the individuals. * * *

It is recommended that no more children be sent to the Chemawa school at the instigation of the Bureau.

SAVINGS ACCOUNTS.

Certain of the Pribilof Islands natives have personal funds in the custody of the United States Commissioner of Fisheries as trustee. These funds are still on deposit with the Washington Loan & Trust Co., Washington, D. C., and draw interest at 3 per cent per annum, calculated on monthly balances.

The condition of the account as a whole on December 31, 1920, is shown in the statement which follows:

Balance on hand Jan. 1, 1920	$3, 093. 57
Interest earned from Jan. 1 to Dec. 31, 1920	89. 92
	3, 183. 49
Withdrawn by natives during above period	343. 62
Balance on hand Dec. 31, 1920	2, 839. 87

An itemized statement of the account showing the individual balances of the natives is as follows:

PRIBILOF ISLANDS NATIVES' SAVINGS ACCOUNTS IN CUSTODY OF THE UNITED STATES COMMISSIONER OF FISHERIES, AS TRUSTEE, DEC. 31, 1920.

ST. PAUL ISLAND.	
Bourdukofsky, Apollon	$90. 42
Bourdukofsky, Peter	60. 70
Fratis, Agrifina [1]	92. 90
Fratis, Akalina [1]	547. 73
Fratis, Martha [1]	92. 91
Fratis, Ouliana [1]	92. 91
Gromoff, Iuliania	348. 70
Kozloff, Parascovia	7. 28
Krukoff, Ekaterina [2]	197. 91
Krukoff, Iuleta	8. 90
Mandregan, Alexandra M	10. 23
Melovidov, Alfey	43. 13
Melovidov, Anton	3. 70
Melovidov, Iosef	43. 13
Merculieff, Agafia [3]	38. 67
Merculieff, Dosofey	38. 67
Merculieff, Makary	38. 67
Merculieff, Mariamna [4]	64. 40
Merculieff, Paul A	$15. 16
Pankoff, Agrippina	235. 69
Pankoff, Maria M	43. 13
Sedick, Feofania	13. 47
Sedick, Lavrenty	13. 47
Sedick, Leonty	13. 47
Sedick, Marina	. 38
Tetoff, Vikenty M	43. 12
ST. GEORGE ISLAND.	
Borenien, Zoya [5]	235. 97
Galanin, Mary	155. 75
Lestenkof, Michael	118. 10
Merculief, Agrippina	64. 54
Merculief, Joseph	24. 28
Merculief, Polyxenia	12. 28
Shane, Michael	29. 65
Zacharof, Emanuel	. 45
Total	2, 839. 87

PAYMENTS FOR TAKING SEALSKINS.

Following the plan of the two preceding seasons, funds for paying certain persons engaged in the sealing operations at the Pribilofs in 1920 were advanced by Funsten Bros. & Co., and the firm was

[1] Not living on islands in 1920.
[2] New account; formerly account of Alexey Emanoff, deceased.
[3] New account; formerly account of Terenty Merculieff, deceased.
[4] Includes $24.98 transferred from account of Auxenia Diakanoff (Mrs. C. H. Hope).
[5] Includes $115.14 transferred from account of Mary Philemonof, deceased. Zoya Borenien was formerly Zoya Philemonof; now deceased and estate undivided.

duly reimbursed from the proceeds of the sale of the dressed and dyed skins. Under this arrangement the funds are deposited in a Seattle bank to the credit of the Bureau's authorized and bonded agent at the Pribilofs, who issues checks against the deposit covering accounts payable therefrom.

The practice of paying the island natives for their labor in taking commercial skins was continued. They were paid on the basis of 50 cents each for skins taken from seals up to and including the 6-year-old class, and $1 each for skins taken from seals of 7 years and upward. No payments are made for labor in taking the skins of seals which are killed primarily for food.

During the calendar year 1920 and through January 31, 1921, the following payments were made from funds advanced by Funsten Bros. & Co.:

Salaries of sealing assistants, St. Paul Island	$3,079.49
Wages of Aleutian Islands natives at St. Paul Island	4,275.43
Amount earned by St. Paul natives, 1920	11,112.00
Amount earned by St. George Island natives, 1920	2,127.00
Total	20,593.92

In addition to the above total, the sum of $645 was paid the natives of St. Paul Island during 1920, this amount representing an unpaid credit for the year 1919, which was entered as an undivided credit in the list of expenditures for that year.

Owing to the death of Peter Tetoff, one of the natives at St. Paul Island, there remains an unpaid balance of $246.50 on account of the sealing work for 1920 on that island; this amount will be paid to the estate of the deceased when it is settled, thus closing the account.

St. Paul Island.—Of the 22,220 skins taken on St. Paul Island during the calendar year 1920, the native workmen received payment for 21,097 skins at the rate of 50 cents each and 710 skins at the rate of $1 each; the other skins were from seals killed for food for which no payment was made. The fund was divided among the participating natives according to their ability, as follows:

DISBURSEMENTS TO ST. PAUL NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

Classification.	Number of men.	Share of each.	Total.	Classification.	Number of men.	Share of each.	Total.
First class	28	$246.50	$6,902.00	Fifth class	3	$99.50	$298.50
Second class	13	197.50	2,567.50	Additional compensation [1]			100.00
Third class	7	160.00	1,120.00	Total	54		11,358.50
Fourth class	3	123.50	370.50				

[1] Allowed 2 native foremen.

St. George Island.—Of the 4,428 skins taken on St. George Island during the calendar year 1920, 4,030 were paid for at the rate of 50 cents each and 12 at the rate of $1 each; the balance of the year's take was composed of skins from seals killed for food for which no credit was allowed. The resulting fund was divided among the natives who took part in the operations according to the extent and proficiency of their work. The division was made as shown in the following table:

DISBURSEMENTS TO ST. GEORGE NATIVES FOR SEALING OPERATIONS, CALENDAR YEAR 1920.

Classification.	Number of men.	Share of each.	Total.	Classification.	Number of men.	Share of each.	Total.
First class	14	$110.00	$1,540.00	Boys' class	3	$10.00	$30.00
Second class	3	79.00	237.00	Additional compensation [1]			100.00
Third class	1	62.50	62.50	Total	24		2,127.00
Fourth class	3	52.50	157.50				

[1] Allowed 2 native foremen.

PAYMENTS FOR TAKING FOX SKINS.

Following the plan of past seasons, natives at the Pribilofs were paid for their labor in taking fox skins during the winter of 1919–20 on the basis of $5 for each skin secured. The funds are credited to each community as a whole and are later divided among the participating workmen according to the extent and skill of their work. On St. Paul Island 188 skins were taken, resulting in a total credit of $940 to be divided among 43 men. On St. George Island 750 skins were obtained, making a total credit of $3,750 to be divided among 30 men. These sums will be paid from the proceeds of the sale of the skins, in February of 1921.

CENSUS.

The usual annual census of native inhabitants of the Pribilof Islands was taken on March 31, 1920. The following recapitulation shows a total of 336 natives accredited to the two islands, 4 of whom are attending the Salem Indian Training School at Chemawa, Oreg. The census of 1920 gives the same number of resident inhabitants for St. Paul Island as were present on March 31, 1919. On St. George Island a gain of 6 inhabitants is shown in the number actually resident:

RECAPITULATION OF CENSUS OF NATIVES, MAR. 31, 1920.

St. Paul Island:	
Resident population Mar. 31, 1919	188
Births in year ended Mar. 31, 1920	9
	197
Arrivals in year	14
	211
Deaths in year	7
	204
Departures in year, permanent—To Biorka Island	3
	201

Departures in year, temporary—	
To Unalaska	11
To St. George Island	2
	13
Total native resident population Mar. 31, 1920	188
Natives at Salem Indian Training School, Chemawa, Oreg	4
Others temporarily residing elsewhere	14
Total natives accredited to St. Paul Island	206
St. George Island:	
Resident population Mar. 31, 1919	122
Births in year ended Mar. 31, 1920	8
	130
Arrivals in year (from St. Paul Island)	2
	132
Deaths in year	0
	132
Departures in year, permanent—To Seattle, Wash	1
	131
Departures in year, temporary—	
To Chemawa, Oreg	1
To St. Paul Island	2
	3
Total native resident population Mar. 31, 1920	128
Natives at Salem Indian Training School, Chemawa, Oreg	2
Total natives accredited to St. George Island	130

FUR-SEAL HERD.

QUOTA FOR KILLING.

On May 26, 1920, the Bureau made recommendation to the Secretary of Commerce regarding the number of male seals which might be authorized for killing at the Pribilof Islands during the calendar year 1920. The Bureau's recommendation, approved by the Secretary May 26, 1920, was as follows:

QUOTA OF SEALS FOR KILLING IN 1920.

Age class.	St. Paul.	St. George.	Total.
3-year-olds	15,830	2,900	18,730
4-year-olds	4,400	1,100	5,500
7-year-olds and over	10,770		10,770
Total	31,000	4,000	35,000

The foregoing figures are those which were given the Bureau's representatives at the Pribilofs for their general guidance, the numbers to be killed being subject to revision should conditions observed at the islands during the progress of operations indicate the necessity therefor. As the season advanced it seemed wise to modify the original instructions, and accordingly, on July 22, the Acting Secretary of Commerce authorized the killing of 3,000 more seals of the 3-year-old class and 1,000 of the 4-year-old class. This was later modified to include only those seals of the 3-year-old class whose length was 43 inches or over. The instructions were conveyed by telegraph.

Killings of previous years having reduced the numbers of seals in the 5-year-old and 6-year-old classes of 1920 rather close to the reserve required by law, it was thought best not to draw further on these classes. A return to the desirable proportion of adult males to females is now reported on both islands, and upon the recommendation of the superintendent at St. Paul Island the killing from this class was stopped on July 23, after 703 skins had been secured.

KILLINGS OF SEALS.

St. Paul Island.—In a total of 54 drives during the period from January 22 to November 29, inclusive, 22,220 seals were secured on St. Paul Island during the calendar year 1920.

St. George Island.—The first drive was made on St. George Island on May 31 and the last on November 19; in a total of 35 drives, 4,428 seals were killed during the calendar year 1920.

The total number of seals killed on both islands during the calendar year was 26,648. Details regarding the killings are shown in the following tables:

Seal Killings on Pribilof Islands in 1920.

ST. PAUL ISLAND.

Date.	Serial No. of drive.	Hauling ground.	Skins secured.	Date.	Serial No. of drive.	Hauling ground.	Skins secured.
Jan. 22	1	Sea Lion Rock	68	July 17	30	Morjovi and Vostochni	1,344
Jan. 30	2	.....do	4	July 19	31	Reef and Gorbatch	1,309
May 18	3	.....do	58	July 20	32	Zapadni, Little Zapadni, and Zapadni Reef.	466
June 4	4	.....do	97				
June 11	5	Reef	225	July 21	33	Tolstoi, Lukanin, and Kitovi.	251
Do....	6	Tolstoi	85				
June 14	7	Morjovi	417	July 23	34	Reef and Gorbatch	697
Do....	8	Vostochni	41	July 27	35	Morjovi and Vostochni	1,432
June 19	9	Zapadni	357	July 29	36	Gorbatch	428
June 21	10	Reef	541	July 30	37	Reef	259
June 23	11	Morjovi and Vostochni	574	Do....	38	Lukanin and Kitovi	89
June 24	12	Polovina	295	Aug. 2	39	Tolstoi	210
June 25	13	Tolstoi	242	Aug. 3	40	Zapadni, Little Zapadni, and Zapadni Reef.	225
Do....	14	Lukanin	114				
June 26	15	Zapadni	394	Aug. 4	41	Morjovi and Vostochni	406
June 28	16	Reef and Gorbatch	1,127	Do....	42	Gorbatch	257
June 30	17	Morjovi	536	Aug. 5	43	Polovina	323
Do....	18	Vostochni	496	Aug. 6	44	Tolstoi	70
July 1	19	Polovina	270	Do....	45	Lukanin and Kitovi	40
July 2	20	Tolstoi	315	Aug. 7	46	Zapadni	49
July 3	21	Reef and Gorbatch	840	Aug. 8	47	Reef and Gorbatch	101
July 5	22	Zapadni, Little Zapadni, and Zapadni Reef.	421	Aug. 10	48	Polovina	143
				Do....	49	Morjovi and Vostochni	257
July 7	23	Morjovi and Vostochni	2,000	Oct. 23	50	Reef	175
July 9	24	Lukanin and Kitovi	99	Nov. 9	51	.....do	34
Do....	25	Tolstoi	399	Do....	52	Lukanin	23
July 10	26	Reef and Gorbatch	1,333	Nov. 20	53	Reef	34
July 11	27	Zapadni, Little Zapadni, and Zapadni Reef.	669	Nov. 29	54	Gorbatch	18
July 14	28	Reef and Gorbatch	1,181			Total	22,220
Do....	29	Tolstoi, Lukanin, and Kitovi.	382				

SEAL KILLINGS ON PRIBILOF ISLANDS IN 1920—Continued.

ST. GEORGE ISLAND.

Date.	Serial No. of drive.	Hauling ground.	Skins secured.	Date.	Serial No. of drive.	Hauling ground.	Skins secured.
May 31	1	North	5	July 13	19	Zapadni	36
June 7	2	East Cliffs and Staraya Artil.	22	July 15	20	North and Staraya Artil	206
				July 17	21	East Reef	354
June 9	3	North	26	July 19	22	North and Staraya Artil	224
June 12	4	East Cliffs	20	July 22	23	East Reef and North	430
June 16	5	North, Staraya Artil, and East Cliffs.	131	July 24	24	North and Staraya Artil	277
				July 26	25	East Reef	103
June 19	6	East Cliffs	11	July 29	26	North and Staraya Artil	269
June 21	7	North and Staraya Artil	100	July 31	27	East Reef	163
June 25	8	East Cliffs and North	58	Aug. 2	28	North and Staraya Artil	26
June 28	9	East Reef and North	117	Aug. 4	29	East Reef and North	80
June 29	10	Zapadni	58	Aug. 9	30	do	104
June 30	11	Staraya Artil	130	Oct. 20	31	East Cliffs and North	199
Do	12	North	88	Oct. 23	32	do	53
July 3	13	East Reef	11	Nov. 2	33	do	53
July 5	14	North	170	Nov. 17	34	North and Staraya Artil	69
July 6	15	Zapadni	37	Nov. 19	35	East Cliffs	12
July 7	16	East Reef and North	175				
July 10	17	North and Staraya Artil	521			Total	4,428
July 12	18	East Reef	90				

AGE CLASSES OF SEALS.

The present method of classifying seals of unknown age has been developed from experimental work conducted since the summer of 1912, when a large number of male and female pups of that season were branded with a permanent distinctive mark. A few of these animals have been killed in each season since 1912 and the body lengths—from tip of nose to root of tail—and other data have been recorded. On the basis of the growth attained by these seals in each of the several years, limits of carcass length have been adopted for each year of age, and seals are now classified in accordance with the position their respective carcass lengths occupy in the scale taken from the branded animals. The limits now in use are as follows:

AGE STANDARDS OF BODY LENGTHS OF SEALS.

Age.	Lengths of summer seals.	Lengths of fall seals.	Age.	Lengths of summer seals.	Lengths of fall seals.
	Inches.	*Inches.*		*Inches.*	*Inches.*
Yearlings	Up to 36.75	Up to 38.75	4-year olds	46 to 51.75	48 to 53.75
2-year olds	37 to 40.75	39 to 42.75	5-year olds	52 to 57.75	54 to 59.75
3-year olds	41 to 45.75	43 to 47.75	6-year olds	58 to 63.75	60 to 65.75

AGES OF SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

Age.	Summer (Jan. 1-Aug. 10), 1920.			Fall (Aug. 11-Dec. 31), 1920.			Grand total.
	St. Paul.	St. George.	Total.	St. Paul.	St. George.	Total.	
Yearlings	7		7				7
2-year olds	166	194	360	2	26	28	388
3-year olds	15,914	2,917	18,831	233	312	545	19,376
4-year olds	4,988	843	5,831	46	44	90	5,921
5-year olds	45	61	106	2	3	5	111
6-year olds	39	4	43				43
7-year olds and over	709	12	721	1		1	722
Cows[1]	68	11	79		1	1	80
Total	21,936	4,042	25,978	284	386	670	26,648

[1] The few cows reported above, about one-third of 1 per cent of the total take, were accidentally and unavoidably killed. Every possible effort is made to avoid the killing of cows, but persons familiar with conditions at the islands will readily appreciate that once in a great while a cow is killed.

BRANDED SEALS.

Fifteen 8-year-old male seals, bearing the brand placed upon them as pups in 1912, were killed during the calendar year 1920. Of this number six were taken on St. Paul Island and nine on St. George Island.

It is from the 1912 series of branded seals that the data were obtained from which the age classification standards now in use were developed. Observations have also been made as to the development and movements of female seals bearing the 1912 brand. It is believed that more dependable information has been obtained as a result of the branding done in 1912 than from any similar work done in the past.

The following table shows certain information secured from the animals killed this season:

RECORDS OF BRANDED 8-YEAR-OLD MALE FUR SEALS KILLED ON PRIBILOF ISLANDS, CALENDAR YEAR 1920.

Serial No. of skin.	Date of killing.	Island.	Carcass weight.[1]	Carcass length.	Green-skin weight.	Trade classification.
	1920		*Pounds.*	*Inches.*	*Pounds.*	
AP6828	June 28	St. Paul	282	59.50	15½	Wig.
AP6829	July 10	...do	288	70.00	27	Do.
AP6830	July 14	...do	309	72.75	50	Do.
AP6831	July 23	...do	271	73.25	41	Do.
AP6885	Aug. 4	...do	251	69.25	27	Do.
AP7380	Oct. 23	...do	297	73.50	33	Do.
G6150	June 21	St. George	249	69.25	24	Do.
G6158	July 5	...do	351	72.25	38	Do.
G6159	July 15	...do	260	69.50	37	Do.
G6160	July 19	...do	243	68.25	23	Do.
G6161	...do	...do	273	69.25	35	Do.
G6162	...do	...do	286	73.00	43	Do.
G6163	July 22	...do	259	73.50	37	Do.
G6164	Aug. 9	...do	322	75.50	32	Do.
G6165	...do	...do	252	72.00	42	Do.

[1] Seals were bled before being weighed.

The above table presents information comparable with that secured from the branded seals of 1912 killed in past years. These earlier data may be obtained by reference to the Alaska fisheries and fur industries reports for the years since the branding was done.

In order to add to the data already secured, it is the purpose of the Bureau to kill some of these male seals in each of the years they may continue to exist, but to insure an adequate remainder for observation during that period it will probably be necessary to reduce the number to be killed to three or four animals in each season.

CENSUS.

Following the practice of previous years a census of the fur-seal herd was taken in the summer of 1920. Details are contained in the report, printed on pages 104 to 120, by Dr. G. Dallas Hanna, who has been in local charge of the census work for a series of years beginning in 1915. Edward C. Johnston, storekeeper on St. George Island, assisted in the actual census work in 1920 on both islands. The growth of the herd from year to year renders it increasingly difficult to enumerate the animals, but, on the other hand, the observations of each year add to the concrete information available as a basis of computation and enable the determination of relatively accurate percentages of loss for the different age classes.

The following is a comparative statement of the numerical strength of the various elements of the herd in the years 1912 to 1920, inclusive:

General Comparison of Recent Censuses of the Seal Herd.

Class of seals.	1912	1913	1914	1915	1916	1917	1918	1919	1920
Harem bulls	1,358	1,403	1,559	2,151	3,500	4,850	5,344	5,158	4,066
Breeding cows	81,984	92,269	93,250	103,527	116,977	128,024	142,915	157,172	167,527
Surplus bulls	....	....	....	....	....	8,977	17,110	9,619	6,115
Idle bulls	113	105	172	673	2,632	2,706	2,444	2,239	1,161
Young bulls (chiefly 5-year-olds)	199	259	1,658	....	....	....	....	....	....
6-year-old males	....	....	....	....	11,167	15,397	13,755	8,991	4,153
5-year-old males	....	....	....	11,271	15,494	14,813	11,941	5,282	5,007
4-year-old males	100	2,000	9,939	15,848	15,427	16,631	7,114	5,747	5,667
3-year-old males	2,000	10,000	13,880	18,282	19,402	19,507	9,117	13,596	10,749
2-year-old males	11,000	15,000	17,422	23,990	24,169	26,815	30,159	33,081	39,111
Yearling males	13,000	20,000	23,068	30,307	33,645	38,013	41,595	46,444	51,074
2-year-old cows	11,000	15,000	17,422	23,990	24,245	26,917	30,415	33,287	39,480
Yearling cows	13,000	20,000	23,007	30,306	33,646	38,018	41,608	46,447	51,081
Pups	81,984	92,269	93,250	103,527	116,977	128,024	142,915	157,172	167,527
Total	215,738	268,305	294,687	363,872	417,281	468,692	496,432	524,235	552,718

SPECIMENS FOR SCIENTIFIC PURPOSES.

For use in the preparation of a natural history group at the American Museum of Natural History in New York, several specimens of fur seals were collected at the Pribilofs during 1920. Thirteen skins were furnished the museum, one from an adult bull and eight from pups, all found dead on St. Paul Island, and one from a pup found dead and three from cows unintentionally killed in the sealing work on St. George Island. The collection was appraised at $29, which amount was paid by the museum and properly deposited in the United States Treasury.

FOXES.

The foxes on the Pribilof Islands have regularly been the source of considerable revenue to the United States. The animals run at large on both islands and call for scarcely any outlay of funds and comparatively little labor.

One of the paradoxical features of the fox life on these islands is that the larger island, with a greater abundance of seal meat and more accessible beaches, has constantly furnished a smaller number of skins than St. George Island. Immediate conditions can not be assigned as the reason for this peculiar difference because of the fact that the situation has remained the same over a period of more than 40 years. Methods of feeding adopted on St. George Island in more recent years have caused a still greater contrast in the size of the catches on the two islands.

In the assumption that the foxes obtain sufficient food from the seal bodies remaining on the killing fields and from the natural food on the seashore, no special effort to feed the animals is made on St. Paul Island. The foxes are trapped with common steel traps during a short season in the early winter. When possible it is always planned to do this trapping before the heavier snowfalls take place, so that the runways may be observed and the traps placed on the ground. The time for trapping is usually selected with respect to the condition of the ground surface and the outlook of the weather.

TRAPPING SEASON OF 1920–21.

During the trapping season of 1920–21 a total of 1,125 blue and 14 white fox skins was taken on the two islands. Of this number 123 blue and 13 white skins were taken on St. Paul Island and 1,002 blues and 1 white on St. George. In addition, there were reserved for breeding purposes on the latter island 242 male and 240 female foxes, making a grand total of 1,485 animals handled there during the winter. The above take is the largest since the winter of 1892–93 when 373 animals were caught on St. Paul Island and 928 on St. George; during that year no reservation of breeders was made, however. The gain in this season's take, as in several past, comes entirely from St. George Island where the herd has been growing rapidly for a number of years.

With respect to the methods in use at St. George Island, Agent C. E. Crompton has recently submitted a detailed report as follows:

METHODS EMPLOYED IN THE MANAGEMENT OF THE BLUE FOXES ON ST. GEORGE ISLAND, ALASKA.

The blue foxes of St. George Island, Alaska, are the stock of what is probably the most successful fox farm in the country at the present time, if not the most promising in the world. The history of the ebb and flow of fox life on that island and the relation of that fluctuation to the influences which man has directly or indirectly brought to bear form a very interesting nature study.

History states that the furs of the seals, sea otters, and foxes were much exploited during the years immediately following the Russian discovery of the island, but no authentic records prior to 1840 are available. James Judge states that during the 19 years ending with 1860 the average annual catch was over 1,200 animals; during the first 19 years of the American tenure of the island the average catch was approximately 1,000 each season. Trapping was conducted during but four of the six winters from 1890 to 1896, inclusive, and with such poor results that a total of only 2,325 pelts was secured. These latter years mark the most important changes in the history of the herd.

Duing the years preceding 1896 the foxes had always been forced to seek their winter food from the summer's accumulation of fur-seal carcasses on the killing fields, and up to the year 1885 had probably secured an abundance of food therefrom. Coincident with the decline of the seal herd, however, and particularly during the modus vivendi of 1891–1893, which restricted the land killing of seals to 7,500 annually, pending the award of the Tribunal of Fur-Seal Arbitration at Paris, the number of foxes became rapidly smaller. The situation, however, was not immediately recognized as a shortage of food, the agents of the Government placing the blame on excessive trapping by the lessees.

The state of affairs was probably first seen in its true light by Treasury Agent James Judge, who, in the summer of 1896, prepared a quantity of surplus seal meat by lightly salting and storing the food in the manner of ensilage. The experiment was successful, and Mr. Judge immediately recognized the possibility of selective killing by catching the animals in box traps instead of the steel traps which had always been used theretofore. A trapping house, with a wire cage adjoining, was the final outcome of the above-described experiment. The foxes came readily to the cage to obtain the much-needed food and were caught when the cage door was closed by a rope leading from within the house.

The methods of trapping outlined in the following pages are based on the work of James Judge, to whom much credit is due. That his principle was right and that it has been properly carried out was shown by the catch of 1919–20, when 750 pelts were secured and 454 animals released as breeders; the largest number of skins obtained since 1892–93, and, with a single exception, the largest total of animals caught in any season since the inauguration of the present system.

Food.

The natural food of the blue fox of the Pribilof Islands is made up of birds, eggs, insects, berries, miscellaneous bits of animal matter cast up by the sea, and occasionally dead seals, sea lions, walruses, or whales. While such food is plentiful during the milder seasons, it is reduced to the single item of beach food during the winter, when the shore is at times in the grip of frozen spray for long periods. Drift ice also closes the beaches for days at a time and usually large deposits of ice are left stranded, and these hinder the foxes in their search for food. It is at once apparent that comparatively few animals would survive a severe winter without a reserve supply of food.

In ordinary seasons the foxes of St. George Island are dependent upon a reserve supply of seal meat as food from September 15 to April 30. These dates are very safe and they will, of course, vary as the seasons are mild or severe, early or late, but will in most instances mark the period of need. "Open" or unfrozen beaches during the winter time often furnish much additional food, and during such intervals the foxes feed but lightly on the seal meat. On the other hand, a protracted period of cold prevents the animals from obtaining the natural food of the seashore, and they then visit the feeding ground in large numbers, consuming surprising quantities of meat. This feeding is necessary by reason of the fact that there are on the island at the present time many more foxes than the comparatively small supply of natural food in the winter season can support, and the size and rate of growth of the herd are primarily limited by the number which can be sustained during that trying period.

Preparation of food.—Seal meat has been found to be a successful and most readily obtainable food for use as a reserve. The foxes use all the seal meat which is not consumed by the native inhabitants of the island. After a killing of seals has been made the natives cut up the carcasses, remove the choicest portions for their own immediate and future needs, and the surplus is stored for winter fox food. At a suitable time (usually the day following the killing) the carcasses are eviscerated and emptied of free blood clots to retard putrefaction. If large, the carcasses are cut into sections, but if the seals are of a size readily handled they may be stored whole. It is not a good practice to store the meat before it has cooled, nor should it be left on the field through a hot, sunny day.

The carcasses are deposited in a large pit or silo, which is cut into the side of a hill of hard, scoriaceous earth. The outer side of this pit is bulkheaded with strong planks and a small doorway, closed by means of flashboards, is placed near the center of the base of the bulkhead. This door serves both as a drain for the effluent water and oil and as a port from which the meat may be drawn as needed.

As the meat is thrown into the pit it must be spread about evenly and sprinkled with a small amount of half-ground salt. Salt which has already served a part of its usefulness in the sealskin kenches is entirely satisfactory for salting fox food. It is of great importance to have the meat spread in such a manner as to leave as little air space as possible; the principle is primarily that of ensiling rather than salting. It is surprising how well the meat will be preserved with but very little salt if the air is properly excluded.

After the summer's sealing has been completed the silo is covered with a sectional hatch, which rests on the edges of the pit. It is not of advantage to store the seal meat resulting from the fall killings, as the natives take large quantities for salting and freezing and the foxes will consume the fresh remains in a short time.

Before the feeding of the reserve food begins it should be freshened by the passage of fresh water through the pit. This is done by laying a pipe line to a siphon, which draws the water from a lake near by. The water should run at least two weeks steadily, but must not be turned on until the time for feeding draws near, else the food will begin to decompose unnecessarily.

Feeding.—Having decided that feeding should begin, a supply of the prepared meat is removed from the silo to the food kenches in the trapping house, where it may be drawn upon with ease as required. The native foreman is then instructed to put out a small experimental amount in the neighborhood of the building and to report the following morning as to the quantity consumed. Upon receiving this report the agent will know how to proceed the following evening. It is a commendable practice to provide for a remainder of food each morning, except during the active trapping season, when the animals must not become satiated. The foreman details a single workman to the work of setting out the food for a week at a time, after which that man is relieved by some one who does the work for a similar period.

The feeding is continued in the neighborhood of the trapping building until two weeks or more before it is expected to begin trapping, at which time it is placed within the cage. Much smaller quantities of food are then put out, and it may be well, in the case of a mild season, to suspend feeding for a day or two, putting out only enough food to attract the animals to that vicinity. This must be decided and gauged by the manner in which the foxes have been feeding during the interval immediately preceding, and it is largely a matter of judgment.

When the beginning of trapping has been decided upon all waste bits of meat and bone are gathered together and stored in barrels in an inaccessible place, where they will not draw the foxes from the lure within the cage. After trapping has started, food is placed only within the cage and the accumulation of bones therein is cleaned out from time to time and disposed of as stated above. Bits of food which have been dragged outside the cage must not be allowed to accumulate, as the more timid foxes will feed on them in preference to entering the cage.

Trapping.

Season.—The season for trapping prime-furred foxes varies in direct relation to the degree and duration of cold weather. Ordinarily the best of the pelts will be secured between December 1 and February 1, though prime furs may be taken on either side of these extremes.

Toward the latter part of November a few foxes may be caught and the fur examined as to its marketable condition. The extent of growth of the guard or crown hairs is a very good guide, as when these hairs have reached a length extending well beyond the heavier fur the pelt takes on its well-known silkiness and luster so highly valued by the trade. The guard hairs are seldom, if ever, fully extended before the fur beneath has become prime. Many skins vary as to fur; some have a heavy growth of dark fur, while others may have comparatively thin coats of light color, but the primeness consists in a uniform growth of whatever class of fur the animal happens to have, accompanied by the full growth of guard hairs. Animals are occasionally seen with no visible growth of guard hairs, but these are presumed to be diseased and are so few in number as to be negligible.

During mild seasons it will be noted that some of the pelts have a decided reddish tinge to the guard hairs, and while the exact effect of this condition is not known to the writer, it appears that its presence is not of sufficient importance to warrant the cessation of trapping. In the two seasons of 1915–16 and 1919–20 this "rusty" condition was particularly noticeable, but on both of these occasions the furriers subsequently stated that the value of the skins was but slightly lessened thereby. While the darkest furs are the most desirable, a good pelt commands a fair price even though the reddish tinge is in evidence.

The approach of the end of the season and the lapse of primeness in the skins can not be determined by any rule. The condition of the fur must be carefully watched, for rubbed or felted patches about the throat or rump are a certain indication of unprimeness. The observations must naturally be made before the fox is killed.

Weather conditions.—There is probably no single indirect factor having a more important bearing on the outcome of the season's trapping than that of weather. Clear, cold nights, with moderate winds from points in the north or east, are the conditions under which trapping may best be conducted at the village. Western winds favor the Zapadni cage. High night tides are advantageous, low ones the contrary. While moonlight makes the trapping work easier, the animals may be seen without difficulty on the darkest night if there is a little snow on the ground. The lower the temperature and the longer the period of cold, the more favorable is the situation; the cold keeps the beaches frozen and the continuation of it forces the most timid animals to visit the cage in search of food. Storms do not necessarily preclude trapping if the winds are from favorable directions and are not exceedingly strong. Wet snow or rain is unfavorable, as the furs become wet and soiled on such occasions; this dampness is very undesirable when the skins are made ready for stretching. Trapping may, however, be conducted with fair results during mild weather when rain is not falling. Persistence is required if a large catch is to be made.

Location of traps.—Two cage traps are used at the present time, one at the village, the second at Zapadni. The advisability of installing a third is doubtful. The second trap was the natural outcome of the feeding of foxes at Zapadni and it is useful when winds are unfavorable for work at the village. The desirability of securing the largest number of pelts at the village trap is readily seen.

The village trap is the original building set up by James Judge shortly after his experiment of 1896, and, like all cage traps, it is near the shore line. The second is simply a wire cage set up in 1919 close by the Zapadni watch house. Efforts are occasionally made to secure foxes at Garden Cove (on the southern shore) by means of string or noose traps, but the results are quite disproportionate to the labor involved. It should also be mentioned that the foxes having their homes in the immediate vicinity of the village form a distinct colony, the members of which rarely visit the cage trap and must be obtained by noose traps placed within the village and operated from the windows of the village buildings.

Description of traps.—Herewith is a diagram showing the arrangement of the village trap. The drop door "F," sliding in a groove, is operated by a man stationed within the darkened room "B," who watches the animals through the small window "H," which commands a view of the trap interior. The Zapadni trap is on the same general plan, the cage standing apart from the house and being operated from the window. At Zapadni the foxes must be caught and removed from the trap by hand, while at the village it is much more readily done, as will be seen later.

The noose trap is a very simple arrangement. A small doorway is cut in the end of a common packing case, which is then placed with its open face to the ground, the door remaining open on the end of the case. Some bait having a strong odor, such as old seal meat or seal oil, is placed within the box, and a noose is hung about the doorway. As the fox endeavors to investigate the contents of the box, the noose is closed about his neck by an operator stationed within a near building. This trap is an unsatisfactory arrangement to use outside the precincts of the village, as when an animal is captured the resulting commotion frightens other foxes away from that neighborhood. Furthermore, but a single fox can be caught at each operation.

Operation of traps.—It must be borne in mind during the trapping season that the foxes are largely dependent upon the seal meat for their sustenance,

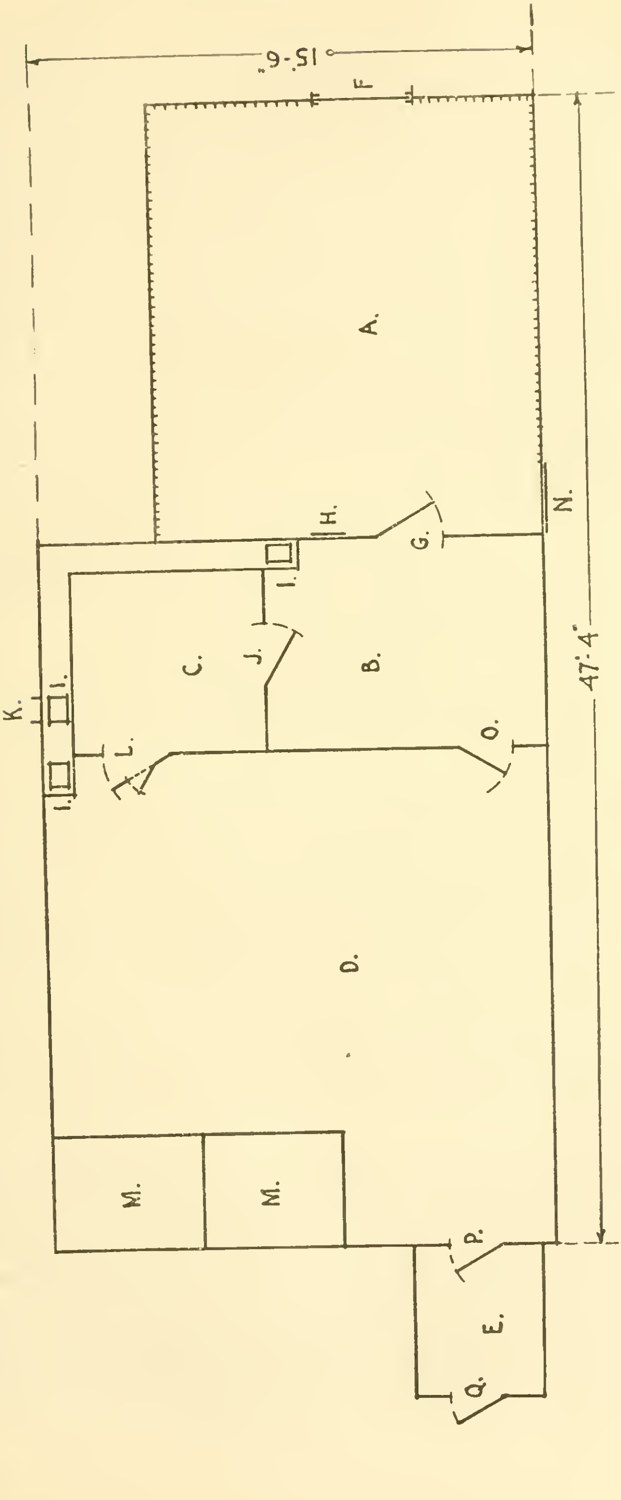

FIG. 1.—INTERIOR ARRANGEMENT OF FOX-TRAPPING HOUSE.

A. Wire cage trap.
B. Trapping room.
C. Retaining room.
D. Killing and skinning room.
E. Vestibule.
F. Sliding drop door.
G. Trap outlet.
H. Small window.
I. Exits for releasing foxes.
J. Door to retaining room.
K. Final exit for released foxes.
L. Special door to skinning room.
M. Food kenches.
N. Food door.
O. Door to trapping room.
P. Entrance.
Q. Storm door.

and, while large numbers of animals visit the cage in the morning after an evening's trapping, continuous operation of the trap over too long a period will cause the foxes to abandon their trips to the cage for food. Such a practice forces the foxes to search for food elsewhere and also prevents any record being made of those animals, either for their pelts or as breeders. The more timid foxes may be seen to wander about the trap for long periods before entering, and each time the trap is sprung these animals are frightened off. The writer believes that the trap should be left open to the foxes at least two full nights in seven, and if all-night trapping is practiced the feeding nights should be increased to three in each week. These precautions are not so necessary if the beaches are unfrozen.

The actual trapping of the foxes may be begun as early as 4.30 p. m. and continued as late as seems desirable. A responsible native, with an assistant, takes up his position in the trapping room opposite the small window and opens the sliding door by means of a rope. The opening of the door by the trapper exposes the food for the first time on any trapping night, so that no foxes will have previously satisfied their hunger. The trapper maintains a constant watch of the trap, and when several foxes are in the cage he lowers the door and imprisons them. This moment for dropping the door must be properly judged. There should be no foxes so near the door that they will be in danger of injury when it drops; the door should not be closed in the face of animals too near the trap, as they would only be unnecessarily frightened thereby; on stormy nights the door may be so carefully closed that even the foxes within the trap are not aware of the change. Only responsible natives should ever be left in charge of the trap rope; such men understand the foxes and do the work well.

After closing the trap the operator sends his assistant into the cage and the foxes are driven through the open doors "G" and "J" into the retaining room "C," where they are held until a sufficient number has been caught to warrant further attention. After closing the doors to the retaining and trapping rooms the cage door is raised and the operation is repeated.

Handling of animals.—It is not advisable to hold more than 20 foxes in the retaining room at one time, as the animals have a tendency to clamber about and will pile up and become overheated, particularly in mild weather. On the opening night of the season the foxes can be caught almost as rapidly as the skins can be handled, the trap taking as high as 10 or 12 in a single operation. Later in the season the more timid foxes appear and only 2 or 3 are taken at intervals of an hour or more.

When a suitable number of foxes has been caught, the skinners and other men take up their places in the large room "D" and the work begins. Two or three men, armed with forked sticks, are sent into the retaining room, where they catch the foxes by pressing them down to the floor until a proper hold has been secured with the hands; the animal is grasped about the neck from behind. This work must be done with as much care as is consistent with a fair degree of speed, as some of the animals are to be reserved as future breeders and must not be injured by unnecessarily rough handling. If any marked breeders are found, they are liberated through the door "I" and the exit "K."

After catching the fox the native passes it through the opening in the special door "L," whereupon a man on the opposite side takes it from him, holding the animal in the same manner. Another man examines the fox and calls out its sex that it may be written down by the agent. The latter then examines the teeth by pushing back the lips or opening the jaws with a soft gag.

The weigher now places the fox's tail in the loop of a broad strap attached to a spring balance and the head of the fox is then carefully lowered so that the animal hangs to the scale by its tail. The fox must not be dropped into a hanging position, as the sudden snap might injure the bone or cartilage of the tail. The weight is then called out and the agent makes note of it; he then notifies the weigher whether the fox is to be killed or released. If to be released, the animal is marked and dropped through the door "I" and makes its escape through the exit "K." If to be killed, it is passed to another man (the fox is still held by the tail) who strikes it a smart blow on the head with a light club. After the fox has been stunned in this manner, its neck is broken by manipulation. The skinner waits a few moments to make certain that the animal is dead, after which he removes the pelt while the body is yet warm.

Handling of Skins.

Skinning.—Fox skins are removed much in the same manner as those of most fur-bearing animals that are prepared for the market. The tail is split for a few inches on the lower side, the cut beginning at the anus; cuts are then made along the inner side of each hind leg, these incisions extending from the heel (the lower end of the metatarsal bones) to the anus. The pelt is first loosened around the base of the tail, the tail is then pulled from its sheath of skin, and the entire pelt is removed by pushing it loose from the fat and flesh with the fingers, a knife being used only about the head. After the skin has been loosened from the posterior part of the body it is simply everted over the head, so that the nose is the last part to be severed. The forelegs are pulled out of the skin without any cutting, except where a knife may be needed to separate the pelt from the tougher subcutaneous tissues.

While the skin is being drawn off there is some danger of tearing it or of forcing a finger through it, but such holes are usually the result of haste or carelessness. However, tears are sometimes made by the best of skinners, and in a large catch it may be difficult to secure perfect work throughout. Naturally, the pressure is always toward better workmanship.

After the skin has been entirely removed by the method outlined above, it is turned right side out and hung up on a peg or nail. When the work of the evening is over, the skins are counted, but are left in the trap building until ready for cleaning and stretching; the skins must be kept as cool as possible during this time.

During the first few killings of the season it is advisable to examine the flesh side of the skins, as the color found there is a good guide to the degree of primeness of the furs as a whole. The earliest skins may be found to be rather dark on the flesh side because of the roots of the growing hair and fur. This color fades as the season advances. While the writer has seen skins having what appeared to be fully prime pelage with the flesh side quite dark, it is not advisable to take any large number of skins during that part of the season when the bluish color on the flesh side of the skin is most pronounced.

The flesh side again darkens with the approach of unprimeness, but it has been observed on St. George Island that felted patches and rubbed spots are the first indication of the change. The fact that decision must be made before the fox is killed makes this a valuable point.

Cleaning.—The morning after the trapping the skins are taken to another building where the cleaning, stretching, and drying is done. The more skillful men sit in a row behind a beam which is placed in a horizontal position about 2 feet above the floor. A nail or peg is fixed in the beam opposite each man. The skin is turned flesh side out, the nose is placed over the peg and all the fat and flesh is removed with a very sharp skinning knife having a curved blade about 6 inches in length. The tail is split and all the fatty tissue removed from it; the forelegs can be cleaned without splitting. The work described here requires genuine skill with the knife.

After the pelt has been thus cleaned it is taken by one of the other workmen who turns the skin, rubs dry corn meal through the fur for the purpose of removing free grease or dampness, and then shakes it out. It is now turned again and searched for holes and if any are found they are sewed up. Small sticks are then inserted within the skin of the forelegs and bound in place; the tail is spread and bound round a larger stick and the skin is then ready for the stretching frame.

Stretching.—The stretching frame is a very simple arrangement of two light boards (1-inch material is usually used) put together on an acute angle, the length of the sides being in the neighborhood of 4 feet. The boards are joined edgewise, the nails of the joint being carefully toed; no third piece enters into the construction. After the joint has been secured, the boards are planed so that the edges form a smooth wedge with a rounded point. Properly made frames will last many years.

The skin is drawn on by inserting the smaller end of the frame in the opening across the hind legs and then slowly forcing it down the frame until the nose fits snugly. The entire surface of the pelt is then gently stretched downward with the palms of the workman's hands, and when it is well in place the hind legs are spread and bound to the sides of the frame in the manner shown in figure 3. The lips have been previously stitched together to prevent distortion of that part of the skin, and after the whole pelt has been well rubbed with corn meal it is set up for drying.

Drying.—The drying may be done in any large room where an even temperature can be maintained. It is always desirable to dry the skins slowly and with as little artificial heat as possible. The present method is to lay the frames in rows across light racks suspended from the ceiling at suitable intervals, the remainder of the frames being stood up about the walls. With the improvement of facilities this practice may be bettered.

After a lapse of from four to six days on the stretching frames the skins may be examined, and if dry all over, may be removed. The nose is one of the last parts of the skin to become fully dry. The skin should also be examined for excessive grease, and if any is found it must be removed with corn meal, for if it is left it will putrefy and weaken the skin. In taking the skin from the frame the hind and fore legs and tail are unbound and the skin gently started with the palms of the hands, after which it may be pulled off by the nose. When the skin has been removed from the frame a tag, bearing the date of capture, is tied into the mouth or eyeholes and the skin is hung up in the drying room for a few days, or until a sufficient number of pelts has accumulated for removal to the storage room.

Storing.—The two most important requirements for a storage room are dryness and darkness. The necessity for keeping the skins dry is apparent; the darkness is a safeguard against the fading of the fur, as the darkest furs command the highest prices. In storing the skins they are usually tied through the nose into clusters of 10 skins each, and these bunches are carefully tallied when stored. All the skins are again counted at the close of the season so as to verify the record of animals killed.

Shipping.—Fox skins are packed and shipped in boxes made of 1-inch boards of spruce or Douglas fir (spruce is preferable), with inside dimensions of 58 inches in length, 16 inches in width, and 12 inches in depth. The case is provided with a set of battens near each end, which lend rigidity to the whole and at the same time prevent any face of the box from coming into solid contact with a flat surface.

The packing of the skins is usually done within a day or two of the time shipment is to be made. The cases are lined with tarred building paper and relined with wrapping or newspaper as a protection against insects and dampness. The skins are carefully counted and laid flat in the case; unnecessary folding or creasing is to be avoided. The skins are shipped pelt side out. From 40 to 45 skins may be packed in a case such as the one described above.

After the proper number of skins has been packed in the box, the top is closed with the layers of paper and then the cover. The cover is nailed to the sides and ends of the case and to the battens on the sides. All cracks and holes are then closed by tacking on strips of galvanized iron or sheet zinc. The cases should be marked on both sides with the name and address of the consignee, the serial number and gross weight of the case, the number of skins it contains, and the legends, "Keep Away From Boiler Bulkheads" and "Keep Dry."

Disposition of Carcasses.

The disposition of fox carcasses is a matter of some importance. It is well known that foxes are, as a general rule, infested with parasites and intestinal worms of various kinds, and it should always be the effort of the agent to see that the carcasses of foxes killed are disposed of in such a manner as to prevent any possibility of infection from that source. The bodies of foxes found dead should be handled in a similar manner when practicable. The method now in use is that of putting the bodies into a covered pit, a practice both simple and effective.

Breeding Reserve.

Selection of animals.—The breeding foxes must be selected with care. The points of judgment are: (1) The condition of the teeth; (2) depth of color and condition of fur, short fur or white patches indicating an undesirable animal; and (3) weight, reserved males to weigh not less than 11 pounds and females not less than 8½ pounds. Cripples are always killed, though a short-tailed fox may be released if the animal appears to be a particularly desirable one from other points of judgment.

Since the beginning of the present method of handling foxes on St. George Island it has been constantly the purpose to eliminate the white foxes. That it has been partially successful is shown by the presence of only 4 white

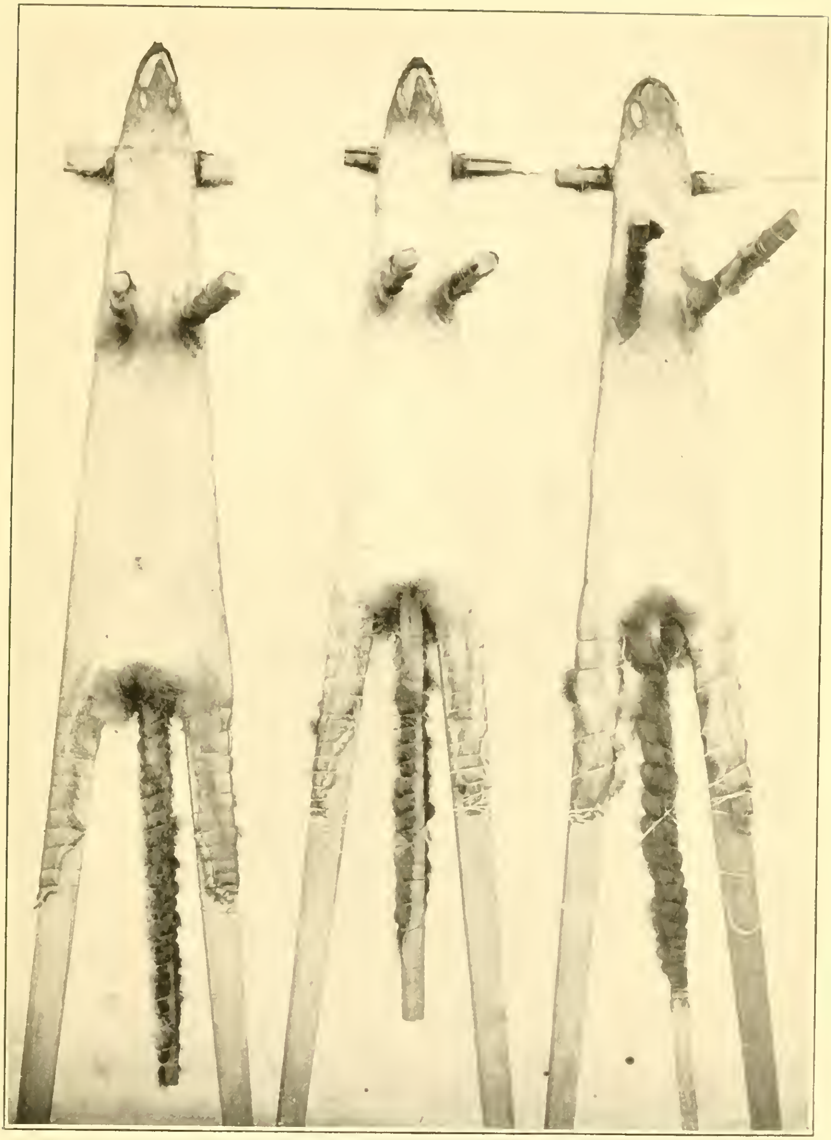

FIG. 2.—NATIVE METHOD OF STRETCHING AND DRYING BLUE FOX SKINS, PRIBILOF ISLANDS, ALASKA.

skins in a catch of 750 taken during the season of 1919–20, as against 15 white pelts in a total of 486 secured in the season 1903–4. On St. Paul Island, where steel traps are being used and the selective killing is not carried on, 33 white animals appeared in a catch of 188 during the winter of 1919–20. The fight against white foxes on St. George Island has in recent years been extended against blue foxes which bear white marks of any kind.

After the selection of the breeder it is marked by clipping the fur of the tail and is then released. This mark is a notch near the tip of the tail in the case of a male and near the middle of the tail for a female. No such marked foxes are killed intentionally, and to avoid the possibility of such error it is a good plan to make the mark sufficiently plain to preclude any chance that the weigher may not notice it. Light marks made early in the season may grow to be almost indistinguishable before trapping stops.

The blue fox of St. George Island is monogamous, and because of this fact the sexes must be released in equal numbers when the reserve is made.

Size of reserve.—The amount of food available during the winter months is the factor which controls the size to which the herd may be allowed to grow. The release of 200 pairs of breeding animals for a number of years past has provided a steady supply of skins, but this number must be gradually increased in proportion to the food supply if a sound policy of growth is to be carried out. During the season of 1919–20 a reserve of 225 pairs was made with a view to such a growth, and it is intended that the reserve be further increased each season that the food situation will allow.

A consideration of the reserve naturally must bring in the factors of the number of young which reach maturity for each pair released and the percentage of natural mortality for all classes of foxes. It is to be deplored that we know little of these factors, except as light has been thrown upon them by the growth or decline of the herd. From the past rate of growth we may assume a given number of maturing young and a given death rate, both of which are subject to an unknown correction of animals not caught, but such figures are somewhat arbitrary and must be used with caution. We can not place dependence on the uncertain figure of the number of maturing young or the unknown reserve of animals not handled; the only reliable figures are those from known reserves, and it is upon these we must base our policy.

REINDEER.

In August of 1911, 40 reindeer were brought to the Pribilof Islands to determine whether these animals would thrive and eventually provide a source of fresh meat for the Government employees and natives stationed there. Twenty-one cows and 4 bulls were landed on St. Paul Island and 12 cows and 3 bulls on St. George Island.

The experiment has proved entirely successful. While the herds have become quite wild and difficult to handle through lack of time for attending them, fairly accurate counts at the close of the calendar year 1920 showed 192 deer on St. Paul Island and 125 on St. George Island. The herds are becoming regularly more valuable as a meat supply, the number used for this purpose being larger each year. On St. Paul Island 22 reindeer were killed for food during the calendar year 1920 and on St. George Island 31 were so used. In the previous year 14 on St. Paul and 22 on St. George were killed for food.

SHIPMENTS OF FUR-SEAL AND FOX SKINS FROM PRIBILOF ISLANDS IN 1920.

Fur-seal skins.—Three shipments of sealskins were made from the Pribilof Islands in the calendar year 1920. The first of these was made up of 900 skins in 47 casks from St. Paul Island and 412 skins in 11 casks from St. George Island, the number from the latter place being the entire remainder of the catch of 1919 on that island. The shipment left the islands April 7 on the Bureau's tender *Eider*, was transferred to the Alaska Steamship Co.'s steamship *Victoria* at Unalaska on April 19 for shipment to Seattle, Wash., and left the latter place on April 27 for St. Louis by freight via Northern Pacific to Minnesota Transfer and Chicago, Burlington & Quincy, arriving at St. Louis May 20.

On June 22 the U. S. S. *Saturn* took the remainder of the 1919 skins from St. Paul Island; the shipment was made up of 37 casks containing 505 skins. The *Saturn* proceeded to Bremerton, Wash., from which place the skins were forwarded July 7 to St. Louis by the same route as the first shipment. They arrived at St. Louis July 26.

The third shipment consisted of 476 casks containing 21,929 skins from St. Paul Island and 24 casks containing 1,133 skins from St. George Island; all were skins of the 1920 take. The skins were placed on board the *Saturn* November 25 for transportation to Seattle, Wash., left that place December 6, and arrived at St. Louis December 15, having been shipped by freight via Northern Pacific to Billings, and Chicago, Burlington & Quincy to St. Louis. This shipment made remarkably good time between Seattle and St. Louis, arriving in a little less than nine days.

Thirteen specimen skins were also shipped during the year. Four of these were from St. George Island and nine from St. Paul Island. The skins were brought south on the *Saturn*, arrived at Seattle September 26, and were shipped from there by express to the American Museum of Natural History at New York City.

Fox skins.—A single shipment of fox skins was made during 1920. This shipment consisted of 4 cases containing 155 blue and 33 white fox skins from St. Paul Island and 18 cases containing 746 blue and 4 white skins from St. George Island, a total of 938 skins. These cases were shipped in the same manner as the first shipment of sealskins as far as Seattle, via the Bureau's vessel *Eider* and the commercial steamer *Victoria*, and from Seattle to St. Louis by express, where they arrived May 3.

SALES OF FUR-SEAL SKINS.

Two sales of dressed, dyed, and machined fur-seal skins from the Pribilof Islands were held in St. Louis during the calendar year 1920. One was on February 2 and the other May 10, at which times 9,100 and 5,752 skins were sold at auction for totals of $1,282,905 and $424,166, respectively.

The highest price secured at the February sale was for a lot of 70 skins, which brought $177 each; the average price obtained was $140.97, an increase of nearly 55 per cent over the average price at the preceding sale in September, 1919. At the sale in May the maximum price was $125 per skin on two lots of wigs, 50 skins in each lot. The average price for the May sale was $73.74, showing a decrease of about 48 per cent as compared with the February sale.

The first two of the following tables show details regarding the prices secured for each lot of skins in the two sales; the third table is a summary showing prices obtained for the skins in the various trade classes, with the percentages which the number of the skins in these several classes bore to the totals in each sale.

Sales of Dressed, Dyed, and Machined Pribilof Fur-Seal Skins at St. Louis, 1920.

SALE OF 9,100 SKINS, ST. LOUIS, FEB. 2, 1920.

Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.
1	50	Wigs	$152.00	$7,600.00
2	50	do	157.00	7,850.00
3	50	do	155.00	7,750.00
4	50	do	157.00	7,850.00
5	50	do	156.00	7,800.00
6	50	do	156.00	7,800.00
7	50	do	156.00	7,800.00
8	50	do	156.00	7,800.00
9	50	do	162.00	8,100.00
10	50	do	162.00	8,100.00
11	50	do	163.00	8,150.00
12	50	do	167.00	8,350.00
13	50	do	169.00	8,450.00
14	50	do	166.00	8,300.00
15	50	do	169.00	8,450.00
16	50	Wigs; cut, scarred, etc	115.00	5,750.00
17	50	do	116.00	5,800.00
18	50	do	115.00	5,750.00
19	50	do	117.00	5,850.00
20	50	do	120.00	6,000.00
21	50	do	118.00	5,900.00
22	60	Extra extra large	167.00	10,020.00
23	60	do	170.00	10,200.00
24	60	do	167.00	10,020.00
25	60	do	166.00	9,960.00
26	60	do	166.00	9,960.00
27	60	do	171.00	10,260.00
28	60	do	172.00	10,320.00
29	60	do	170.00	10,200.00
30	60	do	170.00	10,200.00
31	60	do	171.00	10,260.00
32	60	do	168.00	10,080.00
33	60	do	167.00	10,020.00
34	60	do	174.00	10,440.00
35	60	do	170.00	10,200.00
36	60	do	173.00	10,380.00
37	60	do	171.00	10,260.00
38	60	do	169.00	10,140.00
39	60	do	168.00	10,080.00
40	60	do	172.00	10,320.00
41	60	do	172.00	10,320.00
42	60	do	172.00	10,320.00
43	60	do	171.00	10,260.00
44	60	do	171.00	10,260.00
45	60	Extra extra large; cut, scarred, etc	124.00	7,440.00
46	60	do	124.00	7,440.00
47	60	do	131.00	7,860.00
48	60	do	127.00	7,620.00
49	60	do	130.00	7,800.00
50	60	do	127.00	7,620.00
51	60	do	131.00	7,860.00
52	60	do	130.00	7,800.00
53	60	do	131.00	7,860.00
54	60	do	132.00	7,920.00
55	70	Extra large	161.00	11,270.00
56	70	do	169.00	11,830.00
57	70	do	173.00	12,110.00
58	70	do	172.00	12,040.00
59	70	do	170.00	11,900.00
60	70	do	174.00	12,180.00
61	70	do	171.00	11,970.00
62	70	do	173.00	12,110.00
63	70	do	168.00	11,760.00
64	70	do	169.00	11,830.00
65	70	do	170.00	11,900.00
66	70	do	168.00	11,760.00
67	70	do	168.00	11,760.00
68	70	do	168.50	11,795.00
69	70	do	177.00	12,390.00
70	70	Extra large; cut, scarred, etc	134.00	9,380.00
71	70	do	130.00	9,100.00
72	70	do	128.00	8,960.00
73	70	Extra large; cut, scarred, etc	$127.00	$8,890.00
74	70	do	129.00	9,030.00
75	70	do	130.00	9,100.00
76	80	Large	160.00	12,800.00
77	80	do	157.00	12,560.00
78	80	do	164.00	13,120.00
79	80	do	162.00	12,960.00
80	80	do	162.00	12,960.00
81	80	do	161.00	12,880.00
82	80	do	161.00	12,880.00
83	80	do	160.00	12,800.00
84	80	do	159.00	12,720.00
85	80	do	160.00	12,800.00
86	80	do	161.00	12,880.00
87	80	do	162.00	12,960.00
88	80	do	162.00	12,960.00
89	80	do	161.00	12,880.00
90	80	do	160.00	12,800.00
91	80	do	161.00	12,880.00
92	80	do	160.00	12,800.00
93	80	do	163.00	13,040.00
94	80	do	165.00	13,200.00
95	80	Large; cut, scarred, etc	116.00	9,280.00
96	80	do	118.00	9,440.00
97	80	do	116.00	9,280.00
98	80	do	116.00	9,280.00
99	80	do	125.00	10,000.00
100	80	do	115.00	9,200.00
101	80	do	116.00	9,280.00
102	80	do	119.00	9,520.00
103	90	Mediums	124.00	11,160.00
104	90	do	126.00	11,340.00
105	90	do	123.00	11,070.00
106	90	do	123.00	11,070.00
107	90	do	122.00	10,980.00
108	90	do	121.00	10,890.00
109	90	do	121.00	10,890.00
110	90	do	122.00	10,980.00
111	90	do	121.00	10,890.00
112	90	do	121.00	10,890.00
113	90	do	121.50	10,935.00
114	90	do	120.00	10,800.00
115	90	do	123.00	11,070.00
116	90	do	122.00	10,980.00
117	90	do	123.00	11,070.00
118	90	do	122.00	10,980.00
119	90	Mediums; cut, scarred, etc	100.00	9,000.00
120	90	do	99.00	8,910.00
121	90	do	102.50	9,225.00
122	90	do	104.00	9,360.00
123	90	do	105.00	9,450.00
124	90	Small mediums	90.00	8,100.00
125	60	do	90.00	5,400.00
126	90	Small mediums; cut, scarred, etc	70.00	6,300.00
127	50	III wigs	71.00	3,550.00
128	50	do	71.00	3,550.00
129	60	III extra extra large	82.00	4,920.00
130	70	III—25 extra large, 45 large	64.00	4,480.00
131	60	III—50 mediums, 10 small mediums	57.00	3,420.00
132	20	IV—9 wigs, 3 extra extra large, 2 extra large, 2 large, 4 mediums	56.00	1,120.00
	9,100			1,232,905.00

Sales of Dressed, Dyed, and Machined Pribilof Fur-Seal Skins at St. Louis, 1920—Continued.

SALE OF 5,752 SKINS, ST. LOUIS, MAY 10, 1920.

Lot No.	Number of skins.	Trade classification.	Price per skin.	Total for lot.
1	50	Wigs	$125.00	$6,250.00
2	50	do	125.00	6,250.00
3	50	do	123.00	6,150.00
4	50	do	123.00	6,150.00
5	50	do	122.00	6,100.00
6	50	Wigs; cut, scarred, etc	79.00	3,950.00
7	50	do	72.00	3,600.00
8	50	do	78.00	3,900.00
9	50	do	79.00	3,950.00
10	60	Extra extra large	124.00	7,440.00
11	60	do	121.00	7,260.00
12	60	do	120.00	7,200.00
13	60	do	117.00	7,020.00
14	60	do	113.00	6,780.00
15	60	do	114.00	6,840.00
16	60	do	112.00	6,720.00
17	60	do	112.00	6,720.00
18	60	do	111.00	6,660.00
19	60	do	115.00	6,900.00
20	60	Extra extra large; cut, scarred, etc.	90.00	5,400.00
21	60	do	79.00	4,740.00
22	60	do	72.00	4,320.00
23	60	do	67.00	4,020.00
24	60	do	64.00	3,840.00
25	60	do	64.00	3,840.00
26	30	do	64.00	1,920.00
27	70	Extra large	108.00	7,560.00
28	70	do	98.00	6,860.00
29	70	do	93.00	6,510.00
30	70	do	92.00	6,440.00
31	70	do	92.00	6,440.00
32	70	do	91.00	6,370.00
33	70	do	91.00	6,370.00
34	70	do	93.00	6,510.00
35	70	do	93.00	6,510.00
36	70	Extra large; cut, scarred, etc	65.00	4,550.00
37	70	do	60.00	4,200.00
38	70	do	60.00	4,200.00
39	70	do	59.00	4,130.00
40	70	do	59 00	4,130.00
41	80	Large	92.00	7,360.00
42	80	do	86.00	6,880.00
43	80	do	84.00	6,720.00
44	80	do	83.00	6,640.00
45	80	do	81.00	6,480.00
46	80	do	82.00	6,560.00
47	80	do	81.00	6,480.00
48	80	do	81.00	6,480.00
49	80	Large	$81.00	$6,480.00
50	80	do	81.00	6,480.00
51	80	do	81.00	6,480.00
52	80	do	80.00	6,400.00
53	40	do	81.00	3,240.00
54	80	Large; cut, scarred, etc	57.00	4,560.00
55	80	do	52.00	4,160.00
56	80	do	50.00	4,000.00
57	80	do	50.00	4,000.00
58	80	do	49.00	3,920.00
59	70	do	49.00	3,430.00
60	90	Mediums	71.00	6,390.00
61	90	do	68.00	6,120.00
62	90	do	65.00	5,850.00
63	90	do	66.00	5,940.00
64	90	do	63.00	5,670.00
65	90	do	65.00	5,850.00
66	90	do	64.00	5,760.00
67	90	do	66.00	5,940.00
68	90	Mediums; cut, scarred, etc	50.00	4,500.00
69	90	do	45.00	4,050.00
70	90	do	44.00	3,960.00
71	90	do	44.00	3,960.00
72	90	do	46.00	4,140.00
73	90	Small mediums	55.00	4,950.00
74	70	Small mediums; scarred, etc	39.00	2,730.00
75	50	III Wigs	40.00	2,000.00
76	50	do	41.00	2,050.00
77	50	do	41.00	2,050.00
78	50	III Extra extra large	37.00	1,850.00
79	60	III Extra large	37.00	2,220.00
80	60	III Large	36.00	2,160.00
81	70	III Mediums	26.00	1,820.00
82	30	III Small mediums	19.00	570.00
83	50	IV Wigs	10.00	500.00
84	50	IV—3 extra extra large, 19 extra large, 10 large, 10 mediums, 8 small mediums	21.00	1,050.00
87	12	Skins—4 extra large, 4 large, 3 mediums, 1 small medium	53.00	636.00
	5,752			424,166.00

Comparative Values by Grades and Sizes, with Percentages Each Size of Sealskins Sold in 1920.

Classes and sales.	Grade.	Number.	High.	Low.	Average.	Total.	Total number.	Average.	Total price.	Percentage.
Wigs:										
Feb. 2	I and II	750	$169.00	$152.00	$160.20	$120,150.00	1,159	$140.47	$162,804.00	12.74
	Cut, etc	300	120.00	115.00	116.83	35,050.00				
	III	100	71.00	71.00	71.00	7,100.00				
	IV	9	56.00	56.00	56.00	504.00				
May 10	I and II	250	125.00	122.00	123.60	30,900.00	650	81.38	52,900.00	11.31
	Cut, etc	200	79.00	72.00	77.00	15,400.00				
	III	150	41.00	40.00	40.66	6,100.00				
	IV	50	10.00	10.00	10.00	500.00				

Comparative Values by Grades and Sizes, with Percentages Each Size of Sealskins Sold in 1920—Continued.

Classes and sales.	Grade.	Number.	High.	Low.	Average.	Total.	Total number.	Average.	Total price.	Percentage.
Extra extra large:										
Feb. 2	I and II	1,380	$174.00	$166.66	$169.91	$234,480.00	2,043	$155.06	$316,788.00	22.45
	Cut, etc	600	132.00	124.00	128.70	77,220.00				
	III	60	82.00	82.00	82.00	4,920.00				
	IV	3	56.00	56.00	56.00	168.00				
May 10	I and II	600	124.00	111.00	115.90	69,540.00	1,043	95.43	99,533.00	18.14
	Cut, etc	390	90.00	64.00	72.00	28,080.00				
	III	50	37.00	37.00	37.00	1,850.00				
	IV	3	21.00	21.00	21.00	63.00				
Extra large:										
Feb. 2	I and II	1,050	177.00	161.00	170.10	178,605.00	1,497	156.83	234,777.00	16.45
	Cut, etc	420	134.00	127.00	129.67	54,460.00				
	III	25	64.00	64.00	64.00	1,600.00				
	IV	2	56.00	56.00	56.00	112.00				
May 10	I and II	630	108.00	91.00	94.55	59,570.00	1,063	78.66	83,611.00	18.48
	Cut, etc	350	65.00	59.00	60.60	21,210.00				
	III	60	37.00	37.00	37.00	2,220.00				
	IV	19	21.00	21.00	21.00	399.00				
	Odd skins	4	53.00	53.00	53.00	212.00				
Large:										
Feb. 2	I and II	1,520	165.00	157.00	161.11	244,880.00	2,207	146.42	323,152.00	24.25
	Cut, etc	640	125.00	115.00	117.63	75,280.00				
	III	45	64.00	64.00	64.00	2,880.00				
	IV	2	56.00	56.00	56.00	112.00				
May 10	I and II	1,000	92.00	80.00	82.71	82,680.00	1,544	70.80	109,332.00	26.85
	Cut, etc	470	57.00	49.00	51.21	24,070.00				
	III	60	36.00	36.00	36.00	2,160.00				
	IV	10	21.00	21.00	21.00	210.00				
	Odd skins	4	53.00	53.00	53.00	212.00				
Mediums:										
Feb. 2	I and II	1,440	126.00	121.00	122.22	175,995.00	1,944	115.75	225,014.00	21.36
	Cut, etc	450	105.00	99.00	102.10	45,945.00				
	III	50	57.00	57.00	57.00	2,850.00				
	IV	4	56.00	56.00	56.00	224.00				
May 10	I and II	720	71.00	63.00	66.00	47,520.00	1,253	56.12	70,319.00	21.77
	Cut, etc	450	66.00	44.00	45.80	20,610.00				
	III	70	26.00	26.00	26.00	1,820.00				
	IV	10	21.00	21.00	21.00	210.00				
	Odd skins	3	53.00	53.00	53.00	159.00				
Small mediums:										
Feb. 2	I and II	150	90.00	90.00	90.00	13,500.00	250	81.48	20,370.00	2.75
	Cut, etc	90	70.00	70.00	70.00	6,300.00				
	III	10	57.00	57.00	57.00	570.00				
May 10	I and II	90	55.00	55.00	55.00	4,950.00	199	42.57	8,471.00	3.45
	Cut, etc	70	39.00	39.00	39.00	2,730.00				
	III	30	19.00	19.00	19.00	570.00				
	IV	8	21.00	21.00	21.00	168.00				
	Odd skin	1	53.00	53.00	53.00	53.00				
Feb. 2							9,100	140.97	1,282,905.00	100.00
May 10							5,752	73.74	424,166.00	100.00
Both sales							14,852	114.94	1,707,071.00	100.00

SUMMARY OF FUR-SEAL SKINS SHIPPED TO FUNSTEN BROS. & CO.

The table published in the report on the Alaska Fisheries and Fur Industries in 1919. stated that at the end of the calendar year 1919 there were on hand at St. Louis in all 47.615 fur-seal skins from the Pribilof Islands. Of these 43 were so-called food skins. taken during the close season ended August 24. 1917, and the remaining 47.572 were commercial skins taken after that date. A letter of February 17, 1921, from Funsten Bros. & Co., the Bureau's selling agents, stated that in unpacking the shipment received in November, 1919, one more skin was found than was reported shipped. This made the grand total on hand January 1, 1920, 47,616 skins. The following table shows shipments received and sales of skins by the firm during the calendar year 1920:

SUMMARY OF PRIBILOF ISLANDS FUR-SEAL SKINS RECEIVED AND SOLD BY FUNSTEN BROS. & CO., ST. LOUIS, MO., AND BALANCES IN FIRM'S CUSTODY, CALENDAR YEAR 1920.

Receipts.			Sales.				Balances on hand.		
				Number of skins.					
Date of shipment from Pribilofs.	Date of receipt by firm.	Number of skins.	Date of sale.	Food skins.[1]	Commercial skins.[2]	Total.	Food skins.[1]	Commercial skins.[2]	Total.
							43	47,573	47,616
			Jan. 20	31		31	12	47,573	47,585
			Feb. 2		9,100	9,100	12	38,473	38,485
Apr. 6	May 20	1,312					12	39,785	39,797
			May 10	12	5,740	5,752		34,045	34,045
June 22	July 30	505						34,550	34,550
Nov. 25	Dec. 15	23,062						57,612	57,612

[1] Skins taken from seals killed for natives' food prior to the termination on Aug. 24, 1917, of the 5-year period of restricted killings provided by the act of Aug. 24, 1912.
[2] Skins taken subsequent to Aug. 24, 1917.

FUR-SEAL SKINS ON HAND DECEMBER 31, 1920.

As in the published report for the preceding calendar year, a statement as to the number of fur-seal skins handled during the year and the number on hand, both at the Pribilof Islands and at St. Louis, at the end of the calendar year 1920 is submitted as follows:

ST. LOUIS RECORD OF SEALSKINS.

On hand Jan. 1, 1920		[1] 47,616
Shipments received in 1920:		
May	1,312	
July	505	
December	23,062	
		24,879
Total		72,495
Sales during 1920:		
January [2]	31	
February	9,100	
May	5,752	
		14,883
Balance on hand at St. Louis Dec. 31, 1920		57,612

PRIBILOF RECORD OF SEALSKINS.

On hand Jan. 1, 1920:		
St. Paul Island	1,405	
St. George Island	412	
		1,817

[1] The preceding report for 1919 gave the number on hand as 47,615, but when the shipment received November, 1919, was unpacked in 1920, one more skin was found than was reported shipped, thereby increasing the number on hand by 1.
[2] Funsten Bros. & Co. paid the Government at the rate of $80 each for 31 sealskins, of which the firm reported 17 spoiled in work and 14 prepared for exhibition purposes.

Skins taken in 1920:		
St. Paul Island	22,220	
St. George Island	4,428	
		26,648
Total		28,465
Shipments during 1920:		
St. Paul Island	23,334	
St. George Island	1,545	
		24,879
Balance on hand at Pribilofs Dec. 31, 1920		3,586
Grand total on hand Dec. 31, 1920		61,198

SALE OF FOX SKINS POSTPONED.

The 901 blue and 37 white fox skins taken at the Pribilofs in the winter 1919–20 were not sold during the year 1920, the condition of the fur market making it advisable to defer their sale.

PATROL OF NORTH PACIFIC OCEAN AND BERING SEA.

As in previous years, a patrol was maintained by the Coast Guard for the protection of the migrating fur-seal herd and the prevention of poaching in the vicinity of the Pribilof Islands. Numerous courtesies in the way of transportation of passengers, mail, and freight for the Bureau are also gratefully acknowledged. The following extracts from a statement prepared by the Coast Guard relate in detail the work performed during the year:

MEMORANDUM CONCERNING OPERATIONS OF THE COAST GUARD IN CONNECTION WITH PATROLLING THE NORTH PACIFIC OCEAN AND BERING SEA DURING THE SEASON OF 1920.

The North Pacific Ocean and Bering Sea patrol, commanded by Commander J. H. Brown, United States Coast Guard, for the season of 1920 was made by the Coast Guard cutters *Unalga*, *Algonquin*, *Bear*, and *Bothwell*. These vessels were actively engaged during the season on patrol and in such additional work as furnishing transportation to various persons, including natives, civil authorities, school-teachers, and destitutes; delivering United States mail, food, and supplies to isolated settlements; assisting distressed vessels; extending succor to persons in need; furnishing medical treatment to natives; and enforcing the laws.

The *Unalga*, in command of Lieut. Commander B. L. Brockway, left Seattle on April 28, 1920, for Unalaska. The cutter had on board seven passengers for transportation to various points in Alaska, four of whom were employees of the Bureau of Fisheries. On May 7 she arrived at Unalaska, where all passengers left the vessel. The medical officer attached to the *Unalga* inspected the town of Unalaska and found the health and sanitary conditions to be good.

On May 14 the *Unalga* left Unalaska on her first cruise in Alaskan waters. She proceeded to Unimak Pass, cruised along the southern shore of Unimak Island, then visited Davidson Bank, and traveled along the fishing banks as far east as Sannak Islands. During this trip no fishing vessels were sighted.

On June 18 she left Unalaska for a cruise in the vicinity of Slime Bank. The only vessel seen on this trip was the American schooner *Wawona*, to which mail was delivered and to the crew of which medical treatment was afforded. The cutter later left for the Pribilof Islands and cruised in that vicinity for more than a week, but found no vessels in need of assistance. Two more trips were made to the Pribilof Islands and Slime Bank and to other fishing banks in Bristol Bay as far east as Ugashik River. While on one of these cruises the American schooner *City of Papeete* was boarded and medical treatment given to some members of her crew.

On August 14 the commanding officer of the *Unalga*, while serving in the capacity of United States commissioner, acted as arbitrator in a labor dispute at the Wood River cannery of the Alaska Salmon Co. Through his efforts a reconciliation was effected and the men returned to work. * * * On August 18 the *Unalga* cruised over the fishing grounds off Hagemeister Island, but sighted no fishing vessels while on this trip.

On October 20 Mr. A. H. Proctor, superintendent, Pribilof Islands, and several natives, were transported to the northeast point of St. Paul Island to obtain a quantity of salted sealskins, the motor boat of the Bureau of Fisheries being disabled at the time. * * * On November 23 the cutter proceeded to Sand Point, where the medical officer vaccinated a number of persons. The vessel then left for Port Townsend and arrived there on December 1, 1920.

The *Algonquin*, in command of Lieut. Commander W. A. Wiley, left Port Townsend on April 30, 1920, on her cruise in Alaskan waters, and arrived at Hydar, Alaska, on May 4. Four days later she proceeded to Ketchikan, where she remained until the 20th, awaiting the arrival of supplies forwarded to her from Seattle. On May 20 she left Ketchikan and took up the seal patrol the following day. Two herds, containing about eight seals each, were sighted off Sitka in the evening. The cutter continued the patrol until May 24, when she was called to Yakutat to transport a badly wounded Indian to the nearest hospital. * * * A rumor that about 500 fur seals had wintered in the vicinity of Attu was investigated, with the result that the report was found to be erroneous.

On July 6 Lieut. Commander W. A. Wiley, having become ill, was forced to relinquish command of the *Algonquin*, whereupon Lieut. Commander W. T. Stromberg assumed command. Lieut. Commander Wiley was invalided home.

During the months of June, July, and August the *Algonquin* made a number of cruises in the vicinity of the Pribilof Islands and to other places. While on these cruises she carried United States mail, transported passengers, delivered supplies for the Bureau of Education and others, and afforded medical aid to the sick.

On September 11 the *Algonquin* left Unalaska for a cruise to Unimak Island. Among others taken aboard for transportation to various points was Warden J. N. Braun, Bureau of Fisheries, who desired passage to St. George Island. On her return trip to Unalaska the cutter afforded transportation to Mr. H. Silverstone, of the Bureau of Fisheries.

On September 27, in compliance with the request of Mr. A. H. Proctor, superintendent Pribilof Islands, a board was appointed to examine and report upon the machinery of the U. S. F. S. *Eider*. The board recommended that urgent repairs be made to the vessel.

On October 10 the *Algonquin*, with the cutter *Bear* in tow, the latter having become disabled, set a course for Seattle and arrived there on October 20. * * * Preparations being completed, the cutter left Seattle October 28 on her return to Bering Sea and arrived at Unalaska on November 5. * * * Her duties being completed, the *Algonquin* left Unalaska on November 12 for Seattle. On her return trip she stopped at Akutan, Lost Harbor, the canneries at Ikatan and King Cove, Unga Harbor, Valdez, Juneau, and other places. * * * On November 28 the *Algonquin* left Juneau and arrived at Seattle on December 2, 1920.

The *Bear*, in command of Lieut. Commander F. S. Van Boskerck, sailed from Seattle on May 8, 1920, for Alaskan waters. While en route the commanding officer became ill, which necessitated the vessel's stopping at Alert Bay, British Columbia, where he disembarked to await transportation to Seattle. The executive officer, Lieut. Commander C. G. Roemer, then assumed command. The cutter left Alert Bay on May 18 and arrived at Unalaska on May 27, where she delivered the United States mail.

On June 6 she left for a cruise to the Pribilof Islands. A number of natives were afforded transportation on this trip. Navigation, especially in the vicinity of Nome, was rendered extremely difficult, owing to the prevalence of ice. On June 13 Lieut. Commander F. S. Van Boskerck boarded the vessel at Nome and resumed command. The *Bear* left for a cruise to St. Lawrence Island on June 22, but owing to severe ice conditions, it was found impossible to make a landing, so she returned to Nome, arriving there on September 21. * * *

On October 10 the *Bear*, in tow of the *Algonquin*, left Unalaska. On October 19 the cutter *Snohomish* made contact with the vessels and relieved the *Algonquin* of the tow, arriving at Bremerton Navy Yard on October 23, 1920.

The *Bothwell*, as part of the Bering Sea patrol force, reported for duty at Unalaska on August 1, 1920. This cutter made cruises to Bogoslof Island, Akutan, False Pass, King Cove, Latouche, and other places. While on these cruises the *Bothwell* collected certain geographic information, made reconnaissances of harbors, and delivered United States mail. On September 8 the *Bothwell* left Latouche on her return trip and arrived at Seattle on September 14, 1920.

In his report on the Bering Sea patrol Commander J. H. Brown states that the fishing fleets were not operating during the season in accordance with their usual schedule, and because of this fact but few of these vessels were fallen in with. He further states that there were no fishing vessels operating on the Sannak and Davidson Banks and but few on Slime Bank.

SEALING PRIVILEGES ACCORDED ABORIGINES.

One thousand two hundred and eighty-five fur-seal skins were taken by Indians off the coast of Washington during the months of April, May, and June, 1920. These skins, together with two more taken in June, 1919, were properly authenticated through the cooperation of A. D. Dodge, superintendent of the U. S. Indian School at Neah Bay, Wash. These seals were taken by Indians of the Washington coast in accordance with the privilege granted by the North Pacific Sealing Convention of July 7, 1911, and the act of Congress approved August 24, 1912. Of the total of 1,287 skins, 656 were from male seals, 630 from females, and one from a seal whose sex was not recorded.

JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES.

On January 17, 1921, the Bureau was advised that 56 fur-seal skins, constituting 10 per cent of the total number taken from the Japanese herd on Robben Island in the season of 1920, were ready for delivery to a representative of the United States. Under the convention of July 7, 1911, the United States receives a share of skins taken from the Japanese herd. Instructions were issued for the shipment of these skins, and they reached San Francisco April 15, being forwarded at once to the Bureau's agents at St. Louis, where they were received on April 26. They will be dressed, dyed, and machined in the usual manner and sold for the account of the Government.

FUR-SEAL CENSUS, PRIBILOF ISLANDS, 1920.

By G. Dallas Hanna.

I landed at the Pribilof Islands on June 16, 1920, from the U. S. naval radio tender *Saturn* for the purpose of making a census of the Alaska fur-seal herd which resorts there to breed. In order to complete the work it was necessary at various times to travel from St. Paul Island to St. George Island and vice versa. This was effected through the courtesy of the commanding officers of the *Saturn*, the Coast Guard cutter *Algonquin*, and the Bureau of Fisheries vessel *Eider*, to all of whom my appreciation is extended.

The census was made possible through the active cooperation of the superintendent of the Pribilof Islands, A. H. Proctor, in furnishing material and labor on St. Paul Island when necessary. C. E. Crompton, agent and caretaker, did likewise on St. George Island. E. C. Johnston, storekeeper on St. George Island, ably assisted in the actual census work as much as possible.

The methods used in counting and computing the various classes as given below were similar to those which have been in use for several years and which were outlined in the report of the Alaska Fisheries and Fur Industries in 1918, page 116.

PUPS.

Distribution of Pups in 1920.

Rookery.	Date of counts.	Living pups.	Dead pups.	Total pups.	Per cent dead.
ST. PAUL ISLAND.					
Kitovi		3,718	46	[1] 3,764	1.22
Lukanin		2,853	79	[1] 2,932	2.69
Gorbatch		9,970	281	[1] 10,251	2.74
Ardiguen		1,163	17	[1] 1,180	1.44
Reef		23,048	590	[1] 23,638	2.50
Sivutch		8,281	94	[1] 8,375	1.12
Lagoon	Aug. 12	333	8	341	2.35
Tolstoi		16,898	388	[1] 17,286	2.24
Zapadni		16,031	368	[1] 16,399	2.24
Little Zapadni		12,214	280	[1] 12,494	2.24
Zapadni Reef	Aug. 12	525	7	532	1.32
Polovina	Aug. 11	5,794	212	6,006	3.53
Polovina Cliffs	...do...	2,511	62	2,573	2.41
Little Polovina		1,690	21	[1] 1,711	1.23
Morjovi	Aug. 10	2,818	118	2,936	4.02
Vostochni		31,708	1,149	[1] 32,857	3.50
Total		139,555	3,720	143,275	2.60
ST. GEORGE ISLAND.					
North		8,944	182	[1] 9,126	1.99
Staraya Artil		5,781	163	[1] 5,944	2.74
Zapadni	Aug. 4	894	13	907	1.43
South	...do...	98	1	99	1.01
East Reef	Aug 5	2,543	28	2,571	1.09
East Cliffs		5,493	112	[1] 5,605	2.00
Total		23,753	499	24,252	2.06
Total, both islands		163,308	4,219	167,527	2.52

[1] Based on estimated average harem.

The chief object in the counting of pups is the determination of the average number of cows to each bull, or the average harem. Since birth is given to but one young each year it follows that the determination of the number of young will give the number of breeding females, and by dividing this by the number of harem bulls found earlier in the season the average harem is determined.

Obviously the greater the number of pups counted the greater the accuracy of the census as a whole. Up to and including 1916 it was possible to count this class on all of the rookeries. In 1917, however, the greatly increased number of bulls prevented pup counting until such a late date that breeding areas could not all be gone over. The increase in size of the herd has further complicated matters. While it is not physically impossible to make a complete pup count when bulls are present in no greater numbers than in 1920, still a much larger force of counters would be required for the work than has heretofore been available.

Since 1917 a comparatively small proportion of the pups has been counted. Rookeries have been chosen, however, which were believed to represent the herd as a whole with regard to growth. They have been, in the main, the smaller ones, in order to reduce to a minimum the danger of loss from trampling by bulls and from smothering.

Neither of these factors enters largely into the operations if a competent force of white men is performing the work, because there are expedients which can be used in emergencies which effectually prevent deaths. For instance, if pups have piled up in the counting and are in danger of smothering, they can be scattered by a man wading into the mass. There is no other known means whereby the animals can be spread out quickly enough to prevent loss on a warm day. It so happens that the natives are entirely too irresponsible to be depended upon in such an emergency. In seven years of counting I have never seen one offer to do the scattering in such an emergency. It is obviously impossible for the person who does the actual counting to keep constant watch of the "podding" ahead of him, and if there should be no one else looking after that part of the work danger is sure to result: this is particularly true on the larger rookeries. Unfortunately the natives allowed eight pups to smother on Zapadni Reef rookery during the work on St. Paul in 1920. They have been included among the live pups on that rookery in the table because it is desirable to have the number of dead represent the natural loss only.

In selecting rookeries for counting in 1920 it seemed desirable in many ways to choose those which were counted in 1919. The working out of the average harem for those uncounted rookeries would then give results which were more strictly comparable than if new territory were selected.

While it seems reasonable to suppose that any one rookery would grow at the same rate as the herd, this is unfortunately far from the case. There is great variation among the several rookeries and on any one from year to year. This makes the estimating of the average harem on rookeries where pups have not been counted more or less uncertain. But unless all rookeries are counted—a manifestly impracticable task with a limited force and a large herd—no way to avoid the difficulty is known, and the matter must devolve upon the best judgment of those who have it in hand.

INCREASE OR DECREASE IN NUMBER OF PUPS IN 1920 FROM 1919.

Rookery.	Total pups, 1919.	Total pups, 1920.	Numerical increase.	Increase (+) or decrease (−).
ST. PAUL ISLAND.				*Per cent.*
Kitovi	3,565	3,764	199	+ 5.58
Lukanin	2,788	2,932	144	+ 5.16
Gorbatch	12,308	10,251	−2,057	−16.65
Ardiguen	1,150	1,180	30	+ 2.61
Reef	22,457	23,638	1,181	+ 5.26
Sivutch	7,015	8,375	1,360	+19.39
Lagoon	[1]445	[1]341	− 104	−23.37
Tolstoi	16,027	17,286	1,259	+ 7.86
Zapadni	14,300	16,399	2,099	+14.68
Little Zapadni	10,145	12,494	2,349	+23.15
Zapadni Reef	[1]604	[1]532	− 72	−11.92
Polovina	[1]5,794	[1]6,006	212	+ 3.66
Polovina Cliffs	[1]2,209	[1]2,573	364	+16.48
Little Polovina	1,203	1,711	508	+42.23
Morjovi	[1]3,041	[1]2,936	− 105	− 3.45
Vostochni	30,863	32,857	1,994	+ 6.46
Total	133,914	143,275	9,361	+ 6.99
ST. GEORGE ISLAND.				
North	8,802	9,126	324	+ 3.68
Staraya Artil	[1]5,746	5,944	198	+ 3.44
Zapadni	[1]857	[1]907	50	+ 5.83
South	[1]68	[1]99	31	+45.59
East Reef	[1]2,367	[1]2,571	204	+ 8.62
East Cliffs	5,418	5,605	187	+ 3.45
Total	23,258	21,252	994	+ 4.27
Total, both islands	157,172	167,527	10,355	+ 6.59

[1]Pups counted.

It will be noted that upon some of the eight rookeries counted there has been no gain, whereas on others it has been considerable, and again that the gain on the lot has been only 3.77 per cent. This latter fact indicates very strongly that the gain of breeding cows has not been the 9 per cent which has been considered to be the normal rate.

It is true that the smaller rookeries do not increase as rapidly as the large ones, but there should not be this much discrepancy even though it is possible. It is entirely possible for the rookeries counted to have lost and the herd as a whole gain the normal amount, but it is not probable. The abnormal gain on the other rookeries would have been a noteworthy feature to a person who had had them in view during successive years. After a consideration of all of the factors which enter into the problem, the gains on the several rookeries have been estimated as shown in the above table. This, of course, is made up largely from the data on average harems (p. 116). It shows the gain of pups (and breeding cows) for the entire herd to be 6.59 per cent.

A noteworthy feature of the rookeries on which counts were made is the actual decrease in the number as well as the percentage of pups found dead in spite of an actual increase of total pups. This is entirely in accordance with predictions as to what would happen when the size of the harem would be increased. By using the figures of dead pups found on the various rookeries the numbers have been estimated for those which were not counted. This is shown in the table above and illustrates the value of having a comparatively large average harem. The various proportions of massed areas where death rates are high to scattered rocky areas where they are low have been taken into consideration in arriving at the percentages. Also of prime importance in this connection is the fact that the size of the average harem in 1920 stands almost halfway between the figures for 1915 and 1916. It is reasonable to suppose that the percentage of dead pups would be governed thereby.

In the early days of pelagic sealing, when large numbers of dead pups were washed up by the surf, the impression was general that the animals were drowned by storms. The matter entered into international negotiations when it was maintained by the representatives of the Government of Great Britain that this was a prime cause of pup mortality. The fact that starvation was the cause of death as a result of the mothers having been killed by pelagic sealers was thereby concealed.

Dr. F. A. Lucas[1] has shown the subject in its true light and commented on the fallacy of the much-flaunted "deadly surf nip." By actual autopsy he demonstrated that the number of young animals drowned was insignificant.

I personally had never had an opportunity to make any observations on the subject until 1920, because violent storms had never occurred at the proper season during my seven years of work. But this year a heavy gale from the southwest drove an enormous surf into English Bay for three days during the latter part of July. It was precisely the time for deaths from drowning to occur, if such ever occur. Some pups are then dabbling in the edge of the water, while many others are young and weak.

After the storm thorough search of the entire stretch of English Bay beach was made, where over a thousand had been counted at one time during the days of pelagic sealing, but only 17 dead pups were found there. Not one of these 17 animals had drowned, and the majority of them were in an advanced stage of decomposition. They were simply some of the usual dead which had been washed off the rookery.

Thus the findings of Dr. Lucas in this respect are completely confirmed. Drowning is the cause of a very insignificant portion of the loss of fur seals.

The intestinal parasite Uncinaria may be present among the pups and may cause a few of the deaths recorded from year to year. Autopsies were made in a few cases in 1920 where decomposition had not proceeded too far, but in no instance could death be attributed to this cause. It may be that the parasite is epidemic at periodical intervals and will recur some time in the future. It is a point well worth keeping in mind by future investigators.

In 1915 the presence of a considerable number of animals, both young and adult, was noted and recorded which had the mange or some skin affection allied to it to a greater or less degree. Each year a few cases are seen, and they are usually marked by the presence of small, round, hairless spots. These are known in the fur trade by

[1] Fur Seal Investigations, 1896–97, pt. 3, pp. 83–84.

the erroneous term "rubbed spots." These are usually on portions of the anatomy which could not be "rubbed" under any circumstances. The number of cases of this disease gradually decreased to a minimum by 1917, which remained constant through 1920.

Ectoparasites of the fur seal are very rare, although the enormous amount of scratching which is visible in any "pod" would leave the casual observer with the impression that the opposite is the truth. In 1899 a louse, *Hæmatopinus callorhini* Osborn, was described from "a number of examples from the northern fur seal." And at the same time a tick, *Ixodes arcticus* Osborn, was described from a single individual.[1] I have made repeated search for these parasites, and several years ago located the louse on pups. Not all are afflicted by any means, but occasionally a few specimens can be secured from the eyelids and less often in the fur of the head. No positive information regarding the tick could be secured. A reward of $1 per louse and $5 per tick has been offered to the native workmen who kill and skin some 25,000 animals each year, but there have been only negative results. This leads me to believe that the louse is almost, if not wholly, confined to the pups, and very serious doubt is cast upon the *Ixodes arcticus* being a parasite of the fur seal at all.

COWS.

The number of breeding cows in the herd corresponds to the number of pups, since the one is derived directly from the other. There naturally exists in any year an excess of adult females over young, because there are always a few barren animals. The number, however, has never been considered other than inconsequential and is very properly ignored. The increase or decrease, in fact the existence of the species, is dependent upon the fertile cow; the others in no known way enter into commercial operations of man.

Formerly it was supposed that the cows which resorted to the hauling grounds with the bachelors were barren, but this is not the case at all. Thirteen cows which had been accidentally killed on the fields during the past four years have been examined and only one was found barren. Several of them had already given birth to young, but others had not, while the majority were 2-year-olds with reproductive organs normal in every way.

LOSS OF COWS ON THE ISLANDS.

The spreading of the bulls incident to the larger average harem produced a noticeable decrease in the death rate of cows on the breeding grounds. Since much of the turmoil and fighting of the past three years was thus done away with, such a result would be naturally expected. During the counting of 15,965 pups 9 dead cows were found. This is a percentage of 0.000563, which applied to the entire herd gives 94 as the total number. Comparable figures for preceding years were: 195 in 1919, 213 in 1918, 129 in 1917, and 39 in 1916. It shows that in spite of the increase in the herd there

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[1] Fur Seal Investigations, 1896–97, pt. 3, p. 553.

has been an actual decrease in the number of dead cows, and it constitutes, along with the low death rate of pups, the strongest argument in favor of a reasonably large harem.

In addition to the decrease in number of dead cows found, there was a very noticeable decrease in the number of those which had been bitten and torn by the bulls. In no instance was an injury seen which was believed to be serious.

The closing of commercial operations on July 31 instead of August 10 is even more necessary now than heretofore, and it is again urged that this action be delayed no longer. It is well known that up to 1910 the Government prohibited the leasing companies almost every year from conducting sealing after July 31 on account of the number of cows which would otherwise be driven and unavoidably killed. This was a very efficient and sensible regulation and should by all means be inaugurated in the work of the Government.

During the commercial operations of 1917, 1918, and 1919 it has been pointed out many times that the resorting of the cows to the hauling grounds of the bachelors after August 1 interfered considerably with the work and caused the death of some of them. This flocking of the females to the hauling grounds is due chiefly to the fact that the breeding season has passed and they are free to move wherever they will. When bulls were abundant to replace each other on the rookeries, they held the cows longer in the harems. But the increase in the average harem in 1920 gave the cows a great deal more freedom than they had had for three years. This was evidenced by their flocking to the hauling grounds in greatly increased numbers. It was no uncommon thing on St. Paul for 250 cows to come up in a single drive after August 1. And on St. George they were so abundant that work was very seriously hampered. Naturally some of them were killed; not a large number, to be sure, but it is impossible to conduct the killing with reasonable dispatch so that all will be spared. Some accidents are unavoidable, because the 3-year-olds of both sexes are almost indistinguishable even to the practiced eye. The native workmen are ashamed of the work and unless importuned will not report the killing of a cow.

We may grant that the number of females killed by the extension of the season to August 10 is insignificant. Their value to the herd may not be as great as the increased revenue secured by the additional take of males; a simple calculation will demonstrate that. But the driving of these several thousand mothers, heavy with milk, is very inhumane to say the least. And if we may judge by the effect of similar exertion upon domestic animals permanent injury in many cases results. The long drives particularly tire them to the point of exhaustion, sometimes even to death. In dry weather the skin is worn from the flippers and leaves them raw or bleeding. All of these details are better left untold, but are given in hopes that the real importance of the situation will become apparent and that 1921 will see no driving permitted after July 31. We all of course know that it is not necessary to drive after that date in order to reduce the excess number of males satisfactorily. Forty years of commercial work has demonstrated that point.

LOSS OF COWS AT SEA.

It has been ascertained several times the past few years that the loss of cows at sea the first three years is approximately 50 per cent of all of those born. No data have come to hand which call for a revision of this result. It is an enormous death toll, and though it is almost certainly due to the work of some pelagic enemy, we know very little of it. Killer whales are known to devour the animals and are suspected of being their only enemy, yet proof is not to be had. Bryant has recorded the taking of 18 and 24 fur-seal pups, respectively, from the stomachs of two killers—$2,000 meals, each of them. The investigation of this matter is one of the important tasks for the future. There are few studies which promise such fruitful results as would attend the successful solving of this problem. The protection afforded the cows and the consequent increased rate of growth of this class would be the permanent and most important benefit to the species and to man.

Actual figures as to the number of fur seals killed at sea under the treaty provisions allowing aborigines to hunt them are not yet available to me. Dispatches in the daily press, however, indicate that they are assuming proportions little short of alarming.

The proportions of the sexes taken in this pelagic catch are not known, but there is good reason to suppose that it consists largely of females. For the sake of convenience it may be assumed that 2,000 females were killed altogether on all coasts. This would reduce the Pribilof herd by double the number, or 4,000 in 1920, because the unborn pup is destroyed with the mother. In other words, the mainstay class of the herd has been reduced in a single season by over 1 per cent.

This matter is called to attention in the hope that a beginning may be made in solving the difficulty. Rather than have cows slaughtered it would be far preferable, if skins the Indians must have, to do as we have with Great Britain and Japan, give them an equivalent number of males from the land catch.

BRANDED ANIMALS.

Cows bearing the inverted T brand of 1912 on the top of the head were, as usual, in evidence on many of the rookeries. At Lukanin on St. Paul Island one was noted which was not believed to have been many hours out of the water. Two days later she had given birth to her pup but was located in a harem two bulls removed from where she was first seen. She was then seen each day until the eighth after her arrival. She could not be located later on the rookery, although she must have returned to nurse her pup. This confirms almost exactly a record made by W. I. Lembkey on the same rookery in 1902.

Further information was gained regarding those branded animals which may be conveniently classed as the 1902 series. A close study of them was begun in 1918 and the subject is dealt with at some length in the Alaska report for that year, pages 121 and 122.

The brands of this series consisted of one or more bars burned across the back or in a few cases with a longitudinal bar on the side combined with a cross bar. The work had for its object at the time of its inception the depreciation of the skin of the female to such an extent that it would be unprofitable for pelagic hunters to take it. The first experimental brands were put on in 1896, and when the operation was found to be practicable it was continued each season thereafter until 1902 on St. Paul Island and to 1903 on St. George Island, when it was abandoned. W. I. Lembkey states [1] that it was stopped in 1903 by departmental order. It was found a useless procedure in so far as the original objective was concerned.

A table was published in the 1918 report, page 122, which showed the totals branded each year on St. Paul. It included St. George also for 1896 and 1897. Subsequent records for the latter island could not then be located. Mr. C. E. Crompton has since found some of them and has kindly furnished them to me for use in this report. His records show the brandings on the smaller island for 1901 to 1903, inclusive, and they are embodied in the tables given below. Thus we now have the complete record of this work in so far as the island journals are kept, except for St. George Island, for the three years 1898, 1899, and 1900.

The records secured by Mr. Crompton failed to include one for October 12, 1903, of which I find a published statement in Appendix A to Hearings before House Committee on Expenditures in the Department of Commerce, page 100. It is there stated by Chichester that 274 pups were branded on that date. These have been added to the St. George totals for that year.

FEMALE PUPS BRANDED 1896 TO 1903.

Year.	St. Paul Island.	St. George Island.	Total.
1896	[1] 315	[1] 62	377
1897	[2] 5,371	[3] 1,880	7,251
1898	2,363	(4)	2,363
1899	2,191	(4)	2,191
1900	1,698	(4)	1,698
1901	4,173	686	4,859
1902	1,416	1,326	2,742
1903	(4)	1,352	1,352
Total	17,527	5,306	22,833

[1] Jordan and Clark, Fur Seal Investigations, 1896–97, p. 326.
[2] Murray, ibid., pp. 337, 338.
[3] Judge, ibid., p. 338.
[4] No record.

It seems desirable to record here the character of brands used when it has been possible to ascertain them. During several years when branding was done, a few cows were also captured and received the mark, but the number was so insignificant as to need no further mention in this connection.

[1] Appendix A, Hearings House Committee on Expenditures, Department of Commerce, p. 388. 1911.

Female Pup Fur Seals Branded on St. Paul and St. George Islands, 1896 to 1903.

Year.	Unknown.[1]	Single bar.	Double bar.	Triple bar.	Quadruple bar.	Triple crossbar.	Single diagonal bar.
1896		191	[2] 2	62	[2] 9	124	
1897		[3] 5,389	[4] 1,133	847			
1898		2,029					334
1899		2,191					
1900	[5] 1,076	629					
1901	[6] 4,888						
1902	2,245	497					
1903	[3] 1,370						

[1] Believed to have been single bar across back.
[2] All cows.
[3] Includes 18 cows.
[4] Includes 100 cows.
[5] Includes 7 cows.
[6] Includes 29 cows.

Many records of "branding" after 1903 have been made, but they refer in every case, it is believed, to the marking of a bachelor reserve. This was first undertaken in 1904 and continued up to and including 1911. In every case, with the possible exception of the first year and irregular branding on St. George from time to time, permanent brands were not used. The hair was simply clipped from a spot on the back of the head so as to make the animal recognizable the remainder of that season. Unfortunately this process has been called "branding" almost always and has so confused the record of the real hot-iron work that the truth is in some cases in doubt.

A journal entry on September 25, 1901, was found which stated "* * * one [cow was seen] with a brand just behind its front flippers and another running parallel to its backbone, but a little to one side." In commenting upon this, C. E. Crompton says: "I positively saw [a cow with] this same brand at Staraya Artil while counting pups this year [1919]."

No record of the use of this brand has been found, but it was probably in 1898, or else no record was made when the work was done. Unfortunately the journal entries are usually very brief and do not describe the character of mark at all. As, for instance, "October 10, 1901, branded seals at Little East, 127 branded."

To have been a cow in 1901, the animal must have been born in 1898 or earlier. It is not likely that the odd brand was used on more than one batch of pups, nor in more than one year. This would make the cow seen by Mr. Crompton in 1919 at least 21 years of age. This is three years more than the maximum age which has heretofore been ascribed to a fur seal.

In all, seven cows of the 1902 series were seen on the various rookeries in 1920. Facilities for observation over the great mass of rookery areas are so poor, however, that this can represent but a small fraction of the number which must have actually been in existence.

It is most important to note that these animals were 18 years old, unless by possible chance they were all from the lot branded on St. George in 1903, when they would be 17. This is so highly improbable that it may be dismissed. Thus the maximum age of the cow is several years more than the most sanguine have previously suspected.

This leads to interesting speculation upon the comparative mortality of the sexes. But it will be sufficient here to dismiss the subject with the observation that no record is known to me of any individual bull having returned to the rookeries for more than three successive years. It is believed, however, that in the majority of cases they do return for at least five years.

Undoubtedly a mistake was made once in the branding in sorting the sexes, and a male pup got the mark across his back. He developed and occupied the same position on East Cliffs Rookery for three successive years, 1913, 1914, and 1915 In his last year he had to be at least 12 years old.

BULLS.

HAREM AND IDLE BULLS.

At the height of the breeding season the bulls which had harems and those usually termed idle were counted with the greatest possible accuracy. Steps have already been taken to adopt certain rookery improvements whereby this important count can be continued in the future, regardless of how large the herd becomes. Experiments with a stable skeleton tripod in 1920 demonstrated the superiority of such a structure over any form of elevating apparatus previously tried. The manner in which this was used is shown in figure 3.

By placing such a tripod near the beach line and having a skeleton walkway leading to it over the seals, a cheap and very effective means of counting large flat areas will be provided. It is expected that this will be tried out thoroughly in 1921. A few permanent markers on the breeding areas to divide them into sections should enable the enumerator to have absolute confidence in his result.

On account of the absence of some trustworthy manner to get up high enough to view the rookeries the harem counts since 1917, when bulls became very abundant, have not been as good on the large rookeries as desired. Many expedients have been used to help, such as counting from a boat, erecting markers of driftwood, climbing a long ladder, as well as natural elevations, which are sometimes reached with great danger; but all were more or less makeshifts, which it is planned shall be abandoned.

Although there doubtless is an error in the number of harems given for the larger rookeries, it is really very small and is conservatively estimated to be not greater than one-half of 1 per cent. The desirability of having even this small variation corrected is due to the fact that this is the basis of the census. A small error here will multiply throughout the computations.

The decrease in the number of bulls from 1919 was apparent not only in the records; on the rookeries it was very much safer to approach counting points, and disturbance of even the rear harems rarely resulted. There appeared to be a general "loosening up" of the compact areas maintained when the bulls were stationed closer together, so that the increase of area over 1919 appeared to be more than the figures indicated had been the increase in cows.

If it is possible to do so in the future, the counting dates on St. George Island should be set back to correspond with the beginning of the count on St. Paul Island. It has heretofore been customary to make it after the St. Paul count, when one person was obliged to do both; and in 1920 it was thought best to continue the usual dates. However, if there is some one on the smaller island to whom the work can be delegated, it should be done. It was quite evident that harems had begun to break up, and some of the bulls which had completed their duties had resorted to the hauling grounds and elsewhere before the count was finished. Their places had been filled, of course, but it is better that the count be made just as the first harem masters are leaving.

Before the count was made it was plainly to be seen that the class formerly called "surplus bulls" was not large enough to warrant much killing. It had been the practice in 1917, 1918, and 1919 to class those animals which were found in apparently permanent position as "idle bulls" and others which evidently moved from place to place as "surplus bulls." Naturally, these latter did not constitute the whole of the class, because there were always some on the hauling grounds and in the water in front of the rookeries. Since conditions in 1920 had closely approached those of 1916 in this respect, it seemed entirely proper to follow the former practice and spare the class in the killings. By doing this there is a "margin of safety" for the breeding males which is maintained without entering into the computations.

HAREM AND IDLE BULLS AND PERCENTAGE OF IDLE BULLS TO HAREM BULLS COMPARED TO AVERAGE HAREM, 1920.

Rookery.	Date.	Harem bulls.	Idle bulls.	Total.	Idle bulls to harem bulls.	Average harem.
ST. PAUL ISLAND.					Per cent.	
Kitovi	July 18	132	57	189	43.18	28.52
Lukanin	...do	95	28	123	29.47	30.86
Gorbatch	July 19	253	40	293	15.81	40.52
Ardiguen	...do	40	8	48	20.00	29.50
Reef	...do	528	70	598	13.26	44.77
Sivutch	...do	190	60	250	31.58	44.08
Lagoon	July 20	14	3	17	21.43	24.36
Tolstoi	...do	408	65	473	15.93	42.37
Zapadni	...do	423	85	508	20.09	38.77
Suthetunga	...do	....	16	16	....	....
Little Zapadni	...do	297	62	359	20.88	42.07
Zapadni Reef	...do	28	5	33	17.86	19.00
Polovina	July 18	177	75	252	42.37	33.93
Polovina Cliffs	...do	86	24	110	27.91	29.92
Little Polovina	...do	49	48	97	97.96	34.92
Morjovi	July 17	97	99	196	102.06	30.27
Vostochni	...do	725	333	1,058	45.93	45.32
Total	....	3,542	1,078	4,620	30.43	40.45
ST. GEORGE ISLAND.						
North	July 23	199	17	216	8.54	45.86
Staraya Artil	...do	112	20	132	17.86	53.07
Zapadni	July 22	27	5	32	18.52	33.59
South	...do	4	....	4	....	24.75
East Reef	...do	67	28	95	41.79	38.37
East Cliffs	...do	115	13	128	11.30	48.74
Total	....	524	83	607	15.84	46.28
Total, both islands	....	4,066	1,161	5,227	28.55	41.20

A comparison of the foregoing table with the corresponding one for 1919 shows that there has been a reduction of harem bulls of 1,092 and of idle bulls of 1,078. There were even fewer animals in

FIG. 3.—OBSERVATION TRIPOD FOR USE IN TAKING FUR-SEAL CENSUS.

these classes in 1920 than there were in 1917. Actual numbers, however, mean nothing in this connection. The important features are the ratio of idle bulls to harem bulls and the average harem. Conditions for the series of years 1912 to 1920 are best shown in tabular form as follows:

VARIATIONS IN ADULT BULL CLASSES AND RATIO OF IDLE TO HAREM BULLS, 1912 TO 1920.

Year.	St. Paul Island.				St. George Island.				Both Islands.			
	Harem.	Idle.	Ratio.	Average harem.	Harem.	Idle.	Ratio.	Average harem.	Harem.	Idle.	Ratio.	Average harem.
			Per ct.				*Per ct.*				*Per ct.*	
1912..	1,077	93	8.63	65.0	281	20	7.11	42.5	1,358	113	8.32	60.4
1913..	1,142	77	6.74	69.6	261	28	10.72	49.1	1,403	105	7.48	65.8
1914..	1,316	159	12.0	60.3	243	13	5.3	57.1	1,559	172	11.0	59.8
1915..	1,789	546	30.52	49.27	362	127	35.08	42.51	2,151	673	31.28	48.13
1916..	2,948	2,278	77.27	33.53	552	354	64.13	32.82	3,500	2,632	75.20	33.42
1917..	4,166	2,341	56.19	26.08	684	365	53.36	28.26	4,850	2,706	55.79	26.39
1918..	4,610	2,245	48.69	26.59	734	199	27.11	27.65	5,344	2,444	45.73	26.71
1919..	4,573	2,158	47.19	29.28	585	81	13.81	39.76	5,158	2,239	43.40	30.47
1920..	3,512	1,078	30.13	40.45	524	83	15.83	46.28	4,066	1,161	28.55	41.20

Thus the average harem has increased from 26 to 41, whereas there are 28 per cent as many idle bulls as harem bulls. When this is compared with average harems of 60 and 65 and with percentages of idle bulls from 8 to 11 found in 1912 to 1914, it is at once seen there was still a small oversupply of males in 1920 if conditions in the former years be considered ideal. It has not been contended that there were too few bulls in those years for breeding requirements, although it is generally believed that the ideal average harem is between 40 and 50. This was the condition in 1920, and if it can be maintained with about the same averages and ratios throughout commercial operations, those having charge of the business may well feel gratified at their success.

If we pass without comment on the good or bad judgment shown in creating the enormous surplus of male life with the closed season of 1912 to 1917, still those who have had the administration of the herd in hand deserve great commendation for bringing back an ideal condition in the short space of three years.

AVERAGE HAREM.

The average harem was determined from actual pup counts in 1920 on the same rookeries as in 1919. The gains shown on these rookeries were used as the basis in the computation of the average harem for all rookeries. Due consideration was given in every case to the topography of the various breeding areas, since it is well known that harems are smallest on rough, rocky places. Also it is known that large massed areas grow more rapidly than small scattered ones. Thus, while the harem increased but 6 on the small rookeries counted, it was computed to have increased by 10 for the herd as a whole. A good illustration of this point may be seen in the figures for 1913, when there were over 80 cows to each bull on the average for four rookeries, while many of the smaller ones ran below 40. For purposes of comparison the average harems in 1919 are given, showing graphically the increase in size of harems.

AVERAGE HAREM IN 1920 FOR ALL ROOKERIES.

Rookery.	Breeding cows.	Harem bulls.	Average harem 1920.	Average harem 1919.
ST. PAUL ISLAND.				
Kitovi	3,764	132	[1] 28.52	[1] 23.00
Lukanin	2,932	95	[1] 30.86	[1] 25.34
Gorbatch	10,251	253	[1] 40.52	[1] 34.00
Ardiguen	1,180	40	[1] 29.50	[1] 25.00
Reef	23,638	528	[1] 44.77	[1] 31.19
Sivutch	8,375	190	[1] 44.08	[1] 30.50
Lagoon	341	14	[2] 24.36	[2] 26.18
Tolstoi	17,286	408	[1] 42.37	[1] 29.79
Zapadni	16,399	423	[1] 38.77	[1] 26.19
Little Zapadni	12,494	297	[1] 42.07	[1] 29.49
Zapadni Reef	532	28	[2] 19.00	[2] 21.57
Polovina	6,006	177	[2] 33.93	[2] 30.18
Polovina Cliffs	2,573	86	[2] 29.92	[2] 23.01
Little Polovina	1,711	49	[1] 34.92	[1] 31.66
Morjovi	2,936	97	[2] 30.27	[2] 20.69
Vostochni	32,857	725	[1] 45.32	[1] 30.74
Total	143,275	3,542	40.45	29.28
Total for rookeries counted	12,388	402	30.82	25.19
ST. GEORGE ISLAND.				
North	9,126	199	[1] 45.86	[1] 39.12
Staraya Artil	5,944	112	[1] 53.07	[2] 46.34
Zapadni	907	27	[2] 33.59	[2] 31.74
South	99	4	[2] 24.75	[2] 13.60
East Reef	2,571	67	[2] 38.37	[2] 31.56
East Cliffs	5,605	115	[1] 48.74	[1] 42.00
Total	24,252	524	46.28	39.76
Total for rookeries counted	3,577	98	36.50	39.42
Total, both islands	167,527	4,066	41.20	30.47

[1] Estimate. [2] Pups counted.

LOSSES OF BULLS AND YOUNG MALES.

In 1911 and 1912, when legislation was proposed which would prohibit the killing of the surplus males of the fur-seal herd on land, the principal objection raised was that a vast oversupply of breeding males would result. In view of the fact that commercial operations were curtailed for six years, it will be profitable to review conditions from the standpoint of the effect of the class on the herd.

The law which established the closed period of 1912 to 1917 became effective on August 24 of the former year. The action had been anticipated, however, and, since the intention of Congress was obvious, it was put into effect in the killing season of 1912. This made the closed period cover six seasons. It will be recalled that the herd had been reduced to its lowest point during American ownership in 1911 through the activities of vessel killings at sea. The major portion of the pelagic catch consisted of females. The surplus males up to 1910 were taken on land by private corporations which had leased the privilege, and in 1910 and 1911 by the agents of the Government. Under those methods over 95 per cent of the males were removed and there were left for breeding an average of approximately 1 male to 60 females. Investigators generally agreed that this ratio was sufficient.

On account of the low figure to which the herd had been reduced, however, it was feared that the vitality of the species had been impaired. It was argued that the herd would be benefited by leaving it unmolested by man for a period of years and allowing natural selection to become effective for a time in reducing the number of males.

In a state of nature the polygamous habits of the animals are such that the removal of the excess number of males is effected by fighting. It was believed by some that only the most virile of the males would survive the battles which would inevitably result from the failure of man to remove the excess. An improvement in the breeding stock was thus anticipated. Apparently the fact was overlooked that when a finish fight between bulls takes place neither the victor nor the vanquished is of much value thereafter as a breeder. Both are exhausted.

When the law of 1912 became effective there were 1,358 harem bulls in the herd, or 1 to 59.8 cows. Naturally, no immediate increase in the number of bulls nor reduction in the average harem could be expected, hence we find practically the same condition in 1913 and 1914. It was necessary to wait until those animals 3 years old and over in 1912 became old enough and strong enough to enter the rookeries before any result would become noticeable.

In 1915 we find a slight increase in the number of bulls. The average harem was 48.13. But since those animals 3 years old in 1912 could not have entered the rookeries until they were 8 years old, or in 1917, the cause of this increase in bulls must be looked for elsewhere than from the closed season. It could not possibly result from anything but ample reserves made by the Government agents during the commercial operations in the seasons immediately preceding 1912.

The same is true for the season of 1916, when there was a further decrease in the average harem. This was undoubtedly the result of reserves made during the season of 1911 and previously.

In 1917 there was an enormous increase in the number of bulls. This was the first influx due to the closed season. The average harem went down to 26.39, which we now know to be about as small as it can go, regardless of the number of males present. The habits of the bulls are such that the massed areas would be the scene of continual and disastrous fighting if the males were separated by much less than the space occupied by the minimum average harem.

A further large increase in males in 1918 was due to the absence of killing in 1913. This increase, however, failed to reduce the size of the average harem from the minimum found the previous year. There was thus built up an enormous excess of male life, which no known means enabled us to estimate with reasonable accuracy. There were no data upon which to estimate a natural loss. Fortunately for these computations, we have had the ages of animals killed determined for several years. This is accomplished on the killing fields by measuring the length of the freshly killed animal by means of a pair of beam calipers. The measuring of a series of branded males of known age permitted the establishment of standards showing the prevailing body length for each age, and the recording, in the proper categories, of field measurements of seals killed completed the classification.

By consistent efforts the greater portion of the excess of males had been removed by 1920, so that the average harem increased to

41.20. Recently acquired information enabled the computation with reasonable accuracy of the number of adults in existence in addition to the harem bulls and idle bulls. And since we know the number of births, it now becomes possible for the first time to compute the average natural loss from the third year to maturity. It gives the first concrete information ever available upon the size of a reserve which should be made in the third year to supply the herd with stock at maturity.

In order to present the figures intelligibly, the following table has been prepared. The figures have been taken from the various census reports since 1914. Nothing has been deducted for natural mortality from the third year on. Only animals killed have been removed from the various classes.

Assumed Male Strength of Herd in 1920 Exclusive of Natural Loss.

Class.	Number in 1916.	Killed in census year.[1]					Remainder less killings.
		1916	1917	1918	1919	1920	
3-year-olds in 1912	2,005	....	....	....	....	....	2,005
3-year-olds in 1913	11,271	104	....	....	....	....	11,167
3-year-olds in 1914	15,848	354	97	647	....	....	14,750
3-year-olds in 1915	18,282	2,855	614	1,058	4,302	....	9,453
3-year-olds in 1916	19,402	([2])	2,771	4,690	2,950	2,001	6,990
Total	66,808	Total bulls remaining in 1920 if no natural loss occurred					44,365

[1] Animals killed in the fall of one year have been added to the killings of the following summer.
[2] Killings already deducted.

This table shows that out of a stock of 66,808 animals which reached the age of 3 years from 1912 to 1916, inclusive, there would remain in 1920, 44,365 if there had been no natural loss. These animals would all be 7 years old or over in 1920. The younger ages do not enter into consideration here because they could not have been counted among rookery bulls that season.

It now remains to properly divide this total among the various years and classes and derive the percentage therefrom. The problem is difficult because so many factors enter therein to modify the result, and it is necessary to take these into consideration.

As an illustration, we may consider the 3-year-old class of 1914. The animals composing it were not subjected to any unusual conditions until the seventh year. Only the usual rate of natural mortality would therefor apply during these years. But when they were approaching maturity in numbers vastly exceeding the requirements of the cows, fighting for elimination began. The younger animals would naturally be vanquished. Thus the loss during the seventh year would be excessive and still more so during the eighth and ninth. In later years the percentage of loss would doubtless increase at a regular rate and 100 per cent would be reached at maximum old age. This, unfortunately, is not known and a figure must be assumed therefor. At the present time we seem not to have any good grounds to believe many bulls exceed 15 years. This, of course, is less than the age of females, but there are so many differences between the sexes of this species that the age of the male can no longer be based upon that of the female.

The conditions outlined above are those which are believed to exist when there is a great excess of males. If they had been removed by man so that only approximately enough remained for breeding purposes, the losses during the seventh, eighth, and ninth years would not be so heavy. Also it is probable that the bulls live longer when there is no fighting than when they have to wear themselves out in maintaining a harem position.

It, therefore, becomes apparent that conditions which obtained during 1917, 1918, 1919, are not normal and may never occur again. Everything now indicates that the younger animals suffered a practically constant mortality until the seventh year, and then their losses amounted to 50 per cent or more annually. Under normal conditions with the great excess removed by man, the loss after the seventh year would be variable and dependent upon the care given to the reserving of a proper number of bulls.

It seems unnecessary here to make arbitrary assumptions for the annual losses of the class which was termed in 1917-1919 "surplus bulls." It is definitely known that they were greater than the losses assumed and deducted. Thus in 1919, 50 per cent was estimated to have been the loss from the third year to and including the surplus bull class; that is, animals 7 years old and over. If the loss had been estimated at 50 per cent from the third year to the seventh and at least that much annually thereafter, it would have come nearer the actual condition. But there was nothing until 1920 which would cause one to suspect that the loss had been so enormous.

It now remains to determine what the annual loss of males is from the third year on, when average conditions accompanying commercial work exist. A division which is more or less arbitrary for all ages is as follows: First year, 35 per cent; second, 15 per cent; third, 10 per cent; fourth, 10 per cent; fifth, 10 per cent; sixth, 20 per cent; seventh, 20 per cent; eighth, 25 per cent; ninth, 30 per cent; tenth, 40 per cent; eleventh, 50 per cent; twelfth, 60 per cent: thirteenth, 70 per cent; fourteenth, 80 per cent; fifteenth, 100 per cent.

Considerable of the above is conjecture, but it is believed to represent fairly accurately the conditions existing in 1920. It will be noted that there is a slight revision of the percentages lost from the first to the third year. This does not materially affect the result and gives a working basis for the future. Doubtless additional investigation will adjust any irregularities in the table. It has been used in the preparation of the final census for 1920.

These new percentages of loss were obtainable in 1920, because early in the season it was seen that the surplus believed to be in existence from the accumulation of the closed period did not appear. It was evident that if the bulls were coming at all they would have been at the islands before the middle of July. Since they did not appear at that time it was recommended that no more be removed from the herd. As it turned out the counts at the height of the season showed that a few more could have been removed with safety.

COMPLETE CENSUS OF FUR SEALS AS OF AUGUST 10, 1920.

Pups, counted and estimated		167,527
Breeding cows, 3 years old and over, by inference		167,527
Harem bulls, counted		4,066
Idle bulls, counted		1,161
Yearlings, male and female, estimated:		
Pups born in 1919	157,172	
Deduct 35 per cent for natural mortality	55,010	
Yearlings, both sexes, beginning 1920	102,162	
Yearling females, 50 per cent, Aug. 10, 1920	51,081	51,081
Yearling males, beginning of 1920	51,081	
Yearling males killed in 1920	7	
Yearling males, Aug. 10, 1920		51,074
2-year-olds, male and female, estimated:		
Yearling females, Aug. 10, 1919	46,447	
15 per cent deducted for natural mortality	6,967	
2-year-old females, Aug. 10, 1920		39,480
Yearling males, Aug. 10, 1919	46,444	
Yearling males killed, fall of 1919	7	
Yearling males, end of 1919	46,437	
15 per cent deducted for natural mortality	6,966	
2-year-old males, beginning of 1920	39,471	
2-year-old males, killed in 1920	360	
2-year-old males, Aug. 10, 1920		39,111
3-year-old males, estimated:		
2-year-old males, Aug. 10, 1919	33,081	
2-year-old males killed, fall of 1919	214	
2-year-old males, end of 1919	32,867	
10 per cent deducted for natural mortality	3,287	
3-year-old males, beginning of 1920	29,580	
3-year-old males killed in 1920	18,831	
3-year-old males, Aug. 10, 1920		10,749
4-year-old males, estimated:		
3-year-old males, Aug. 10, 1919	13,596	
3-year-old males killed fall of 1919	820	
3-year-old males, end of 1919	12,776	
10 per cent deducted for natural mortality	1,278	
4-year-old males, beginning of 1920	11,498	
4-year-old males killed in 1920	5,831	
4-year-old males, Aug. 10, 1920		5,667
5-year-old males, estimated:		
4-year-old males, Aug. 10, 1919	5,747	
4-year-old males killed fall of 1919	66	
4-year-old males, end of 1919	5,681	
10 per cent deducted for natural mortality	568	
5-year-old males, beginning of 1920	5,113	
5-year-old males killed in 1920	106	
5-year-old males, Aug. 10, 1920		5,007

6-year-old males, estimated:		
5-year-old males, Aug. 10, 1919	5,282	
5-year-old males killed fall of 1919	37	
5-year-old males, end of 1919	5,245	
20 per cent deducted for natural mortality	1,049	
6-year-old males, beginning of 1920	4,196	
6-year-old males killed in 1920	43	
6-year-old males, Aug. 10, 1920		4,153
Surplus bulls (7-year-olds and over), estimated:		
6-year-old males, Aug. 10, 1919	8,991	
6-year-old males killed fall of 1919	300	
6-year-old males, end of 1919	8,691	
20 per cent deducted for natural mortality	1,738	
7-year-old males, beginning of 1920	6,953	
Surplus bulls, Aug. 10, 1919	9,619	
Surplus bulls killed fall of 1919	980	
Surplus bulls, end of 1919	8,639	
30 per cent deducted for natural mortality	2,592	
Remaining surplus bulls for 1920	6,047	
Breeding bulls of 1919	7,397	
30 per cent deducted for natural mortality	2,219	
1919 bulls remaining in 1920	5,178	
Breeding bulls in 1920	5,227	
1919 bulls remaining, deducted	5,178	
Increment of new bulls in 1920	49	
7-year-old males computed for 1920	6,953	
Surplus bulls computed for 1920	6,047	
Total theoretical surplus bull stock for 1920	13,000	
7-year-olds and over killed in 1920	721	
Total surplus in 1920	12,279	
Increment of new breeding bulls in 1920, deducted	49	
Surplus bulls in 1920	12,230	
50 per cent deducted for abnormal losses due to excessive number of bulls	6,115	
Surplus bulls, Aug. 10, 1920		6,115

RECAPITULATION.

Pups	167,527
Cows	167,527
Harem bulls	4,066
Idle bulls	1,161
Yearling females	51,081
Yearling males	51,074
2-year-old females	39,480
2-year-old males	39,111
3-year-old males	10,749
4-year-old males	5,667
5-year-old males	5,007
6-year-old males	4,153
Surplus bulls (males 7 years old and over)	6,115
Total	552,718

NATURAL-HISTORY RECORDS OF PRIBILOF ISLANDS.

By G. Dallas Hanna.

It seems to be highly desirable that there shall be published in a readily accessible place a résumé of the scientific work which has been done in connection with the biology of the Pribilof Islands. This group of islands has been more intensively studied than any other similar area in Alaska and will continue, doubtless, to attract attention in the future. Records of publications on the various groups of plants and animals are often widely scattered, and employees of the Bureau stationed on the islands have little opportunity to search for them.

The last bibliography of the subject was published in 1915 in a report by Osgood, Preble, and Parker.[1] This list was known to be incomplete at the time of its preparation and was intended to cover the subject "fur seals" only. Yet it is very valuable to anyone who has occasion to study the literature of the Pribilof Islands.

The following list is the result of note taking through several successive years and is intended to cover the general natural history of the islands in so far as I have the records. It also is known to be incomplete, but it takes up the most important work which has been done since the appearance of the above-mentioned bibliography. In some cases papers published prior to 1914 are included because of their interest to island students.

It should be explained that in addition to the following titles many Pribilof Islands records are contained in general publications which are not listed. For instance, Dall[2] has mentioned a large number of marine mollusks from the Pribilofs in his work on Northwest Coast Shells. The same is true of birds in Ridgway's "Birds of North and Middle America,"[3] Hamilton's "Coleoptera of Alaska,"[4] Evermann and Goldsborough's "Fishes of Alaska,"[5] and others. A new work is expected from the National Herbarium soon and it will contain full records of Alaska plants, including those from the Pribilof Islands.

The report of Alaska Fisheries and Fur Industries in 1918 (Bureau of Fisheries Document No. 872, pp. 105–107) contained a check list of birds of the Pribilof Islands, Alaska, with the names of persons first recording the species from the islands. This list contained names of 129 species and subspecies. It has been increased by six, the first three added in 1920, the fourth restored on evidence col-

[1] The Fur Seals and Other Life of the Pribilof Islands, Alaska, in 1914. Bulletin, Bureau of Fisheries, Vol. XXXIV, 1914 (1916), pp. 149–167. Washington, 1915.
[2] U. S. National Museum, Bulletin 112. 1921.
[3] U. S. National Museum, Bulletin 50.
[4] Transactions, American Entomological Society, Vol. XXI, pp. 1–38. 1894.
[5] Bulletin, U. S. Bureau of Fisheries, Vol. XXVI, pp. 219–360. 1906.

lected during the winter of 1919–20, and the remaining two recorded in 1921:

Limnocryptes gallinula, European Jack-snipe.[1, 2]
Macrorhamphus griseus scolopaceus, Long-billed Dowitcher.[1]
Passerella iliaca unalaschcensis, Shumagin Fox Sparrow.[1]
Corvus corax principalis, Northern Raven.
Micropus pacificus, Japanese Swift.[2, 3]
Loxia leucoptera leucoptera, White-winged Crossbill.[3]

This brings the total number of species known from the Pribilof Islands up to 135. All but six of these records are supported by specimens in some public museum. Since the 1918 list was compiled the little brown crane has been collected, but the restoration of the raven keeps the number of uncollected species the same as at that time.

In the paper by Mailliard and Hanna[3] a few corrections of former records were made. It was decided that the citation of *Arquatella maritima couesi*, Aleutian sandpiper, from the Pribilof Islands, by Seale[4] was unwarranted, and the record would have to be based on later work. A specimen taken on St. George Island February 12, 1917, by G. Dallas Hanna, was referred to in support of the record. The specimen is now in the National Museum.

The credit for recording *Pisobia acuminata*, sharp-tailed sandpiper, was given to Bishop[5] in the 1918 list as Grinnell[6] had done. Seale, however, had recorded it three years previously.[4]

The record of *Larus hyperboreus hyperboreus*, glaucus gull, by Oberholser, cited in the 1918 list, is rather obscure. It is to be found in The Auk, Volume XXXV, No. 4, page 470, October, 1918. The subspecies *L. h. barovianus*, first taken by Palmer, is also listed by Oberholser from the Pribilofs on page 473 of his article.

BIBLIOGRAPHY.

FUR SEALS.

APPENDIX A.

1911. Appendix to Hearings before the Committee on Expenditures in Department of Commerce and Labor, House Resolution No. 73, to investigate the fur-seal industry of Alaska; June 28 and July 6, 1911. [This publication is said to contain all the correspondence pertaining to the Pribilof Islands from 1905 to date of publication. It contains a wealth of information on administrative matters and natural history. The more important reports in the document are listed in this bibliography under the names of their authors.]

CLARK, GEORGE A.

1911. Report of the seal census for 1909. Appendix A, Hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 827–897; comments thereon by W. I. Lembkey, pp. 898–903. Also preliminary report dated August 15, 1909, pp. 715–716 and 826–827.

[1] Hanna, G. Dallas: New and interesting records of Pribilof Island birds. Condor, Vol. XXII, No. 5, pp. 173–175, September, 1920.
[2] New to North America.
[3] Mailliard, Joseph, and G. Dallas Hanna: New bird records for North America with notes on the Pribilof Islands list. Condor, Vol. XXIII, No. 3, pp. 93–95. 1921.
[4] Seale, Alvin: Notes on Alaskan water birds. Proceedings, Academy of Natural Sciences, Philadelphia, Vol. 50, 1898, p. 139.
[5] Bishop, Louis B.: Birds of the Yukon region, with notes on other species. North American Fauna, Vol. 19, p. 66. 1901.
[6] Grinnell, Joseph: Record of Alaskan Birds in the collection of the Leland Stanford Junior University. Condor, Vol. III, p. 19. 1901.

EVERMANN, BARTON WARREN.
1919. The northern fur-seal problem as a type of many problems of marine zoology. Scientific Monthly, September, 1919, pp. 263–282. [Fully illustrated.]

HANNA, G. DALLAS.
1917. Census of the fur seal herd. *In* Alaska fisheries and fur industries in 1915, by Ward T. Bower and Henry D. Aller, Appendix III, Report, U. S. Commissioner of Fisheries, 1915, pp. 83–96.
1917a. Census of the fur seal herd. *In* Alaska fisheries and fur industries in 1916, by Ward T. Bower and Henry D. Aller, Appendix II, Report, U. S. Commissioner of Fisheries, 1916, pp. 91–98.
1918. Fur-seal census, Pribilof Islands, 1917. *In* Alaska fisheries and fur industries in 1917, by Ward T. Bower and Henry D. Aller, Appendix II, Report, U. S. Commissioner of Fisheries, 1917, pp. 97–123.
1919. Fur-seal census, Pribilof Islands, 1918. *In* Alaska fisheries and fur industries in 1918, by Ward T. Bower, Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 116–128.
1920. Fur-seal census, Pribilof Islands, 1919. *In* Alaska fisheries and fur industries in 1919, by Ward T. Bower, Appendix IX, Report, U. S. Commissioner of Fisheries, 1919, pp. 106–117.
1921. Fur-seal census, Pribilof Islands, 1920. *In* Alaska fishery and fur-seal industries in 1920, by Ward T. Bower, Appendix VI, Report, U. S. Commissioner of Fisheries, 1920, pp. 104–121.

HEATH, HAROLD.
1911. Fur-seal investigations in 1910. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 1209–1225; uncorrected page proof. The full report appeared as U. S. Bureau of Fisheries Document No. 748. Quoted complete *in* Fur Trade Review for November, 1911, pp. 79–86.

LEMBKEY, W. I.
1911. Reports for years 1905 to 1910, inclusive. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor as follows:
1905: pp. 157–208.
1906: pp. 260–319.
1907: Preliminary, pp. 482–485; annual, pp. 486–533. Also published as Senate Document No. 376, 60th Cong., 1st sess.
1908: pp. 593–658. Also published as House Document No. 63, 62d Cong., 1st sess.
1909: pp. 746–787. A summary appears on pp. 722–725.
1910: pp. 1011–1044. Uncorrected page proof. Also published as U. S. Bureau of Fisheries Document No. 749 and *in* Fur Trade Review, December, 1911, and succeeding numbers.
[While these reports are largely of an administrative character, they contain a great deal of information on the censuses of fur seals for the several years mentioned.]

MARSH, M. C.
1911. Report of the census of fur seals in 1906 and other matters. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 351–371. Comments thereon by Lembkey, pp. 373–375.

PARKER, GEO. H.
1915. The problem of adaptation as illustrated by the fur seals of the Pribilof Islands. Proceedings, American Philosophical Society, Vol. LIV, pp. 1–6, 1915.
1917. The fur seals of the Pribilof Islands. Scientific Monthly, Vol. IV, pp. 385–409, 1917. [A popular well illustrated account.]
1918. The growth of the Alaska fur-seal herd between 1912 and 1917. Proceedings National Academy of Sciences, Vol. IV, pp. 168–174, 1918.

SIMS, E. W.

1911. Report on conditions on the fur-seal islands. Dated August 31, 1906; appendices omitted. Appendix A, hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 378–402. Criticism and comment, pp. 403–434, and on p. 459. [This important document was published separately, but is exceedingly rare. It probably did more to secure the abolishment of pelagic sealing and provide adequate patrol than any other work.]

FOXES.

JUDGE, JAMES.

1909. The blue foxes of the Pribilof Islands. Report of American Breeders' Association. Vol. V, pp. 325–340. *Also in* Fur farming in Canada, by J. Walter Jones, pp. 71–80; published by Commission of Conservation, Ottawa, Canada, 1914. [This article gives an account of the methods of farming blue foxes which were developed by Mr. Judge on St. George Island. The Judge method is the only one which has proved successful with this species and the results now being reaped are a tribute to the zeal of the man who had the courage to overcome the obstacles in his way.]

MERRIAM, C. HART.

1902. Four new Arctic foxes. Proceedings Biological Society of Washington, Vol. XV, pp. 167–172, 1902. On page 171 *Vulpes pribilofensis* is described as new from St. George Island. This is listed as Alopex pribilofensis (Merriam) by Miller in his North American Land Mammals *in* Bulletin No. 79, U. S. National Museum, p. 82, 1912.

BIRDS.

EVERMANN, BARTON WARREN.

1913. Eighteen species of birds new to the Pribilof Islands, including four new to North America. The Auk, Vol. XXX, No. 1, pp. 15–18, January, 1913.

HANNA, G. DALLAS.

1916. Records of birds new to the Pribilof Islands, including two new to North America. The Auk, Vol. XXXIII, No. 4, pp. 401–403, 1916. [Thirteen species new to the islands are here recorded.]

1919. Additions to the avifauna of the Pribilof Islands, Alaska, including species new to North America. Journal, Washington Academy of Sciences, Vol. IX, No. 6, p. 176, 1919. [Here appears a list of the new birds for the Pribilof Islands, recorded in greater detail in The Auk, Vol. XXXVII, pp. 248–254, 1920. Also see The Auk, Vol. XXXIII, p. 443, 1919.]

1919a. Check list of birds of the Pribilof Islands, Alaska, with the names of persons first recording the species from the islands. *In* Alaska fisheries and fur industries in 1918, by Ward T. Bower, Appendix VII, Report, U. S. Commissioner of Fisheries, 1918, pp. 105–107.

1920. Additions to the avifauna of the Pribilof Islands, Alaska, including four species new to North America. The Auk, Vol. XXXVII, pp. Vol. XXII, pp. 173–175, 1920. [Three species new to the islands are here recorded.]

1920a. New and interesting records of Pribilof Islands birds. The Condor, Vol. XXII, pp 173–175, 1920. [Three species new to the island list are here recorded, including one new to North America. Another species is restored to the list, and there is given in tabular form a list of the breeding species on each of the five islands of the group.]

1920b. Birds of the Alaska fur-seal islands. The Gull, Vol. 2, No. 12, 1920. [Abstract of lecture given before the Audubon Association of the Pacific.]

1921. The Pribilof sandpiper. The Condor, Vol. XXIII, pp. 50–57, 1921. [An account of the nesting habits, migrations, etc., with a photograph of the eggs.]

JUDGE, JAMES.

1911. A report on Walrus Island. Appendix A, Hearings before the Committee on Expenditures in Department of Commerce and Labor, pp. 907–912. [A detailed account of this wonderful bird rookery and its birds. Additional information on natives' egging expeditions is given on p. 1180.]

MAILLIARD, JOSEPH, and G. DALLAS HANNA.

1921. New bird records for North America, with notes on the Pribilof Island list. The Condor, Vol. XXIII, pp. 93–95, 1921. [Two species new to the Pribilofs are here recorded, and the entire list is corrected up to date, as shown in the notes herewith.]

OBERHOLSER, HARRY C.

1918. Subspecies of *Larus hyperboreus*. The Auk, Vol. XXXV, p. 470, 1918. [Two subspecies of the glaucous gull are recorded here from the Pribilofs, one of them for the first time.]

RILEY, J. H.

1917. A bird new to the North American fauna. The Auk, Vol. XXXIV,. p. 210. [The Kamchatkan pine grosbeak, collected by A. H. Proctor, is here recorded from St. George Island.]

MISCELLANEOUS.

ALLEN, J. A.

1902. The hair seals (family Phocidæ) of the North Pacific Ocean and Bering Sea. Bulletin, American Museum of Natural History, Vol. 16, pp. 459–499, 1902. [On page 495 is described *Phoca richardii pribilofensis*, a new subspecies from the Pribilof Islands, collected by C. H. Townsend. On page 493 *Phoca richardii* is recorded from the islands, and on page 475 True's record of the ribbon seal *Histriophoca fasciata* is repeated. Allen does not mention the bearded seal (*Erignathus barbatus*) from the Pribilofs; it is known to have been taken on St. George Island on two occasions, however, the first authentic record having been made by C. E. Crompton from a specimen taken in the winter of 1917–18.]

BANKS, NATHAN; HARRISON G. DYAR; TREVOR KINCAID; THEODORE PERGANDE; E. A. SCHWARZ; WILLIAM HARRIS ASHMEAD; and JUSTUS WATSON FOLSOM.

1900–1902. A series of papers by the above entomologists appeared *in* Proceedings, Washington Academy of Sciences, Vols. II and IV, recording insects collected by the Harriman Expedition in Alaska. The papers were reprinted verbatim *in* Vols. VIII and IX of the reports of the Harriman Expedition, published by the Smithsonian Institution in 1910. To them was added a paper on Myriapoda by O. F. Cook in which three species were listed from St. Paul Island, one of them new. [Many Pribilof species of insects are mentioned in the above series of papers and they will be found invaluable to those making a study of the insect life of the islands.]

CARDOT, JULES, and I. THÉRIOT.

1900–1902. Mosses of Alaska. Proceedings, Washington Academy of Sciences, Vol. IV. A joint paper on mosses collected by the Harriman Expedition.

CHAMBERLAIN, RALPH V.

1921. Linyphiidæ of St. Paul Island, Alaska. Journal, New York Entomological Society, Vol. XXIX, No. 1, pp. 35–42, Plates III and IV, March, 1921. [A collection of spiders made on St. Paul Island in 1910 by Harold Heath is here described. Eleven species are listed of which six are described as new; four of them represent new genera, which are also described.]

COCKERELL, T. D. A.

1898. New North American insects. Annals and Magazine of Natural History, Ser. 7; Vol. II, p. 324, 1898. [On page 324 is described *Bombus kincaidii*, a new species of bumblebee from St. Paul Island, Alaska.]

DALL, WM. H.

1915. A new species of Modiolaria from Bering Sea. The Nautilus, Vol. XXVIII, No. 138, 1915. [*Musculus phenax* is described as new from specimens collected on kelp roots at St. George Island by G. Dallas Hanna.]

DALL, WM. H.—Continued.

1916. A new species of Onchidiopsis from Bering Sea. Proceedings, Academy of Natural Sciences, Philadelphia, 1916, p. 376. [*Onchidiopsis* (*Atlantolimax*) *hannai*, a new sea slug, is described as new from specimens collected on St. Paul Island in 1914 by G. Dallas Hanna.]

1919. Paleontology. Journal, Washington Academy of Sciences, Vol. IX, No. 1, pp. 1–3, 1919. [A list of the fossil mollusks from two deposits on the Pribilof Islands is here given; 44 species are listed, seven of them mentioned as new but only one of which, *Chrysodomus solutus cordatus*, is named. The deposits are located at Tolstoi Points, St. Paul and St. George Islands, and the material was collected by G. Dallas Hanna.]

1919a. New shells from the northwest coast. Proceedings, Biological Society of Washington, Vol. 32, pp. 249–252, December, 1919. [On page 251 *Nodulus palmeri* and *Skeneopsis alaskana*, two marine shells, are described as new from material collected by William Palmer and A. G. Whitney on St. Paul Island.]

1920. A new Alaska Chiton. Nautilus, Vol. XXXIV, p. 22, July, 1920. [*Schizoplax multicolor* is described as new from St. Paul Island, Alaska.]

FRANKLIN, HENRY J.

1912. The Bombidae of the New World. Transactions, American Entomological Society, Vol. XXXVIII, Nos. 3–4, 1912. [On p. 295 the description of *Bombus kincaidii* (Cockerell) from St. Paul Island is repeated.]

HANNA, G. DALLAS.

1914. Interesting mammals of the Pribilof Islands. Proceedings, Biological Society of Washington, Vol. XXVII, No. 218, 1914. [Polar bear, walrus, and sperm whale mentioned from St. George Island.]

1919. The introduction of *Acanthinula harpa* (Say) and *Circinaria vancouverensis* (Lea) into St. Paul Island, Alaska. The Nautilus, Vol. XXXII, p. 143, April, 1919. [An account of the introduction of two land snails from Unalaska is here given.]

1919a. Geological notes on the Pribilof Islands with an account of the fossil diatoms. American Journal of Science, Vol. XLVIII, pp. 216–224, 1919.

HARRING, HARRY K.

1917. A revision of the rotatorian genera Lepadella and Lophochasis with descriptions of new species. Proceedings, U. S. National Museum, Vol. LI, pp. 527–568, 1917. [On p. 550, Plate 92, figs. 13–16, is described *Lepadella borealis*, a new species of rotifer from Ice House Lake, St. Paul Island, collected by Geo. H. Parker in 1914.]

MALLOCH, J. R.

1920. A synoptic revision of the Anthomyiidian genus Hydrophoria Robineau-Devoidy (Diptera). Canadian Entomologist, Vol. LII, pp. 253–257, 1920. [On page 257 appears the description of *Hydrophoria alaskensis*, a new species from St. George Island, Alaska, collected by G. Dallas Hanna and on St. Paul Island by the same and Harold Heath.]

1921. A synopsis of the North American species of the genus Helina R.-D., Sens. Lat. (Diptera: Anthomyiidae). Ibid., Vol. LIII, No. 5, pp. 103–109, 1921. [*Helina hannai*, a species of Diptera, is described as new from St. George Island, Alaska.]

PEARSE, A. S.

1913. Notes on a small collection of amphipods from the Pribilof Islands, with descriptions of new species. Proceedings, U. S. National Museum, Vol. XLV, pp. 571–573, 1913. [Five species are listed from St. Paul Island, two of which are described as new. They were collected by M. C. Marsh and W. L. Hahn.]

STERKI, V.

1917. A new mollusk of the genus *Pisidium* from Alaska, with field notes by G. Dallas Hanna. Proceedings, U. S. National Museum, Vol. LI, pp. 475–477, figs. 1–2, 1917. [*Pisidium hannai*, a minute fresh-water bivalve shell, is described as new from Ice House Lake, St. Paul Island, collected by G. Dallas Hanna.]

INVESTIGATION OF THE SALMON FISHERIES OF THE YUKON RIVER.

By Charles H. Gilbert and Henry O'Malley.

OUTLINE OF PROPOSED INVESTIGATIONS.

An exhaustive investigation of the problems presented by the salmon run of the Yukon River obviously would require practical and scientific inquiry extending over a series of years. During the few summer months no very ambitious program could be attempted. Many of the most important problems must remain untouched. Time would not permit an examination of the tributaries with their spawning beds. No study could be made of spawning habits nor observation of the fate of eggs and fry where these must lie beneath the gravel of the ice-locked streams during the long severe winter and spring. Yet the possible destruction of eggs by freezing may be an important factor in limiting the size of salmon runs in far northern rivers and may, indeed, be responsible for the practical elimination of salmon from the streams that enter the Arctic Ocean. If natural propagation on the Yukon is rendered relatively ineffective because of severe climatic conditions, the operation of hatcheries would here produce proportionately greater results than in more temperate regions. To the extent that natural propagation in any region is wasteful and unproductive do the advantages of artificial propagation appear.

In a single short season it could not be hoped to carry out more than the following program:

1. To inspect the spawning runs as these enter the mouth of the river and to ascertain by microscopic examination of the scales as much as this method can furnish of the life history of the Yukon salmon.
2. To examine the fishery operations carried on by the Carlisle Packing Co., in the Delta of the Yukon, this being the only cannery which packs salmon bound for the spawning beds of the Yukon.
3. To investigate the consumption of fresh and dried salmon by the resident population of the Yukon Valley and to estimate the importance to them of this salmon supply.
4. To draw such conclusions as the facts warrant concerning the magnitude of the Yukon salmon run and its adequacy to support cannery operations in addition to meeting the needs of the local population and providing a sufficient spawning reserve.

ITINERARY.

In carrying out the program above outlined the writers arrived in Skagway on May 12 and crossed White Pass and Lake Lebarge in time to take the first steamer down the Yukon, close behind the running ice of the spring breakup. At Tanana, which was reached May 31, transfer was made to the gasoline launches of the Bureau of

Fisheries, and from June 8 to 13, in company with C. F. Townsend, inspector, Alaska Fisheries Service, the party proceeded by launch to the mouth of the river, arriving June 13 at the entrance to Kwiguk Channel, where was located the floating cannery of the Carlisle Packing Co.

From this date until August 1 attention was given to the fishing grounds located in the Kwikluak mouth of the river and in the offshore district beyond this mouth, and to the principal channels of the delta which are closed to commercial fishing. From June 25 to July 1 the party proceeded by launch from Kwiguk to Holy Cross and return, to inspect the fishing camps of the lower river during the height of the king-salmon run. From July 5 to 7 a trip was made by launch from Kwiguk to the middle mouth of the Yukon, traversing both the Kwikpak and the Kawanak Passes, returning by way of Old Fort Hamilton, and inspecting en route the run of salmon in these channels. From July 23 to 29 a trip was made by steamer from Kwiguk to St. Michael and return, passing through the Apoon mouth. During the fishing season in the delta careful scrutiny was given daily to the salmon runs, and scale data were secured from extensive series of the different species of salmon which comprise the run.

From August 2 to 20 visits were made to fishing camps along the river from Kwiguk to Rampart, an approximate census secured of the amount of dried salmon, and fishermen interviewed concerning the runs of 1919 and 1920. Having proceeded by steamer from Rampart to Dawson, August 23 to 31, the return was made by launch from Dawson to Tanana, September 1 to 5, visiting on the way the fishing camps of the upper river. This phase of the inquiry terminated at Fairbanks on September 11, after ascending the Tanana River by launch as far as Nenana.

IMPORTANT SPECIES OF SALMON WITH DATA CONCERNING RUNS.

All five of the species of salmon known on the Pacific coast of North America make their appearance at the mouth of the Yukon and ascend that stream for a greater or less distance. Two of these species, however, the humpback salmon and the red or sockeye salmon, are present in such limited numbers as to have no practical significance. The three other species, namely, coho or silver, king, and chum or dog salmon, have substantial runs in the Yukon River, the latter two being of real economic importance.

RED OR SOCKEYE SALMON.

During the entire fishing season of 1920 the Carlisle cannery secured only 5 cases of sockeye salmon, in the neighborhood of 60 fish. As the majority of these were taken on the flats outside the mouth of the river, there might seem warrant to consider them as strays which had wandered from the Kuskokwim, or from some other stream to the southward which possesses a well-marked run of this species. In that case they might not even be entering the river, but playing about for a time in brackish water before finally resorting to their native streams for spawning purposes. In favor of this theory stands the fact that no breeding ground of the red salmon has yet been reported from any part of the Yukon Basin. The breeding ground of this species could be looked for only in connection with some lake, as the red salmon will not spawn under other than lake conditions. And the males of the species, when on the spawning grounds along the shores of a lake, or in the shallows of the creeks which enter it, are of such brilliant color as invariably to attract attention. It may be, therefore, that no permanent colony of red salmon exists in the Yukon, and that the major portion of the individuals observed off the mouth of the river would not enter and ascend the stream. Occasional individuals do, however, ascend the Yukon, for the writers learned of their infrequent occurrence from observers acquainted with the different species of salmon, and one specimen (a male, decidedly pink in color) was seen at Ruby on August 14. During the much longer fishing season of 1919, 20 cases of red salmon were packed by the cannery.

HUMPBACK SALMON.

The humpbacks appear at the mouth of the river more numerously than the red salmon, but never in sufficient numbers to constitute a run, even of small dimensions. It was noticeable that they were far advanced toward spawning in July, often with liquid milt and partly free eggs. It would be impossible for them to ascend the river far with their spawning period so close at hand. In fact, there were no reports of their occurrence above Andreafski, where a ripe male was observed on August 3.

COHO SALMON.

The least in value of the three principal species is the coho, which runs much less numerously than the other two, and, in addition, is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall. This species is little dried on account of its late appearance, but may be fed fresh to the dogs or frozen for later consumption. It seems not to be highly valued for human food.

During the season of 1920 it was entering the mouth of the river in very limited numbers during the last week in July, but nothing approximating a run had at that time developed. The individuals then entering were bright silvery on the sides of the body, without trace of the red coloration which later appears, and the jaws of the male had developed no hook. Later, while inspecting the fishing camps between the mouth of the river and Tanana, from August 2 to 15, everywhere occasional individuals of this species were being taken. At Ruby on August 14 the fish wheels were catching from one to six cohos each day; but at the Ramparts above Tanana on August 20 the species had not yet put in an appearance, nor could anything be learned of its occurrence in the main river above Tanana up to the date of the party's return from Dawson on September 5. The individuals observed below Tanana were running principally along the left (south) limit of the river, and it was reported that their main run was always along the left bank in company with the bright chums ("silver") and such king salmon as run late. To what extent the early cohos turn into the Tanana it was impossible to determine.

In the lower two or three hundred miles of the river the cohos during the early days of August may maintain the bright silvery coloration with which they enter from salt water, but soon a pinkish tinge appears, which becomes intensified to a bright red before Ruby is reached. At the same time the upper jaw of the male becomes bluntly hooked over the lower jaw, producing the characteristic snub-nosed appearance of this species on the spawning grounds, and the enlarged teeth of the males are soon in evidence. These changes in appearance may have already occurred before entering the river in the case of the latest individuals to enter.

It is most unfortunate that the only name by which the coho salmon is commonly known on the Yukon is "chinook," which is the special name of the king salmon of the Columbia River and is totally inapplicable to the coho. Near the mouth of the Yukon, where the influence of the cannery has been felt, the coho is generally and properly designated as the silver salmon, which is one of the two names by which the species is known in other fishing centers of Alaska. Unfortunately, as will later appear, elsewhere throughout the Yukon the term "silver salmon" is generally but mistakenly applied to an entirely different species. To avoid confusion, therefore, it is suggested that this species be known on the Yukon as the coho, a name by which it is generally known to the trade.

KING SALMON.

The king salmon appears at the river mouth shortly after the ice has run out—in the last week of May or the early days of June. The numbers rapidly increase, the run culminates quickly, and then almost as quickly declines. During the season of 1920 the first king salmon was obtained on June 13, although nets had been set to test the grounds for five days prior to that date. The rapidity with which the run sets in is well shown by the records of the first few days at the cannery. On June 15, 34 king salmon were obtained; on June 16, 175; June 17, 1,639; and on June 18, 5,228, this being the next to the largest take on any day during the season. The largest capture of king salmon in any one day was 6,104 on June 21. In no other day, except the two above mentioned, did the number captured quite reach 4,000. The run may be said to have begun on June 15 and to have culminated within the first week. It continued for some 10 days thereafter at a high level, and then registered unmistakable decline. The average take at the cannery for the best consecutive 16 days of the run was a little more than 3,000 fish per day.

The experience during the previous season, 1919, was very similar as regards the beginning, culmination, and decline of the king salmon run. The fish appeared during the second week in June, ran most abundantly during the following week, continued at a high level for two weeks more, and then rapidly fell off.

The average size of the 1920 king salmon was greater than that of 1919, as is shown by the average number required to make a case in each of the two years. The average number in 1919 was 3.54 to the case, while in 1920 it required but 3.03. The difference was even greater than is indicated by these figures, for in 1919 comparatively few fish of larger size were taken out for mild curing, while in 1920 there were put up 145 tierces of mild-cured kings, with 800 pounds to the tierce. These were all selected from the larger sizes and would have materially diminished the number required per case if all had been canned.

During the early part of the fishing season the king salmon were silvery in color, without trace of red; the testes are small, hard, and purplish in color; the eggs are always small, not more than half the size when mature. The snout of the males was then so little produced as to give no certain indication of sex. This condition continued during the greater part of June, near the latter end of which the run indicated a decided falling off. But on June 29 a second run appeared of small dimensions, and it was at once apparent that these fish were further along in their development. The jaws of the male were now somewhat prolonged and hooked, and the enlarged teeth had begun to show. They were now reddish in color, and the bellies were so thin that they were little valued for mild-cure purposes. These changes were abrupt and coincided with the sudden increase in the run.

The natural enemies which left traces of their presence on the entering salmon were the white whales, or belugas, and the lamprey eels. Belugas were very much in evidence in the lower river channels during the latter part of the season, the size of their schools increasing as the salmon were running more abundantly. Undoubtedly they were feeding on the salmon, and it is safe to assume that they captured and devoured a very large proportion of those on which they succeeded in closing their jaws. But the number of salmon which appeared on the cannery floor bearing unmistakable tooth marks of the beluga was surprising. The sides were scored lengthwise by widely spaced lines, which usually described a gentle curve, but were occasionally angulated. Evidently these salmon had escaped from the very jaws of their pursuers.

Other marks which attracted universal attention and were usually mistaken for hatchery brands were the scars made by the lamprey eel. This slender eel-shaped animal has an oval sucker-shaped mouth provided with rows of rasping teeth. By means of the sucker mouth it attaches itself to the salmon and may rasp off the skin and even deeper-lying tissues for food. A scar is left which often reproduces with great fidelity the details of the mouth, with its outer fringe of filaments and its inner groups of teeth, which in the scar often give the impression of printed characters.

Such lamprey scars have been occasionally observed in other rivers, but never before in such abundance as on the Yukon. This fact probably stands related to the large lamprey run which is indigenous to this stream. They enter the mouth of the river in the fall after the surface has frozen and run up under the ice, to the under surface of which they often attach themselves when resting. Although the run lasts but few hours at any locality, it is of enormous dimensions and furnishes tons of food to those who dip them up through holes cut in the ice.

Like the salmon, the lampreys enter the river for purposes of propagation, and all die after the eggs are laid. The young soon after hatching burrow in the mud of the river banks and live like earthworms for an indefinite period of two or more years. After this they pass out to sea when some 6 inches long, and spend the remainder of their life in the ocean. So far as known to the writers, the lamprey scars have been found on salmon exclusively, and on the Yukon never on chums or dog salmon. Some king salmon would have two or even three scars and one was found on a sockeye, but among the thousands of Yukon chums that we inspected there was not one that had been attacked by a lamprey. It is an interesting question whether the Yukon lampreys follow the king salmon of their own river on their feeding grounds and prey on them. It is not known that their attacks are ever dangerous. The salmon observed seemed in no case to have been seriously injured.

That the king salmon ascend the Yukon at a high rate of speed has been accepted generally. An attempt was made to secure reliable records of their first appearance at a large number of localities along the river. Wireless messages were sent to a number of points during the early days of the run before the dates should be forgotten. And, in addition, a number of important records were secured during visits to the fishing camps, some of these giving the catch in detail day by day throughout the season. While it is recognized that the capture of the first salmon of the season at different points along the river may vary within a day or two in relation to the beginning of the run, an examination of the data indicates that this source of error is not serious and that reliable conclusions concerning the rate of travel can be drawn from the table presented. In this table, when two or more records have been obtained from the same locality, the earliest has been selected as giving the first appearance of the king salmon in that portion of the river.

Date of Capture of First King Salmon at Localities on Yukon River, Season of 1920.

Locality.	Date.	Approximate distance traveled.
		Miles.
South mouth of river	June 13	....
Run begins south mouth	June 15	....
Pilot Station	June 20	107
Marshall	..do....	144
Russian Mission	June 21	204
Tucker's fish camp	June 23	221
Paimiut	June 22	259
Holy Cross	June 23	279
Halls Rapids, above Anvik	June 24	346
Camp 51 miles below Kaltag	June 27	440
Kaltag	June 28	491
Koyukuk	June 29	555
Whisky Creek, above Louden	June 27	622
Ruby	..do....	659
Tanana	June 28	804
Fish Creek, above Rampart Rapids	July 3	851
Circle	July 11	1,227
Charlie Creek	July 12	1,317
Eagle	July 13	1,402
De Wolf's fish camp	July 14	1,478
Dawson	..do....	1,504

Inspection of the above table shows the slowest rate of travel in the first hundred miles of the river above its mouth. From the entrance of the South Mouth to Pilot Station is approximately 130 miles, but it was five days after the run began in the mouth of the river before the first king salmon appeared at Pilot Station, indicating a rate of about 30 miles per day. Between Pilot Station and Tanana, on the other hand, the rate of travel was slightly more than 80 miles per day. This discrepancy is probably due to the habit of playing back and forth in brackish water, on entering the river mouth, before beginning their serious ascent of the river. It is well known to the fishermen at the mouth of the river that salmon enter the gill nets as numerously from the upstream as from the downstream side. They pass back and forth on the tides, lingering within the fishing district, thus giving the nets many more opportunities to capture them than would be the case if they pursued a direct course on entering the stream.

Three records below Tanana, those of the camp 51 miles below Kaltag, Kaltag itself, and Koyukuk, do not align themselves with the remainder of the series. At the average rate of travel king salmon should have reached Kaltag by the 24th instead of the 28th and Koyukuk by the 25th instead of the 29th. In both of these localities the capture of king salmon was considered of little relative importance, and the records are doubtless defective.

Above Tanana the current of the river increases materially, rapids are encountered, and the intricate channels of the Yukon Flats are to be threaded. It is not surprising to find that the rate of travel in the upper portion of the river becomes reduced. Not only are the difficulties of ascent increased but the potential store of energy in the fish approaches exhaustion. When they enter the mouth of the river they are the richest in oil of any salmon known, but by the time they reach Dawson their flesh is comparatively dry and flavorless, the oil having been expended to supply the energy needed in ascending 1,500 miles against the current and in carrying forward at the same time the sexual changes which precede the act of spawning. The average rate of travel from Tanana to Dawson was slightly less than 45 miles per day, while from Pilot Station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day.

No record of any other river approaches this in completeness nor in the high rate of travel indicated. The unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the northern summer.

Inasmuch as the investigators were compelled to restrict their attention to the main river, they are unable to designate the principal spawning areas of the king salmon. Limited numbers of kings are reported to turn aside into all the principal tributaries of the lower and middle sections of the river, but it is believed that a relatively large proportion of the run passes beyond the mouth of the Porcupine into the upper portion of the basin.

CHUM OR DOG SALMON.

Although the king salmon is an important source of food to the natives and the white population, it is far surpassed in value by the chum or dog salmon, which must be considered the principal food product of the Yukon River.

It makes its appearance off the mouth of the river only a few days later than the advent of the king salmon. In 1920 the first chum was obtained June 17, and from the 17th to the 19th, 138 became entangled in the coarse mesh of the king salmon nets set outside the mouth of the river; but none apparently had as yet entered the stream. On June 20, 2 were reported inside the river; June 21, 82; and June 22, 26; but during these three days 856 were taken in the outside nets, indicating clearly that the chums were beginning to school in some abundance outside the river, but that few were entering up to June 22, when the run up the river may be said to have begun. It became greatly accelerated on June 29 and maintained itself with minor fluctuations, until the cannery ceased operations the middle of July. No strictly quantitative results concerning the run of chums could be obtained from the cannery records during this season, as nets with appropriate mesh for capture of chums were not employed until the last week in June. For this reason, the apparent increase in size of run during the latter days of June is certainly overemphasized by the cannery statistics.

The first chums to arrive were further advanced toward sexual maturity than were the king salmon. In the latter the testes and ovaries were small and the snout so little produced in the males that there was no certain external evidence of the sex of the individuals examined. But in the case of the chums, even those earliest to run had the milt white in color and obviously enlarged, and the large eggs were already loosening in the ovary. The jaws of the males were not hooked, but were showing a slight sharpening and elongation, so that sex determination could usually be made from the appearance of the head. All the early chums were bright silvery in color, with abundant oil, and pinkish flesh which turned a deeper red on drying. All of them were in such condition that they would have been classed as "silvers" rather than as "dog salmon" by fishermen of the upper river.

But changes in the appearances of the chums were soon apparent. At first, as in the case of the king salmon, rare individuals, usually males, showed themselves in an advanced stage of development, with brightly colored bars on the sides of the body and long hooked jaws. They stood out conspicuously from their fellows, which were still in the "silver" stage.

But by the last of June, when a great increase suddenly occurred in the take of chum salmon, obvious seasonal changes had appeared in this species, as in the king salmon running at the same period. It was now the rule for the males to exhibit elongated jaws provided with canine teeth, and to show the beginnings of the conspicuous color marks which characterize the spawning males of this species. During the first days of July the run of chums again fell off, accompanied by a further increase in the matured appearance of the fish. As this occurred at the same time in chums and in king salmon, it appeared to the fishermen that the end of the run was in sight.

On July 7 a new run of chums suddenly set in, the great majority of which were of bright silvery appearance and with no further seasonal advancement than had been shown by the fish that ran first in June. Among them were a few stragglers of the previous run, the males and females equally conspicuous among their silvery companions. On subsequent dates these stragglers became more rare, and when the party left for the upriver on August 2 the few chums that were then running were almost wholly of the pronounced silvery type.

It is unfortunate that confusion should have arisen in the Yukon from a failure to recognize that the dog salmon and the so-called "silvers" represent different phases in the development of one and the same species.

The "dog salmon" are the individuals furthest advanced toward spawning. They exhibit the elongated hooked jaws and enlarged teeth in the male, the bright nuptial coloration, and the impoverished condition of the flesh, which is light in color, largely devoid of oil, and possessing very little substance when dried.

In the "silvers" the eggs and milt are less developed, the jaws of the male are little or not at all hooked, the external coloration is silvery, or with a light flush of red, and the meat is red in color when dried, rich in oil, and valuable both for human food and for dogs.

In general, the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and principal source of nourishment during the long journey still before them.

Many fishermen recognize the difficulty of distinguishing sharply between "dogs" and "silvers" and relieve their embarrassment by recognizing a third class, the "half-breeds." But the term "silver salmon" has acquired a fairly definite and useful significance in the trade. "Dog salmon" are so poor in nourishment that they have indifferent value even for dog feed, and will not be purchased except during times of extraordinary scarcity. The natives will feed them to their dogs, but will not eat them themselves unless king salmon and "silver salmon" are unobtainable.

The use of the term "silver salmon" for bright silvery chums, still rich in substance, is so universal and of such long standing in the interior of Alaska that it seems useless to attempt to supplant it with any other name. Confusion will inevitably result owing to the presence of the totally different species, the coho, which is commonly known in outside waters as the silver salmon. It is proposed, therefore, that the term "silvers," when referring to the Yukon basin, be restricted to the chums known commercially by that name, while the three species of salmon of importance on that stream be known as the king, the chum, and the coho.

It became evident, as we were ascending the river in August, that the "dogs" and the "silvers" were in general keeping apart from each other and were following distinct migration routes. Throughout the entire lower course of the Yukon, from Tanana at least as far as Anvik, the "dogs" predominated on the right (north limit) of the river and the "silvers" on the left limit. This is generally recognized by all the fishermen of that region, who also agree that the "dog salmon" turn into all the creeks and smaller tributaries, while the silvers "dislike the taste of fresh water," as a native fisherman stated the case. It is also recognized that a heavier run of kings and of cohos is found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are bound for the upper reaches of the river. This may have connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

The run of chums is not of uniform character and quality throughout the season. Fishermen recognize a succession of phases in the run, characterized by fish which on the average are recognizably different. In general, it is stated that the run of chums which accompany the king salmon are of relatively small size and poor quality, commonly known as dog salmon. Following these is a run of bright fish of good quality but inferior size, known as "silvers," while the last chums to run, late in August and early in September, are the finest of all, the "silvers" par excellence, a bright rich form distinctly of larger size. This last run of "silvers" ordinarily is of short duration, but is frequently of great intensity, and furnishes the most highly prized fish of the season.

As it was necessary to make a canvass of the entire river before the fishing season had come to a close, the writers were unable to observe the alleged succession of forms of the chum salmon at any locality. Distinct differences in the character and quality of the fish appeared at the various camps visited, but these differences were apparently dependent either on the proximity of the camp to important tributaries into which spawning chum salmon would pass, or, more especially, on the location of the camp with reference to the river itself, whether on the right bank or the left. In general when following up the right (north) bank of the river the quality of the fish became poorer as one approached the mouths of the tributaries. The impression was strong that the fish destined for these tributaries were farther advanced than those with which they were associated on the same side of the river bound for more distant spawning grounds. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance equally from the biological and from the strictly practical point of view. During the season of 1919 the bright chums, or "silvers," were said to be almost wholly wanting. If these were the fish bound for the more distant spawning beds, then the upper sections of the river must have remained largely unseeded in 1919 and incapable of producing their quota of a subsequent season's supply. In 1920 the run of chums was peculiar, in that it lasted longer than is usual in good years, but was of less intensity, and the August run of "silvers" failed to attain its usual proportions. In subsequent years the late run of "silvers" should be carefully noted. If there is evidence of a progressive decline, steps should be taken to protect this most important part of the run. To accomplish this result information should be obtained concerning the spawning beds which are resorted to by this large and valuable race of chums.

The chums travel up the river at a rate approximately equal to that of the king salmon. In 1920, as has been shown, they were schooling on the tide-flats off the mouth of the river nearly a week before they began to ascend the stream in any numbers on June 22. Adopting the latter date as the beginning of the run, it appears that they started about a week later than the king salmon. In the section of the river between Louden and Tanana, they were reported as 8 to 10 days behind the kings, and in the district between Circle and Dawson, the first chum was recorded 11 to 17 days later than the first king. It is evident, therefore, that the chum salmon, also, although apparently far less vigorous than the king, ascend the river at an astonishing rate of speed, maintained without cessation for well over a month, under the necessities imposed on them by the short summer and the rigorous fall climate of the Yukon.

The opinion has already been recorded that the king salmon of the Yukon is the richest in oil of any known king salmon. The same statement, made with even greater emphasis, may be advanced regarding the Yukon chums. This species is noted in other localities for its poor oil and poor color. The canned product is the reverse of attractive in color or in richness, and occupies the lowest rank in the markets of the world. In other river basins the chums do not travel far from the sea, but enter late in the season and seek spawning beds not far inland. But the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current. They form a rich table fish in the lower section of the Yukon, where the king salmon, to ordinary palates, contains a superabundance of oil. No more striking evidence of the richness of the king salmon can be found than that presented in the smokehouses of natives in the lower river. Here the drying salmon constantly drip a pure, clear red oil, which is collected in vessels and preserved for winter use. At the village of Ohogamute, above Marshall, we observed some 30 quart bottles filled with red salmon oil, secured this season from drying king salmon.

YUKON DELTA, ITS PRINCIPAL CHANNELS, AND ROUTES MAINLY FOLLOWED BY SALMON.

The Yukon River subdivides numerously within its extensive delta, and sends its waters to the sea through a large number of distinct channels. Many of these are narrow winding canals, which meander in every direction interminably through the flat lands, before they attain the outer edge of the delta. Through all of them, doubtless, some salmon pass, but three of the channels so far transcend the others in size and importance that for practical purposes they may be considered as forming the mouths of the Yukon and the main migration routes of the entering salmon. The channels in question, in order of importance, are Kwikluak Pass, or south mouth, with its important branch, the Kwiguk Pass; Kawanak and Kwikpak Passes, which coalesce before entering the sea and form together the middle mouth; and Apoon Pass, or north mouth.

Much the smallest of the three is the Apoon Channel, which traverses the northern sector of the delta, and forms the most direct route for river steamers bound to and from St. Michael. Although exclusively used as a steamer channel, it is poorly adapted for this purpose, being so shallow both within and without the mouth that light-draft boats have quite the habit of going aground there and waiting until a favoring tide shall float them.

Few salmon apparently find their way through Apoon Pass. A few families of natives from Kotlik village had established a fish camp on the shore just outside the mouth of the river, but the drying frames were scantily supplied with salmon when they were seen in the last week of July. Between the mouth of the pass and old Fort Hamilton no fishing stations were occupied, and the nets operated by the white trader at old Fort Hamilton were having no success. The general belief that Apoon Pass is of little importance as a fishway seemed wholly justified by observations. It has probably no greater importance than have some of the subsidiary channels through the delta.

The lower Kwikpak and the Kawanak Passes, which together constitute the middle mouth, are the least known of the three main divisions of the river. No steamers traverse them and very few natives have their summer fishing camps along their banks. The Kawanak is a stream of large size and fair depth of water and the lower Kwikpak, although choked with sandbars, carries a considerable current.

This middle mouth was visited July 5 to 7, at a time when the Carlisle Packing Co., on request, was testing the run of salmon by setting nets in the lower Kawanak Channel. Two nets were set along the left bank and two others were set offshore along the edge of a bank. This test was made during a slack period in the run in the south mouth, when the king salmon especially were running in greatly reduced numbers and the chums were not coming in full force. During 14 hours' fishing in the Kawanak Channel the four nets took 3 king salmon and 67 chums. In a second test of equal length the following day the showing was even less favorable.

One native fishing camp, which obviously has been occupied for many years, is located on the upper point of the long island which separates the Kawanak and Kwipak channels, immediately below their first confluence near the mouth. Four families were encamped at this place, and reported a favorable catch of king salmon during the preceding two weeks. The run had now slackened, they said, and the chums were just beginning to appear. They had found the season thus far very much better than the preceding year, when they had fished in the same locality. During the season of 1919 they had been unable to secure many more salmon than they had needed for their summer's use. At the time the camp was visited they had caught enough king salmon to fill one rack and two smokehouses, and had made use of two short gill nets of their own make set in an eddy along the bank of the island. The nets were not more than 25 feet long. Later, when a fresh run had entered the south mouth, word was received that the native fishermen in the middle mouth were again making good catches. It seemed, therefore, that the runs in the two mouths were well synchronized, the fluctuations during different seasons and between different days of the same season, following each other closely. This was well shown in a test made in the middle mouth, on request, during the earlier part of the season, when king salmon were running abundantly in the south mouth. This test was made on June 25 and 26, and resulted in a satisfactory catch of king salmon, with very few chums.

In view of the tests here indicated and observations at the fishing camp, it can not be said that the middle mouth lacks importance as a route for salmon. Yet it is considered to be very far indeed behind the south mouth in this respect. It is doubtful whether it equals in importance the subsidiary channel known as the Kwiguk, which branches off from the Kwikluak Pass, a few miles above its mouth. It may safely be inferred that the native fish camps are located at the most favorable fishing sites. These are occupied year after year and generation after generation by the same families and their descendants. Where native fishing villages are most thickly grouped will be found the largest and most unfailing supply of salmon. With this as a basis, the writers are compelled to conclude that the south mouth serves as the migration route for the greater part of the Yukon run. While no data are available for an estimate, it is not considered beyond the bounds of probability that nine-tenths of the entire run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk. About 100 families of natives were fishing in this district in 1920, while not to exceed 10 families were seen in the middle mouth below Dogfish Village. In no case did the latter families have equal success with those camped on the Kwikluak Pass.

It is on the Kwiguk Channel, just below its emergence from the Kwikluak, that the floating cannery of the Carlisle Packing Co. has been located during the two seasons of its operation in the delta. Protected from the heavy southerly winds which blow up the main channel during the summer months, this site is within easy distance of the main fishing grounds in the lower part of the Kwikluak Channel and among the offshore shoals and islands. Inasmuch as the Yukon salmon appear largely to travel along the banks, in the eddies, and along the margins of submerged banks, it is believed possible during a favorable fishing season to secure from this location as a base a very considerable proportion of the salmon of the Kwikluak Channel. Fortunately, no commercial fishing for export is permitted in the Kwiguk Channel. Several native families were located on this channel in 1920, and one white trader maintained a wheel. Good catches of king salmon and chums were secured at all of these camps, but it was believed that the run of kings was proportionally not as heavy as in the main channel.

COMMERCIAL FISHERY OPERATIONS IN YUKON DELTA IN 1920.

The fishery operations of the Carlisle Packing Co. in 1920 were conducted principally in the south or Kwikluak mouth of the river and beyond that mouth among the seaward channels which diverge from it. The mouth of the Kwikluak Channel was designated as it was during the previous season by a stake set in the right or northern bank on the projecting point of land at Ingrakaklak (see U. S. C. & G. S. chart 9373) and by a stake set on the left or southern bank of the channel at the entrance to the well-marked lagoon some half mile below Nilak.

A few fishing camps were established by the company as far up the Kwikluak Channel as Dogfish Village, where the main river makes its first grand division into the Kwikluak Channel and a channel which later divides to reach the middle and the Apoon mouths. Above Dogfish Village no fishing camps were established by the company, but they purchased limited numbers of salmon from a few independent fishermen, who operated at points below the mouth of Clear River near Andreafski.

Commercial fishing for export was thus carried on exclusively in the main Yukon, between the mouth of Clear River and Dogfish Village and below Dogfish Village, in the main Kwikluak Channel and its seaward extensions. All subsidiary channels branching off from the Kwikluak were closed to commercial fishing, whether these served as communicating links between larger channels, as in the case of Aproka Pass, or, as in the case of the Kwiguk Channel, secured independent egress to the sea.

But in no case were the salmon which entered through these protected channels given unimpeded access to the upper river. All of them must pass through the 40 or 50 mile stretch of the main river between Dogfish Village and Andreafski, where they were exposed to capture for commercial purposes; and those that enter through the important Kwiguk Channel must in addition run the gauntlet of a further 40 miles of river between the Kwiguk entrance and Dogfish Village. During the past season very little commercial fishing was in fact carried on in the stretch of river above Dogfish Village, but this was of choice and not from necessity, for no restrictions are there imposed by existing regulations.

During the season of 1919, 65 per cent of the king salmon and 61 per cent of the smaller fish—chums, cohos, and sockeyes—were taken beyond the mouth of the river, while in 1920 the proportion was even greater, 69 per cent of the king salmon and 68 per cent of the chums being taken outside.

The fishing grounds in 1920 extended much farther away from the river than in 1919. During a part of the season 12 fishing boats were located between 10 and 20 miles outside Nilak, along the shallow banks bordering the Acharon Channel on the mainland side (U. S. C. & G. S. chart 9373). The outermost stations were for a time the most successful, meeting the Yukon salmon well down the coast toward the mouth of Black River. How much farther in the direction of the Kuskokwim the advancing schools may be encountered in numbers adequate to warrant commercial fishing is as yet undetermined. An expedition which they sent down the coast to Cape Romanof testifies to the interest of the Carlisle Packing Co. in this question.

The fishing methods employed by the company in 1920 did not differ from those in use in 1919. Almost their sole dependence was on gill nets, set in convenient lengths in the eddies and on shallow banks along the main channels. For the most part these were set nets or anchored gill nets, with one end made fast to the shore and the outer end anchored. But during the latter end of the season, when the river was no longer at flood, it became possible to fish on shallow banks, which were not available during the height of the king salmon run. Stake nets were then used in larger numbers and would unquestionably have been availed of more extensively throughout the season had the stage of water permitted.

The gill nets used were of two kinds, the king salmon nets of $8\frac{3}{4}$-inch mesh and the nets for chums and other small salmon of $5\frac{3}{4}$-inch mesh. As the company from the beginning of the season contemplated fishing largely, if not exclusively, for the king salmon, only nets of the larger mesh were issued during the height of the king salmon run, which lasted up to the last days of June. After this date the smaller mesh nets were also issued, but the number of these on hand was not adequate to supply all the fishermen.

Forty-one boats in all were employed in fishing, 34 of these throughout the season, the remainder for varying periods. Four of them were engaged so short a time and obtained so few fish that they may well be omitted from consideration. To each boat was issued 200 fathoms of king salmon net, and subsequently 200 fathoms of the small mesh salmon net, to the extent that this was obtainable.

In addition to the gill nets, renewed attempts were made in 1920 to use fish wheels. Two of these were constructed by the company, but were no sooner placed for fishing than they were put out of commission by the heavy drift which was running during the early days of the fishing season.

In addition to the above, nine wheels were privately owned and operated within the area open to commercial fishing, and the catch of seven of these was sold in whole or in part to the cannery. A very limited number of salmon were obtained from independent fishermen using nets. The number thus purchased from independent operators using wheels or nets amounted to some 7,400 kings and 27,000 chums, out of a total number handled by the cannery of 58,467 kings and 155,655 chums.

The fishing gear operated by the cannery and by private parties occupied only a narrow fringe along the margins of the channels. No attempt was made to fence or block the main channels in any manner, nor could such an attempt at any time be successful.

The employees at the cannery numbered 254. Of these, 122 were brought in from Seattle, including 40 Orientals and 44 fishermen. Of the 132 Alaskans, 40 were employed as fishermen, while 48 were natives, of which the first crew of 25 ceased work in the middle of the season. It was pleasing to learn from the superintendent that the Alaskan fishermen gave a good account of themselves and would hereafter be preferred by the company.

The pack put up by the cannery in 1920 was far less extensive than in the previous year, as is shown by the following table:

PACK OF SALMON BY YUKON CANNERY IN 1919 AND 1920.

Product.	1919	1920
Canned (cases):		
King salmon	28,582	15,934
Chums	24,543	12,819
Cohos	3,181	0
Reds	28	5
Mild-cure (tierces)	....	145

The comparative lack of success in 1920 was due in part to the unfavorable fishing conditions and in part to voluntary shortening of the fishing season. In 1919 fishing was continued until the close of August, but in 1920 only until the middle of July, as the low market price for chums did not warrant the company in continuing to operate after the run of king salmon was over. The season of 1920 was extremely late on the Yukon, and the king salmon entered with a rush, while yet the river was very high and was carrying down enormous quantities of drift, which clogged the nets and rendered them inefficient. Also, during July the weather was unusually stormy, interfering with the fishing and endangering both fishing gear and the lives of the fishermen exposed on the flats beyond the river's mouth. From the cannery standpoint, the season was a failure, redeemed from actual loss—if such indeed was the case—by the extremely high price quoted this year for king salmon. Yet the cannery pack of 28,758 cases fell short only 1,242 cases of the maximum number of salmon which had been designated by the Secretary of Commerce as safely to be spared for commercial purposes from the Yukon River run.

No fish intended for export from Alaska were salted on the Yukon River in 1920.

SUPPLY OF DRIED SALMON PREPARED ON YUKON RIVER IN 1920.

On the voyage down the Yukon from Lower Lebarge to the delta, following close behind the running ice, May 24 to June 13, few indications could be observed of preparation for the fishing season. Here and there a white fisherman was engaged in constructing his fish wheel in time for the short king salmon run, but the native fish camps were unoccupied. Later it was evident that in comparatively few instances did the natives have wheels in the water in time to obtain any considerable number of king salmon.

On the lower river, below Holy Cross or Paimiut, the natives belong to the Innuit stock, and fish much less extensively with wheels than do the Indians of the upper river. They employ for the most part short lengths of homemade gill nets, which they set in eddies behind projecting points of the shore. As favorable localities are found almost exclusively along the high right (north) bank of the lower river, the fishing villages are confined to that side.

Above Holy Cross the use of nets becomes less and less an important factor, and wheels are relied on almost exclusively for the capture of salmon. Rarely was the primitive fish trap or basket or the dip net seen in use. The small fish wheels, which seem to have been introduced on the Tanana River in 1904, have been generally adopted on the upper river by whites and natives alike. They cost about $50 each, in addition to the labor of building them, and are wonderfully effective when skillfully placed.

In the section of the river between Holy Cross and Rampart little dependence is placed by the natives on the king salmon. There is an early short run, and the natives are traditionally dilatory in making preparations. By the time their wheels are in the water the king salmon run is largely over. It is also true that the king salmon are more difficult to preserve, being larger in size and richer in oil. Those that are put up by the natives are kept largely for their own consumption and for this purpose are most highly prized. Taking the river as a whole, a distinct hardship is imposed on whites and natives alike when the king salmon run is below normal.

Unquestionably, however, the chum furnishes by far the larger share of the dried salmon. Along some stretches of the river almost complete dependence is placed on this species, locally known as the dog salmon and the "silvers." The higher grade of chums, known as "silvers," form the staple dog food throughout the Yukon country.

All the traders handle them and may deal in from 5 to 50 tons in a year. But they refuse to purchase dog salmon except as a last resort. The majority of the natives at the close of the fishing season sell a portion of their salmon supply to the trader with whom they deal, frequently leaving themselves without adequate provision for their families and their dogs. Later in the year they are often compelled to repurchase dried salmon at an advanced price, paying for it with the proceeds of their winter trapping. They are, of course, more or less improvident, as in the case of other primitive peoples. Their sale of salmon in the fall is frequently to liquidate their debts to traders who had extended them credit earlier in the season.

In the section of the main river below Rampart, where salmon are still rich in oil and the rainfall during the summer months is usually heavy, resort is had to smoking the salmon in order to preserve them. There is no commoner sight along the Yukon than the cluster of white tents in some picturesque nook among the hills of the right bank, and with them one or more high, barnlike smokehouses, which emit a faint blue vapor. There will be a fish wheel turning in the current along the rocky shore and a number of open-air racks, more or less protected from the weather, on which the salmon are hung for a time until partially dried and ready to be smoked. The picture is, of course, not complete without the native men, women, and children of the summer camp, nor without the invariable row of dogs closely tethered to stakes driven near the water's edge. Here the dogs fatten on the salmon heads and back bones and other refuse. They scratch out shallow holes to lie in alongside their stakes or burrow deep into the adjacent bank, if one be at hand, to escape the implacable swarm of mosquitoes.

Along the Tanana and the upper Yukon is a region of less rainfall, in which also the salmon have relatively dry meat, which is easily preserved. Here smoking is frequently dispensed with and dependence had entirely on air drying. But, by whatever method prepared, the fish of the upper river, of the Innoko, the Koyukuk, and the Tanana, are of inferior grade, and bring a lower price than do fish imported into these districts from the main river. The best product of all is secured from the Rampart Rapids. Here the "silvers" are said to average larger and fatter than in any other section. It is not improbable that inferior strains of dogs and "silvers" have turned into the lower tributaries, leaving at the rapids almost exclusively high-grade fish bound far up the river.

In the coastal district when salmon are running abundantly trenches are often dug in the soil by natives and hundreds of salmon are thrown in without preparation of any kind. They are then covered with earth and nature is permitted to have her unrestricted way with them. When the contents of these trenches are scooped out at some convenient season, perhaps in midwinter, they are said to make acceptable dog feed and to be not wholly shunned by the natives themselves.

The king salmon intended for their own food is often carefully prepared and stored away by natives of the lower river. When sufficiently dried and smoked, the sides are cut into pieces of convenient size and packed solidly in large baskets made for the purpose of woven grass, or willow roots, or frequently of salmon skins which are neatly fitted together and sewed with sinew. The dog and "silver" salmon are tied in bundles weighing about 60 pounds and stored away in the caches in this shape. King salmon are also put in bundles on the upper river. Mention has been made of the salmon oil obtained as drippings from king salmon. In addition to this product, the eggs are very generally saved, being closely packed in any convenient receptacle, without special attempt at preservation.

During the early part of the king salmon run, from June 25 to July 1, a launch trip was made from Kwiguk to Holy Cross and return for the purpose of inspecting the condition of the salmon racks and obtaining a clue to the extent of the king salmon run along the river. The run had been on in this district about one week, and all the fish racks along the river contained considerable numbers of king salmon. The opinion was general that the season was opening favorably. It is in the delta and along this stretch of river that fishing is conducted largely with short lengths of gill nets set in eddies, and in this district the run of king salmon is a very important factor in providing the winter's supply of food.

In addition to the native camps, there are numerous fishing stations occupied by white men. Many of these men are married to native women, and some of them are found in native camps, dividing the proceeds with the native families. In such cases we observed commonly that the efficiency of the camp was increased. The white men operating on the largest scale were usually holders of winter mail contracts, which necessitated the use of large numbers of dogs. One such mail carrier keeps some 60 dogs and requires annually for their feed from 12 to 14 tons of dried salmon. As these are exclusively dog or "silver" salmon, the number used is between 15,000 and 20,000.

Other white men take dogs to board during the summer and sell all salmon they are able to put up beyond their own needs. Many of the more intelligent natives now count on doing the same. There is a wide and legitimate demand for dried salmon, for use during the winter season when all travel in the interior of Alaska must be by dog team. As it is impossible to carry enough salmon for a long journey, all "dog mushers" depend on the country they pass through. The road houses maintain a supply for this purpose, the dried salmon taking the place of hay and grain in regions where horses are employed, and being equally indispensable.

During the month of August and the first 10 days of September the Yukon was traversed from the delta to Dawson and the Tanana as far upstream as Nenana, traveling in a launch and calling at the fish camps on the way. The number of families was ascertained as accurately as possible, the number of wheels engaged in fishing, and the total amount of dried salmon prepared for the season. In practically every native camp visited, one or more persons had a sufficient understanding of English to enable them to furnish the required information. In the majority of instances the racks, smokehouses, and caches were inspected, and finally some facility was acquired in verifying by observation the estimates furnished.

By this method the writers are enabled to present an estimate of the dried salmon prepared on the Yukon in 1920, which is based on more extended data than any heretofore furnished. That it is an understatement of the amount of salmon actually captured and used on the river is obvious from the following considerations:

1. The lower river was canvassed from the 1st to the 15th of August, and there was a later run of "silvers" of limited extent, of which the figures give no account. A message from Holy Cross, dated September 15, indicated a medium run of "silvers" for some three weeks after that point was passed. The still later run of cohos is also not included in the estimates.

2. No clue could be obtained as to the number of salmon eaten fresh during the season, but this must be a considerable item.

3. None of the tributaries of the Yukon were visited, with the exception of the Tanana below Nenana, yet some of these, like the Innoko, the Koyukuk, the Porcupine, and the Stewart, are important streams. The natives in these regions draw on the rivers for their supply of dried salmon, and the white prospectors and miners out on the creeks may obtain their dog feed from the very spawning beds. To what extent spawning beds are invaded for this purpose is not known, but from reports that have been received it would seem probable the figures may reach dimensions of some local importance.

On the Yukon River, from the mouth to Dawson, 97 native fish camps were observed, each of which contained from 1 to 15 families. Three hundred and seventy families were listed, who were engaged in fishing, but the matter was sometimes obscure and the number of families may have been somewhat greater than this. The natives operated 166 wheels, in addition to the short gill nets of the lower river, which were not enumerated. The dried salmon put up by them amounted approximately to 350 tons, or nearly 1 ton to each known family. Many families had less than this amount, but others compensated for the deficiency by harvests of 3, 4, or even 5 tons. The younger generation gives promise of being more provident than the old. Some of them put up large surplus stocks for sale and carry over fish from one season to the next. There is some apparently well-founded complaint that sufficient care is not always given to curing the salmon, so that in rainy seasons like 1920 large stocks may be offered for sale which are rendered almost worthless by mold and decay. One Japanese fisherman operated a wheel on the river and put up 1,200 pounds.

There were 76 white fishing camps, usually with a single white man in a camp, but in a few instances two white men were working in partnership, or a white man in conjunction with natives. There were 91 white men in all, and they prepared approximately 190 tons of dried fish.

On the Tanana River below Fairbanks there were 24 native fishing camps, operating 24 fish wheels and containing approximately 30 tons of salmon. There were also 26 white fishing camps, with 34 wheels and some 52 tons of salmon.

Altogether, on the Yukon and the Tanana, 301 fish wheels were operated in 1920 and resulted in a take of 622 tons. Of this amount 8 per cent were king salmon and 92 per cent were chums. If an allowance of 100 tons is made for the tributaries not visited and for the later runs on the Yukon which were not seen—and this allowance is almost certainly inadequate—there would be a total provision of dried salmon for the Yukon and its tributaries in 1920 amounting to 722 tons.

The only previous estimate known, based on a partial canvass of the fishing camps, was that prepared by Messrs. H. J. Christoffers and C. F. Townsend, of the Bureau of Fisheries, in 1918 for the purpose of the Yukon hearing of that year. They enumerated 393 fish wheels and a total product of 650 to 700 tons for the Yukon and Tanana Rivers, exclusive of Yukon Territory. Mr. Volney Richmond, manager of the Northern Commercial Co. stores, basing his estimate on conditions throughout the Yukon Valley, intimately known by him for many years, gave 600 tons as a fair annual provision of dried salmon for the region. It is possible that more salmon were dried in 1920 than would represent a fair average for the river, inasmuch as the previous year had been largely a failure, prices for dried salmon had risen to unheard of figures, and all reserve stocks had been exhausted.

Estimating the average dried king salmon at 5 pounds, and the average chum at $1\frac{1}{3}$ pounds, there were about 23,000 kings and 1,000,000 chums put up on the Yukon in 1920 for local use.

COMPARISON OF 1920 WITH 1919.

At all fish camps visited expressions of opinion were invited as to the relative size of the runs in 1920 and in 1919. The evidence given was overwhelmingly in favor of the run of 1919 being considered one of the worst if not the very worst ever known on the Yukon. Natives and whites all were practically a unit in this belief. Those who believed the cannery was not responsible for the shortage were as well satisfied on the subject of the shortage itself as were those who laid the entire responsibility at the door of the cannery. Those who did put up fairly satisfactory supplies of salmon recognized that they were especially favored in their locations, but thought that the river as a whole was relatively bare of fish.

In the lower section of the river more fish would have been prepared if storms had not broken the wheels and interrupted the fishing. Storms also broke wheels and interrupted fishing along this section of the river in 1920, but racks and smokehouses were not empty of fish. The natives about Nulato and Koyukuk would have made better provision for the winter of 1919 had they fished diligently throughout the season instead of potlatching as they did. They would unquestionably have had more fish, but it is doubtful whether they could have secured enough even had they fished consistently with as much diligence as they ever display. It was impossible to doubt, after interviewing several hundred people distributed along the entire length of the Yukon, that the run of 1919 was phenomenally deficient; and, furthermore, that if this condition should become permanent, or should frequently recur, a very serious condition would arise in the interior of Alaska.

No basis is available for a well-founded estimate of the amount of dried salmon put up in 1919, but we believe that 150 or 200 tons would be an outside estimate for the entire river. The price rose to 25, 30, and 35 cents per pound, with no stocks available even at those prices. Men compelled to travel during the winter experienced the utmost difficulty in securing substitute dog feed. Fresh meat was used, although this is by no means satisfactory, and deplorable numbers of caribou were slaughtered by natives and others for this purpose. Cereals and bacon were made use of, and stores and trading posts soon found their stocks running low. The natives killed, or permitted to die of starvation, half or more than half of their dogs, and many white men were compelled to adopt the same course. Undoubtedly the best dogs were retained and the least valuable were culled out of the teams. But the general opinion entertained by those best acquainted with the natives and their needs was to the effect that the great reduction in the size of their dog teams was disastrous and the dog shortage was sure to hamper them in their efforts to make a living during the coming winter.

There were no reported cases of starvation or of serious suffering among the natives during the winter of 1919 because of the shortage of salmon, although they might well have occurred in outlying districts if help had not been given by white traders and by others. At Tanana rations were issued from the military post at Fort Gibbon, intended to relieve distress among the sick and aged natives of that vicinity. But the winter was in some respects unusually favorable. On the upper river heavy snows drove the caribou to the lowlands near the river, where natives could hunt them without making long sledge journeys with their dog teams into the mountains. Commissioner Mackenzie at Dawson said that had it not been for this fortunate coincidence the Indians in that vicinity would have suffered severely. In the Tanana-Fairbanks district moose were abundant and were easily captured in the deep snows. And farther down the river, in the Nulato-Koyukuk region, the grouse, which had been scarce for a number of years, had begun to come back in their former abundance. Here again had the season not been unusually favorable for securing fresh meat near at hand severe suffering would have been experienced. Such favorable conditions can not be expected to recur should the salmon supply again fail.

To resume, it does not admit of doubt that there was a most serious scarcity of salmon last winter, nor that this was occasioned primarily by an equally serious shortage in the run. By no other theory can so general a failure in the river fishing be explained. The lower and middle sections of the river, the Ramparts and Upper Yukon, the Porcupine, the Tanana, and the Koyukuk, all tell the same story. Dogs were sacrificed in large numbers, which were neither useless nor superfluous, and the natives were saved from serious suffering only by a series of happy coincidences, which could not again be expected.

TO WHAT EXTENT WAS YUKON CANNERY RESPONSIBLE FOR 1919 SHORTAGE?

As the cannery of the Carlisle Packing Co. at the mouth of the Yukon did not operate prior to 1917, and as neither the king, chum, nor coho salmon matures in two-year cycles, it is evident that the cannery could have had no influence on the size of the run which presented itself at the mouth of the river in 1919 and sought access to the spawning beds. The individuals which comprised this run had all been derived from eggs deposited in the Yukon gravels before ever the cannery was established. There could be no question, therefore of impairment of the run having resulted in 1919 from previous cannery operations.

The only possible effect of the Carlisle cannery up to the present time has been to diminish, by the number of salmon captured, the runs which enter the river and are available to the native and white inhabitants of the valley. In 1919 the company reported the capture of 101,107 king salmon and 357,081 small salmon, largely chums. If these had been captured upriver and dried, the king salmon would then have averaged about 5 pounds each and the chums $1\frac{1}{4}$ to $1\frac{1}{3}$ pounds. Adopting the lower figure, the cannery pack, dried, would have amounted to 252 tons of king salmon and 223 tons of the smaller varieties, or 475 tons altogether. This is held to be more than twice any possible estimate of the amount of dried salmon actually put up during that season on the entire river.

If the 100,000 kings and the 350,000 chums taken by the cannery had been permitted to ascend the river, to what extent, we may ask, would the situation have been helped? It would depend on the size of the run and the proportion which, under the conditions of 1919, would escape capture at the hands of the river fishermen. If the fishing camps along the river were catching 50 per cent of the run, the cannery fish would have added some 235 tons, and the catch would thus have been more than doubled. If they were capturing a third of the run, the cannery fish would have increased their small catch by over 150 tons.

Data for such an estimate are not available. In the muddy waters of the Yukon the schools of salmon are invisible, and no direct estimate can be formed of their numbers. There is abundant evidence, however, that a large majority of the king salmon running in 1919 were captured in nets or encountered nets and escaped from them on the way into the river. White fishermen and natives, practically without exception, including those who felt no hostility to the cannery, agreed that the king salmon averaged smaller in size than ever before and that the relatively few larger individuals were net marked in the majority of cases. The same fishermen, operating in the same localities in 1920, state almost without exception that the king salmon in 1920 averaged large in size, and the number of net-marked fish was so small as to be negligible.

Many opportunities have occurred to observe elsewhere salmon caught in wheels or traps above a district heavily fished with gill nets. The results are always the same. The smaller salmon filter through the nets, which screen out the larger sizes, leaving the average size of the escaping fish always greatly diminished. And many of the fish escape through the web after being temporarily captured, the twine having become so tightly constricted about the body as to leave permanent marks that can not be mistaken. At the rack which was maintained in Wood River above the Nushagak fishing district there was opportunity to examine the fish escaping from gill nets that were capturing from 75 to 90 per cent of the running fish, but never were the escaping sockeyes so extensively net marked as the Yukon king salmon are credibly reported to have been in 1919.

Not all the screening out of the larger sizes and the net marking was due to the operations of the cannery. Natives in the lower river also fish for king salmon with nets, but the extent of their operations is so very small compared with that of the cannery in 1919 that the effect was negligible. Fishermen interviewed stated that they had in previous years seen a few net-marked fish prior to the opening of the cannery, but never anything to compare with the condition observed in 1919. The prevalence of small-sized king salmon in 1919, taken in connection with the extent of the net marking, may justly be considered a measure of the closeness with which these salmon were fished in 1919.

What was true of the king salmon was true also, it is believed, of the run of chums. Fishing for these was prosecuted during the months of June, July, and August. Conditions at the mouth of the river were comparatively favorable for a maximum catch throughout the season. As the salmon move back and forth with the tides, passing up and down the banks where nets are staked, and loitering in the eddies where other nets are anchored, the cannery gear has repeated chances to ensnare them. One of the principal deficiencies in the 1919 run in the upper river was the almost total failure of the "silvers." These, it will be recalled, are the bright chums of high quality which run after the king salmon have passed. It was to these that the cannery devoted its attention after the king salmon nets had been retired. In 1919 the king salmon run had materially declined by July 5, and it was after this date that 272,717 out of the total 357,081 small salmon (principally chums) were taken. It is considered certain that the operations of the cannery in 1919 very materially added to the scarcity of fish on the river. Had the fish captured by the cannery been free to enter the river, the run would still have been below the normal size, but the distress and inconvenience occasioned to the interior of Alaska by the salmon shortage would have been largely mitigated.

EFFECT OF CANNERY IN 1920.

The run of 1920 has been universally approved by fishermen as the most favorable since 1916. Salmon were abundant, of good average size, and of excellent quality. Some fishermen acclaimed it the largest run they had ever seen on the river, but the majority called it a fair average run of the better class of years. Certain it was there was no necessary lack of dried salmon anywhere on the main river as far upstream as Dawson. Some complaint was heard of insufficient fish supply on the Yukon Flats in the vicinity of Fort Yukon, and it was noted in certain native villages between Circle and Forty-Mile that scant provision seemed to have been made for the winter. But it was not evident that there was any lack of salmon. All white fishermen and some natives in these districts made good catches and reported the fish abundant. At Dawson, where serious complaints were heard the previous year, sufficient supplies were secured in 1920. Such slackness as apparently existed in certain native camps may find its explanation perhaps partly in the effects of the "flu," which ravaged some of these communities in the spring of the year, partly in superabundance of money, owing to high prices received for muskrat pelts, and partly, in some communities, to a general shiftlessness, which habitually leads to privation and suffering in the winter.

A similar condition was observed in certain fish camps on the lower Tanana, in which natives seemed obviously less intelligent and less efficient than in the great majority of camps on the main river. In a few of these was heard the complaint that there were no fish, but it is believed that their scant supply was due to other causes. It is of course true that any scarcity will first declare itself on the upper river and among the tributaries, after the salmon, which run in a single channel in the main river, have distributed themselves over a far wider area. It is regretted that reliable reports could not be obtained from the Innoko, the Koyukuk, and the Porcupine.

In comparing the effects of the cannery in 1920 with those in 1919 conditions are met in the two years that were the very reverse of one another.

In 1919 the total run of salmon was far below normal, the conditions for fishing at the mouth of the river were favorable, the cannery catch was very large, and considered in relation to the number of salmon running it was far larger.

In 1920 there was at least a fair average run of the better class, and not improbably it was one of the best runs that can be expected in the Yukon; but the cannery was unsuccessful, owing to adverse fishing conditions. It obtained little more than half as many kings as in 1919 and less than half as many chums. Had the 58,000 kings and 155,000 chums been permitted to enter the river more salmon undoubtedly would have reached the spawning grounds, but the amount of dried salmon would not have been greatly increased. In the first place the number released would bear a small ratio to the total number running in so good a year; and, furthermore, along that section of the river which put up by far the larger amount of dried salmon, wheels, if operated more than a few hours each day during the height of the run, caught more fish than could be cleaned and prepared for drying. It does not then appear that with a large run of salmon and a relatively small cannery pack the latter has any recognizable effect in lessening the dried salmon supply of the Yukon. We are not prepared, however, to venture the assertion that such would have been the case had the cannery pack in 1920 reached as large proportions as it attained in 1919. But even had the cannery put up the full 60,000 cases in 1920, for which it made preparations, it would not have reproduced the severe conditions which existed on the river in 1919. These, as has been shown, were the result of a phenomenally poor season, made much worse by a large cannery pack.

GENERAL DISCUSSION AND RECOMMENDATIONS.

The dependence of the native and white population on the salmon supply of the Yukon admits of no question in the minds of any who have acquaintance with the conditions of life in the great interior of Alaska. The natives have other sources of food, but the salmon form their main provision for the winter—their insurance against starvation when other sources of food fail them, as they not infrequently do. No one who inquires into the matter can doubt that if the supply of Yukon salmon should become seriously curtailed widespread suffering and death would in many seasons be visited on the natives.

The question of furnishing food for the whites is less urgent, but is not without importance. It was brought to our attention that with the price of all articles of food rapidly rising, while wages in the interior of Alaska have shown practically no increase during recent years, the presence of a cheap source of food is of value.

But one of the most important phases of the salmon question, which concerns whites and natives alike, is in relation to the dog. The whole scheme of things in the sparsely populated Yukon wilderness is predicated on the dog, and the use of the dog necessitates dried salmon. The winter is the only time for travel except along the waterways of Alaska, and winter travel is impossible without the dog team. Dogs are equally indispensable as draft animals and pack animals. Transportation of the winter mails over thousands of miles of the interior of Alaska must be accomplished by dog team. Men of the Army and the Signal Corps, like all other people in Alaska, are dependent on the dog whenever business makes it necessary for them to undertake winter travel. Fort Gibbon alone needs 40 tons of dried salmon each year to feed the dogs that they find indispensable in their work. Prospectors need them to carry their supplies into the hills. Wood choppers require them to haul in the wood. Indians must have them on their long hunting and trapping expeditions, and without them can neither secure meat for their families nor furs to exchange for the other necessaries of life.

The dog is as essential in Alaska as is the horse in other regions, and the only acceptable dog feed is dried salmon. Various substitutes have been tried out when salmon could not be procured. They were used extensively by the "dog-mushers" of 1919, when dried salmon often could not be had at any price. Fresh meat was used, and enormous numbers of caribou and moose were slaughtered for this purpose. But it is impossible to carry sufficient meat for many days, and the supply is precarious. Furthermore, the dogs do not thrive and work well on this diet. A diet of cereals and fat in some form was extensively used. Stocks of rice, flour, corn meal, and bacon were heavily drawn on. Dogs traveled well on a ration of corn meal and bacon, but the expense was almost prohibitive, and there was the labor of cooking up each night in camp a meal for the dogs after the exhausting travel of the day with the temperature perhaps 50° below zero and a weary famished team waiting to be fed. Dried salmon forms a light condensed food which contains all the elements needed to keep a hard-working team in excellent condition, and it is always ready to be fed without preparation. There is no acceptable substitute, and there is not in Alaska any divergence of opinion on this subject. No single need in the interior of Alaska is more generally or more urgently felt than dried salmon for its various uses.

It is clear, then, that the Yukon and the Kuskokwim offer salmon problems which are not pressing on any other Alaskan rivers with the exception of the Copper River. These streams drain the far northern interior districts of Alaska with long severe winters and the briefest of summers. The inhabitants are few in number and are distributed widely over a wilderness which is largely without population. Their lives are subject to the most severe conditions of existence. Largely they are dependent on the resources of the country. To deprive these people of one of their most valued and most important resources would seem under such circumstances peculiarly indefensible. The principle should be adopted with regard to the interior rivers of Alaska that no commercial interests should be permitted to exploit them until it should be demonstrated that a portion of their salmon run could be spared without detriment to the run itself and without encroaching on the supply needed by the populations that inhabit the valleys of these rivers. And if there is any question whether the salmon run in a given stream is adequate to supply the demands of commercial operations as well as the needs of the inhabitants, the doubt should at once be resolved in favor of the people. The subject should not be one for experiment. Canneries should not be permitted to establish themselves on these streams while we calmly await the result. They may create havoc before the evidence thereof is clearly shown, and in the meantime they will have secured those highly prized "vested rights" which make their position difficult of attack.

A floating cannery operated by the Carlisle Packing Co. is already established at the mouth of the Yukon, and it becomes appropriate to inquire whether the continued operation of this cannery is compatible with the best interests of the Yukon Valley. It is evident that if the fish required by this company can without question be safely spared, the cannery should be welcomed, for it provides much needed freight for a transportation company that supplies the Yukon and it offers much needed employment for a limited number of natives and others during a brief period of the summer. But if the operation of the cannery should threaten encroachment on the supply of salmon needed in the interior it should be compelled to close, as no advantage to its few employees could possibly compensate for widespread inconvenience, distress, and suffering.

As a result of the Yukon hearing, given in Seattle, Wash., November 20, 1918, the Secretary of Commerce promulgated an order that limited the pack of canned salmon to 30,000 cases in any year from the Yukon River, embracing all waters of its delta to and including the area 500 yards outside each mouth or slough of the delta at mean high tide. Beyond this area of 500 yards outside the mouth or mouths of the river the Secretary of Commerce exercises no jurisdiction, the Congress having failed to confer it upon him. He is therefore helpless to extend protection to channels between shoals and islands off the mouth of any river, although such channels may be regular migration routes of the salmon bound for that river and as much open to attack as any part of the river channels.

Realizing this deficiency of the laws, the Carlisle Packing Co. in 1919 put up approximately the maximum pack inside the river, and then proceeded nearly to double this with salmon equally bound for the Yukon which they captured outside the mouth of the river. In doing this they were wholly within their legal rights, but they evinced thereby an indifference to the obvious purport of the order, which was to provide for a strictly limited pack of Yukon fish. In making this increased pack they happened on a year when the run was poor and the fishing conditions were excellent. They were enabled, therefore, to give a demonstration of the results of such operations when these two conditions appear in conjunction. The disastrous year of 1919 resulted.

As to the future, there is no assurance of better protection than in 1919. From our inquiries it appears that the Yukon runs of salmon are by no means uniform in size. Good years and poor years alternate, and occasional very poor years have always appeared. Meanwhile the Carlisle company continues to operate without check beyond the mouth of the river. Should they consider the prospect of success warranted the expenditure, there is nothing to prevent their increasing the number of fishermen and preparing for a pack of 100,000 instead of 60,000 cases. Or one or more other companies may join in the business of catching Yukon salmon off the mouth of the river if they consider the venture a promising one. The Yukon run is wholly without adequate protection as long as the approaches to the river are open to unrestricted fishing and are outside the jurisdiction of the Secretary of Commerce.

Finally, it is the judgment of the writers that the Yukon River salmon run is not to be relied on annually to produce a surplus for export in addition to the supply needed for local requirements and the further quantity essential for propagation. During good years a surplus might be spared sufficient to produce a limited pack, but during poor years the operation of a cannery will have the effect of making a bad situation very decidedly worse.

It is recommended, therefore, that all commercial fishing for export be prohibited in the Yukon River and its tributaries, including the waters of the delta and an area 500 yards outside the mouth of each channel or slough of the delta.

Furthermore, it is recommended that immediate steps be taken to have brought within the jurisdiction of the Secretary of Commerce all those channels between the shoals and islands which form the approaches to the Yukon in order that commercial fishing in said channels for export may be effectively limited or entirely prohibited.

O

DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS.[1]

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Recently the casting of oil on already sorely troubled waters has increased at such a rate, has been accused as the source of so many ills of fishermen and shell fishermen and even of ornithologists, and has become such an obvious nuisance, that a considerable realization of the extent of the contamination and a sense of the possible evil effects have been aroused. So great is the discharge of oils of various sorts that in this country it has been proposed to skim off the oil from some harbor waters and make it available by proper treatment. In Switzerland a patent has been taken out for the recovery of oils from backwaters. It is very desirable, therefore, to present a brief review of the information available regarding the extent and nature of oil and oil-like pollutions with consideration of the possibilities of danger therefrom.

SOURCES OF POLLUTION.

Danger of fatal contamination from the poisonous substances seems to lie chiefly in the gas plants and petroleum distilleries, which on one occasion or another, if not regularly, find it convenient to let certain products drain into the nearest body of water; in tankers and oil-engined craft, which are able to use tar, tar oils, and a great variety of petroleum distillates; in oil-burning steamships; and in the washings of oils and tars from roads.

Gas houses and oil refineries are located on all sorts of bodies of water larger than brooks. In smaller streams, and particularly in those inhabited by salmonids, discharges are doubtless frequently fatal to fish life and quite ruinous to the fish value of the water. In larger bodies the actual destruction of fish is apt to be small or incident to exceptional discharges, and the chief harm probably will come from the uninhabitability of the water, especially if this means the rendering unfit of a spawning ground or the forming of a barrier thereto as for salmon or shad.

In streams large enough for steamers, and in all larger bodies of water, there are added to the contributions from gas houses and refineries those from tankers and other ships, and the dangers to fishes from poisoning or coating of gills are correspondingly increased. These larger navigable bodies may be spawning grounds and are almost sure to be gateways to what should be spawning grounds. The danger here, therefore, of keeping fish away from the spawning

[1] Appendix VII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. 910.

grounds is far greater than the danger of destruction. It has been charged, but apparently not specifically established, that fish in harbors and the lower stretches of rivers have been killed by the dumping of oil from tankers. All of these vessels must clean out their tanks before they refill them and are prone to do so in harbor or as near there as may be.

Well out at sea and in the larger bays the only source of considerable oil pollution seems to lie in the shipping, which, if it can not discharge in or near harbors, will do so at sea. Moreover, it seems clearly established that great oil films do form at sea. Huge patches have frequently been observed, and Collinge reports that sea birds have been found dead and dying by hundreds off the English coast, their feathers saturated with oil. Death of sea birds from the same cause is reported from our Pacific coast.

Tar from freshly tarred roads may be washed bodily into gutters and thence into streams or other bodies of water. Apparently, however, the greatest danger of direct action from tarred roads is from the fact that under the various influences at work—presumably heat, the mechanical action of vehicles, and soluble action of oils—poisonous substances are yielded to road washings for a great length of time. Various people in England, as recorded especially in the (London) Fishing Gazette, have described instances or experiments which indicate the continued poisonous action of tarred roads. Richmond found that although an undisturbed tarred surface became innocuous in three weeks, washings from material chipped from a road which had not been tarred for approximately one year were fatal to fish. Tarred road washings appear to be noticeably destructive of fish and, largely through the destruction of food organisms, of fisheries, chiefly in streams not larger than small rivers and ponds, particularly trout waters. In well-developed country so fortunate as to possess salmon streams, tarred roads doubtless constitute a menace to the salmon fishery.

Oil from motor cars, etc., goes into small as well as large bodies of water and is of greatest volume at large towns.

EFFECTS OF OIL POLLUTION.

Oil remains in part as a surface film on the water, and is probably in part emulsified and distributed in intermediate strata, while the heavier fractions are deposited on the bottom, where they persist for a long time. All parts are washed ashore to be deposited on the beaches and vegetation between tide marks.

This pollution may affect the fisheries in various ways: By actually killing or repelling the fish when they approach the shores in their migrations, at the only time when they can be caught; by sickening or killing bottom-dwelling species such as oysters; by killing floating eggs and the delicate larvæ which, swimming at or near the surface, are suffocated by the deposit of an impervious film on the gill surface; by destroying the minute surface plants and animals on which these larvæ and some of the adult fishes subsist; by diminishing the aeration of the water at the surface and thereby aggravating the deoxidizing effects of organic pollutions from municipal sewage and similar sources; by destroying spawning grounds; by killing the shallow water vegetation which directly or indirectly furnishes fish food and shelter; and by impairment of the market value of fish through imparting to them an offensive taste.

DIRECT TOXIC EFFECTS.

A great variety of tars and tar oils, either from coal or petroleum, have been shown to be highly poisonous. Butterfield and writers in the (London) Fishing Gazette and the Salmon and Trout Magazine, and Shelford and Thomas in this country (see bibliography) have reported various experiments which show that tar and tar oils are poisonous in great dilutions. Tars or tar oils result from distillations of coal, petroleum, woods, etc. These distillation products are very complex and varying in composition, but all may be assumed to contain some of the substances which, in very weak dilutions, have been shown to be highly poisonous to various fishes. Phenols and cresols (in dilutions of less than 100 parts per million) have been found quickly fatal by Butterfield and Shelford. Other constituents which are quickly fatal in the dilutions indicated are phenanthene and naphthalene (4 to 5 parts per million); xylene, toluene, benzene, and ethylene (22 to 65 parts per million); sulphur compounds, as hydrogen sulphide (5 parts per million), sulphur dioxide (16 parts per million); carbon bisulphide (100 parts per million); thiophene (27 parts per million); ammonia (7 parts per million); and ammonium salts and other nitrogenized compounds (some hundred parts per million); quinoline and isoquinoline (50 to 65 parts per million). The strengths given as quickly fatal are those which have caused death in one hour, or very little more, to sunfish (American) or gudgeon (European), fish which seem more than ordinarily resistant to poisons. It is stated (Seydel) that Russian investigators find hexahydrobenzoic acid ($C_6H_{11}CO.CH$), to be the essential poison of Russian petroleum, and that 4 to 16 parts per million were quickly fatal to a cyprinid and a percid.

The experiments of Thomas and others indicate that prolonged exposure to very much greater dilutions of these substances are fatal. Dilutions of various tars and crude distillates of petroleum, which required 66 or more parts per million for quick fatality, have proved fatal in strengths of from 13 to 33 parts per million in from 1 to 3 days. A great variety at 13 parts per million proved fatal in 3 days. One liquid tar waste at 2 parts per million killed sunfish (*Lepomis humilis*) in one day.

MECHANICAL EFFECTS.

Certain petroleum products appear to contain no poisonous substances soluble in water and to have little direct effect when allowed to form a surface film, but when emulsified by agitation prove deadly. A high-boiling petroleum distillate and a light fuel oil were found by Thomas to be quite harmless, unless as aeration retarders, or unless emulsified, as by continued moderate agitation, when they coated the gill membranes of the fish and caused death by suffocation. Rushton found that by shaking up 1 part of benzine with 40,000 parts of water, a mixture was formed which killed fish in five minutes, apparently entirely from poisonous action.

Doubtless under the agitation of continued wave action many, if not all, oils and oily substances will emulsify or mix to a considerable extent and so coat the gills of fish or other forms, or have a poisonous effect which their insolubility would otherwise prevent. According to Weigelt, ulcerations and attacks of disease have been found to follow the irritating action of petroleum products.

The eggs of sea fishes which do not seek fresh, brackish, or shore waters in which to spawn differ from the eggs of all these and of fresh-water species in that they are typically floating. In many cases, at least, the larvæ for a time are also floating. This fact renders the possibility of grave danger to the great sea fisheries a very striking one, for it can scarcely be thought that eggs can hatch and young normally develop in a medium of oil. The eggs and larvæ of oysters and other shellfish are not surface floating, but are carried up and down by the current, sometimes to the surface. A special danger to them lies in the fact that both oil and larvæ (and eggs) are prone to collect in eddies.

PREVENTION OF AERATION OF THE WATER.

The question of aeration prevention by an oil film is a very important one. Butterfield and Thomas have questioned considerable prevention, Butterfield on the supposition that mineral oil is similar to water in its oxygen absorption, and Thomas apparently on the theory that incomplete rather than complete films tend to form. There need be no question that extensive films do form. Furthermore it seems established by Adeney, especially in salt water and any water of considerable mineral content, that streaming, with the consequent distribution of the air saturated surface water, is largely dependent upon evaporation and increased density at the surface. If this is the case it must follow that an oil film, by preventing evaporation, greatly checks aeration. Danger from this seems chiefly to center in harbors where, because of general pollution, particularly sewage pollution, the oxygen consumption is greatest and where, because of gas plants and shipping and the great number of automobiles, the discharge of oil is also extreme. These are the same harbors which are the gateways to the great natural spawning areas of the anadromous fishes.

In connection with the prevention of aeration, oxygen loss by the absorption of dissolved oxygen, by fatty acids and other substances present in oils and tars, should be taken into consideration.

DESTRUCTION OF FISH FOOD.

Indirect action of oils and tars may consist of poisonous action on food organisms. Prawns appear very susceptible to tar poisons, and in English streams it has appeared that tarred road washings are even more destructive of insect life than of trout directly. It can scarcely be doubted that the susceptibility of minute forms is at least of the same order as that of fish. With a number of microscopic forms, particularly diatoms, it is known that their susceptibility to a number of poisons is greater than that of fish (Whipple, Moore, and Kellerman). Destruction may, of course, be secondary, as from lack of oxygen, or from the destruction or spoiling of emergent or littoral vegetation with an oil coating, particularly in tidal areas (by which means wild fowls may also greatly suffer), and the consequent loss of a productive habitat.

From gas houses, tarred roads, and refineries much of the contamination eventually finds its way to the bottom to render it more or less sterile according to thickness and completeness of the deposit and the constancy with which the deposit is maintained. Wadham indicates that he found apparently complete strata for each fresh tarring of road, and that it took two or more years for a trout brook to recover proper productivity of fish.

In some waters the basic fish food consists in part of air-breathing larvæ and pupæ of insects, which, if a layer of oil is present, as is well known, will be unable to come to the surface to breathe and so will be destroyed. Young of food fishes or the small fish on which food fishes feed will in consequence be deprived of an important source of food, and the productivity of the region will be correspondingly decreased. In 1920, through the Gulf States, Mr. Hildebrand found that Gambusia and Fundulus, which feed largely on such larvæ and pupæ, disappeared from oil-covered water. He took no special notes in regard to larger species, but believed they disappeared also, presumably because their food had disappeared.

SUMMARY.

Three main sources of oil and tar pollution have been found: Road washings, carrying great quantities of lubricating oil; gas houses and oil refineries; tankers, oil burners, and oil-engined shipping. Tars, tar oils, and crude distillery products are found generally to be highly poisonous, whether in weak or great dilution. Some oils have been found to emulsify to a sufficient degree, with continued agitation, to coat the gills of fish and so produce death by suffocation. An oil film, through prevention or checking of aeration, is dangerous, particularly in busy harbors. The deleterious effect on spawning, by rendering spawning grounds unfit or inaccessible, is a grave danger arising from the pollution of harbors and streams. Another serious danger is found to lie in the possible effects on the diminution of the food supply. Through whatever means, it is an observed fact, according to Weigelt, that in Germany fish have completely disappeared from pools and ponds following the discharge of mineral oil into the water. In the sea a great danger is suggested by the fact that the eggs of sea fishes are typically floating, and that oil-burning and oil-engined shipping is greatly increasing.

Remedial measures may (now or in the future) be found: (1) In the recovery of oils from drainage water, as already has been proposed; (2) in the prevention of gas-house and refinery pollution, which prevention should be helped by the increased use of "wastes" in by-products; and (3) in prevention, by international arrangements, of the dumping of oil from ships in harbors or in the region of spawning grounds or special feeding areas.

BIBLIOGRAPHY.

ADENEY, W. E.

1912. Report of W. E. Adeney. *In* Present sanitary condition of New York harbor and the degree of cleanness which is necessary and sufficient for the water. Report of the Metropolitan Sewerage Commission of New York, 1912, p. 80–121. Wynkoop Hallenbeck Crawford Co., New York.

ALLEN, E. J.

1914. Letter telling of deadly effects on swimming prawn of creosote oil in great dilutions. *In* Net curing by creosote. Fish Trades Gazette, Vol. 31, Feb. 28, 1914, p. 36. London.

BUTTERFIELD, W. J. A.

1912. The relation of modern road surfacing to fish life. The Surveyor, Vol. 41, Feb. 16, 1912, p. 277–284. London.

COKER, R. E.

1920. Progress in biological inquiries. Report of the Division of Scientific Inquiry for the fiscal year 1920. Appendix II, Report, U. S. Commissioner of Fisheries for 1920. Bureau of Fisheries Doc. No. 896. p. 23. Washington.

COLLINGE, WALTER E.

1921. The effects of oil from ships on certain sea birds. Nature, Vol. 106, Feb. 24, 1921, p. 830. London.

FISHING GAZETTE (THE). LONDON.

1910. Note by editor, R. B. Marston, containing letter from R. C. W. H. Butler telling of harmless leakage of a barrel of crude tar into trout ponds. The Fishing Gazette, Vol. LX, June 4, 1910, p. 508.

Note by editor quoting letter from Arthur J. Belcher (extracted from the Daily Mail of June 14) telling of the immediate destruction of hundreds of trout following the washing of tar from a freshly tarred road into trout brook. Ibid., Vol. LX, June 18, 1910, p. 559.

Letter from A. R. Peart telling of experiments showing deadliness to fish life of water which has been in contact with fresh crude tar; also pointing out that road washings may be expected to reach stream while it is still shrunken by preceding drought. Ibid., Vol. LX, June 25, p. 607.

Account by Field of destruction of fish and vegetation following tarring of roads, and of finding a high tar content in road washings. Ibid., Vol. LXI, July 23, 1910, p. 99–100.

Letter (anon.) telling of experiments showing deadliness to trout at various dilutions of water which had been in contact with coal tar. Ibid., Vol. LXI, July 30, 1910, p. 125–126.

Note by editor containing letter from "Elfa" telling of development of fungoid growth following the washing of tar from road into stream. Ibid., Vol. LXI, Aug. 6, 1910, p. 144.

Note by editor quoting note from Percy Wadham on the road-tarring question. Ibid., Vol. LXI, Aug. 20, 1910, p. 188.

Investigation of an epidemic of fish poisoning by tar at Drinkwater Park, Manchester, by E. J. Sidebotham and A. Sellers. (*From* Archives of the Public Health Laboratory of the University of Manchester, Vol. I, 1906.) Ibid., Vol. LXI, Aug. 27, 1910, pp. 210–211.

1911. Note by editor quoting account from Dundee Courier of Aug. 5, 1911, of the washing by thunder storm of tar from freshly tarred road in the River Fary, the killing of many scores of fine trout, and the ruining of the fishing below. Ibid., Vol. LXIII, Aug. 12, 1911, p. 163.

Letter from F. I. C., one technically informed, telling of amounts of naphthaline and phenol bodies allowed in road tar and maintaining that treatment which renders tar innocuous spoils it for road work. Ibid., Vol. LXIII, Aug. 26, 1911, p. 233.

1912. Note by editor quoting letter from S. Jaffé telling of destruction of fish and small and microscopic forms by leakage of 2,200 cubic yards of tar and by-products and of over £1,600 paid in damages; and letter from Karl Heintz to the effect that it is illegal in Bavaria (or all Germany?) to construct drains from tarred roads into streams. Ibid., Vol. LXV, Dec. 21, 1912, p. 582.

1913. Note by editor quoting extract from Isle of Wight County Press telling of settling with F. T. Mew, of Carrisbrooke, Isle of Wight, for £325 for damage to fishery by tarred-road washings. Ibid., Vol. LXVI, Mar. 15, 1913, p. 66.

Letter from Percy Wadham on the difficulty of determining the real danger from tar poisoning by laboratory experimentation. Ibid., Vol. LXVI, May 24, 1913, p. 480.

1914. Note by editor quoting letter from F. Napier Sutton on the effect of leakage from gas works on a fishery. Ibid., Vol. LXVIII, Jan. 3, 1914, p. 2.

1917. Note by editor quoting letter from Percy Wadham telling of lasting poisonousness of tar on roads and of formation of tarry strata on pond bottoms, etc. Ibid., Vol. LXXIV, Feb. 24, 1917, p. 100.

1921. Report of address by J. A. Simpson delivered at Nottingham January 12 before "An Alliance for Prevention of River Pollution," telling of fining of Derbyshire County Council and of damages obtained by riparian owners for destruction of fishing by tarred-road washings. Ibid., Vol. LXXXII, Jan. 22, 1921, p. 45.

Note by editor to the effect that the Joint Committee of Ministry of Agriculture and Fisheries and the Ministry of Transport have been unable to find a safe tar; refers to an account by Dr. Smith, U. S. Commissioner Fisheries, of experiments to find a safe tar without success. Ibid., Vol. LXXXII, Feb. 26, 1921, p. 117.

FORBES, S. A.

1894. Report on effect of oil-well and gas-house waste on fish and fisheries of the Wabash River. *In* House of Representatives Miscellaneous Document No. 196, 53d Congress, 2d Session, p. 2–5. Also *quoted by* Richard Rathbun *in* Report of Commissioner, U. S. Commission of Fish and Fisheries for 1894 (1896), p. 109–112. Washington.

HILDEBRAND, SAMUEL F.

1921. Top minnows in relation to malaria control, with notes on their habits and distribution. Public Health Bulletin No. 114, U. S. Public Health Service, Treasury Department, p. 17. Washington.

HOME, DAVID MILNE

1883. Salmon and salmon fisheries. International fisheries exhibition. London, 1883. Conference on July 17, 1883. The Fisheries Exhibition Literature, Vol. VI, Conferences, Part III, 58 p. William Cloues and Sons, Limited, London.

LENZING, C. W.

1917. Effect of gas-house waste on the biochemical oxydation of sewage. University of Illinois Bulletin, Vol. 15, No. 11, Water Survey Series No. 15, Chemical and Biological Survey of the Waters of Illinois, Report for . . . 1916, p. 168–171. Urbana.

McDONALD, MARSHALL

1885. Report on the pollution of the Potomac River by the discharge of waste products from gas manufacture. Bulletin, U. S. Fish Commission, Vol. V, 1885, p. 125–126. Washington.

Effect of waste products from Page's ammoniacal works upon young shad fry. Ibid., p. 313–314.

MARSH, MILLARD CALEB

1907. The effect of some industrial wastes on fishes. (*Reprint from* The Potomac River Basin, U. S. Geological Survey, Water Supply and Irrigation Paper No. 192, p. 337–348.) U. S. Fisheries Doc. No. 619. Washington.

MOORE, GEORGE T., and KARL F. KELLERMAN

1905. Copper as an algicide and disinfectant in water supplies. Bulletin 76, Bureau of Plant Industry, U. S. Department of Agriculture, 55 p. Washington.

MOSELY, MARTIN E.

1920. Trout fishing and road tarring. Salmon and Trout Magazine, No. 21, March 1920, p. 70–73. London.

RICHMOND, F. G.
1914. Some questions of tar. Salmon and Trout Magazine, No. 9, December, 1914, p. 35–42. London.
RUSHTON, W.
1921. Biological notes. Salmon and Trout Magazine, No. 25, April, 1921, p. 114. London.
SALMON AND TROUT MAGAZINE. LONDON.
1916. Road tarring. Salmon and Trout Magazine, No. 14, October, 1916, *in* Editorial Notes, p. 6–7.
1919. The road-tarring question. Ibid., No. 18, April, 1919, p. 51–57.
Road tarring. Ibid., No. 20, November, 1919, *in* Editorial Notes, p. 7.
1920. Road tarring and fisheries.—Work of the Joint Committee. Ibid., No. 23, September, 1920, *in* Editorial Notes, p. 9–10.
SCIENTIFIC AMERICAN.
1921. When oil stops the shifting sands. Scientific American, Vol. CXXV, No. 5, July 30, 1921, p. 83. Munn & Co., New York.
SEYDEL, E.
1914. Über die Wirkung von Mineralölen auf Fischwasser. Mitteilungen des Fischereivereins, f. d. Provinz Brandenburg, Bd. 5, p. 26–28. Reviewed *in* Wasser U. Abwasser, Bd. 7, p. 49.
SHELFORD, VICTOR E.
1917. An experimental study of the effects of gas waste upon fishes, with especial reference to stream pollution. Bulletin, Illinois State Laboratory of Natural History, Vol. XI, Art. VI, p. 381–412. Urbana.
SHIPLEY, A. E.
1921. Oil from ships. Effects of discharge in the sea. Suffering fisheries. Letter to the editor, London Times, January 21, 1921, p. 6.
THOMAS, ADRIAN.
——. A study of the effects of certain oils, tars, and creosotes upon brook trout (*Salvelinus fontinalis*). Manuscript.
TOWNSEND, CHARLES H.
1908. Pollution of streams—an appeal to anglers. Reprinted from the twelfth annual report of the New York Zoological Society, 1908, 7 p. New York.
WARD, HENRY B.
1919. Stream pollution in New York State. A preliminary investigation of the problem from the standpoint of the biologist. Made in July and August, 1918. State of New York Conservation Commission, Albany. J. B. Lyon & Co., Printers.
WEIGELT, C.
1904. L'assainissement et le rapeuplement des rivières. Traduction française de C. Julin. (Extrait du tome LXIV, Mémoires couronnés et autres Mémoires, publiés par l'Académie royale de Belgique, 1903.) 668 p. Carl Heymanns Verlag, Berlin.
WHIPPLE, GEORGE CHANDLER.
1914. The microscopy of drinking water. 409 p. John Wiley & Sons, Inc., New York.
WILSON, H. MACLEAN and H. T. CALVERT.
1913. A text-book on trade waste waters: their nature and disposal. XII, 340 p. C. Griffin & Co., Limited, London.

PROGRESS IN BIOLOGICAL INQUIRIES, 1921.

REPORT OF THE DIVISION OF SCIENTIFIC INQUIRY FOR THE FISCAL YEAR 1921.[1]

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CONTENTS.

[1] Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1921. B. F. Doc. No. 911.
[2] With the collaboration of the investigators.

INTRODUCTION.

The fisheries industries are immediately confronted with such acute problems of distribution of products that it would seem only natural if attention were temporarily detracted from the underlying and enduring problems of the industry—those relating to maintenance of the resources upon which the industries are based. Nevertheless the discussions among representatives of all phases of the industry when gathered together in such meetings and conferences as have been held during the recent period of stress have always brought to the front the problems that have to do with the perpetuation of fishery resources. Such conditions as the depletion of shad, the decline of the blue-crab fishery, and the deterioration of inshore waters through pollution, command such earnest consideration on these occasions as to prove that fishermen and dealers of broad vision are not misled through immediate difficulties in one department of the industry to minimize the importance of permanent sources of supply.

Upon due thought, of course, it is evident that the problems of supply must not be forgotten even momentarily; for the difficulties of distribution can be only heightened by continued depletion of resources and an inevitably accompanying increase in costs of production relative to the costs in competing industries. Obviously it can not become easier to market fish when they become less easily obtainable relative to other materials of protein food. No economic fact can be plainer than that diminishing abundance of fish must be followed by increasing prices and decreasing consumption.

It is, then, a fundamental and enduring principle that the perpetuation of the fisheries and the maintenance of their relative rank among other food-producing industries are contingent upon the continued productiveness of the fisheries—in a word, upon conservation. Conservation in turn depends upon the exercise of intelligence and restraint in the exploitation of fisheries resources, upon sound action in removing unnecessary causes of depletion, and upon wisdom in adopting plans for bringing about where possible an increase of particular fish or shellfish. The decline of valuable fisheries has been witnessed too often to admit of continued faith in the inexhaustibility of fish or shellfish of any kind. Yet the intelligent determination of what restrictive measures are necessary, what means of exploitation are unreasonable, or what plans of propagation or development are profitable can be made only upon the foundation of full and correct knowledge of the life histories, habits, and conditions of life of the fish that are to be considered.

It seems generally agreed, for example, that the blue crab of the Chesapeake is in actual course of extermination by unwise fishery methods, although there may not yet be agreement as to the particular methods which are unwise. Recently this very important question was referred to a conference of representatives of the two States concerned, together with officers of the Department of Commerce. The practical results of such a conference depend much, of course, upon the sound practical judgment and the broad spirit of those bearing the responsibility for determination of action; but the one indispensable basis of action is an understanding of the life of the crab. The sole hope of practical results from a conference of any group of persons having this problem in view rests upon such knowledge as we have of the life history of the crab—in short, upon the results of scientific work previously done. Emphasis must be put upon the adverb of time. The significant thing is that the work must in great part, at least, have been already done: for knowledge can not be secured immediately; one can not produce the life history of an aquatic animal upon demand; it is the result of painstaking study through a period of time which can not be fixed in advance, and by the application of methods which can not be definitely plotted beforehand.

It is work of this kind which must be done, and continuously done, so that gradually and steadily we learn more and more about our fishery animals, if we are to be ready at all times to meet the changing problems of regulation and exploitation as they arise.

The scientific knowledge which is the basis of the future welfare of the fisheries requires not only time and application, but also skill and special training. Of greatest importance are the services of men who have not only natural qualifications and the preliminary training which institutions of learning can give, but also such special experience, interest, and devotion as can be gained only as the result of prolonged application to fisheries studies. Something may be done with inexperienced and changing agents, but the most successful and economical work will be done with a trained and continuing force.

In the following report will be found not an account of what might have been done, or what ought to have been done—but rather a statement of the progress which has been attained under the difficult conditions by which the scientific work of the Bureau has been circumscribed. It may be added that the Bureau again closes the year with a less effective force than it had at the beginning. Two members of the already depleted staff have resigned to accept better paying positions elsewhere, and two (including one rendering largely volunteer service) have died and not been replaced. Special acknowledgments are due to those whose interest and loyalty have held them in the public service.

In reviewing the subject of investigation it must be understood that while the Bureau has a definite policy of restricting expenditures to investigations of the most direct practical bearing, it is not entirely untrammeled in the selection of subjects of investigation. The qualifications of the personnel available necessarily determine in part the character of problems which can be profitably attacked.

STUDIES OF FISHES.

THE PACIFIC SALMON.

When consideration is given to the magnitude of the industries based upon the salmons and their near relatives, to the unrivaled rank which some of these fishes hold in the realms of sport and recreation, to the comparative ease with which the more important species may be brought to virtual extermination, and to the fact that all important species are the subject of artificial propagation, it is apparent that no group of fishes demands a greater share of attention in the way of scientific study.

For many years investigations have been directed particularly at the Pacific salmon, and the facts of life histories which are easiest to secure have been acquired, but yet we are far from having possession of the full knowledge necessary to direct propagation most efficiently, or to determine correctly the restrictive measures which may be enforced with least interference with the proper utilization of the fishes. The problems before us now are those requiring the closest and most persistent study, and yielding solution only slowly and by small stages.

IMMATURE SALMON IN THE OCEAN.

The investigations of salmon in Pacific Coast States have been conducted by Willis H. Rich, special assistant. The study of salmon taken by troll and purse seine in the open ocean has practically been completed. A preliminary report was prepared and, by authority of this Bureau, was published by the California Fish and Game Commission. The conclusions reached may be briefly summarized.

The fish taken in the ocean off the mouth of the Columbia River contain, in the spring and early summer, approximately 70 per cent of individuals which will not become sexually mature for one or two years, but by the middle of August this condition has changed so that nearly 90 per cent are fish which will soon enter the river for the purpose of spawning. The rate at which this change takes place and the time at which it occurs have not yet been determined, but will be taken up in a later report. A comparatively small percentage of the fish found just within the mouth of the Columbia River are immature. It should be mentioned in this connection that it is only occasionally, when unusual tidal conditions obtain, that any immature fish are taken inside the mouth of the stream.

The fish taken by troll in Monterey Bay in June contain a considerable proportion of immature individuals. The data obtained in 1918 are most reliable and indicate that only about 40 per cent of the fish taken would have spawned during the same year. The data for 1915 indicate that 75 per cent were mature, but selection may well have taken place in making this collection which consisted of egg samples only.

The fish taken near Drakes Bay and Fort Bragg in July and August, 1918, contain approximately 30 per cent of immature fish. It is of interest to note that this is an approach to the conditions found off the mouth of the Columbia River in August and suggests that the composition of all the schools found near the coast changes materially during the summer season.

It is understood that the preliminary report was used to advantage in the recent movement restricting the operations of both trollers and purse seiners off the coasts of Oregon and Washington. Additional data will be embodied in a later report.

Incidental to the work with the fish taken in the ocean considerable data have been collected which will apply to the report dealing with the general life history of the chinook salmon. Progress has been made in the identification of races, and additional evidence from the scales of returned marked fish has confirmed the work done last year on the significance of the various types of nuclear growth.

RESULTS OF MARKING EXPERIMENTS.

Mr. Rich has also submitted a report on "Returns from the experiments on the marking of young chinook salmon on the Columbia River." The experiments were started in 1916–17 and described in Economic Circular No. 45.

The percentage of returns of marked salmon was rather low, but the results obtained are of some significance. Examination of the scales of the marked fish which have returned after a period of three to four years corroborates the theory that the arrangement of the concentric rings (circuli) provides an accurate record of the previous history of the fish. A study of the scales of these marked fish will, moreover, aid very materially in the solution of perplexing problems which have arisen in interpretation of the scales of the chinook salmon.

Facts gathered during the investigation throw some light upon the rate of spawning migration of adult chinooks, indicating that the rate is approximately the same as that previously determined for sockeye salmon passing through Puget Sound and the Fraser River, that is, some 10 to 15 miles per day.

Perhaps the most interesting and important contribution which these experiments have made to our knowledge of the biology of the salmons relates to the hereditary character of the factors determining the time of the year at which the adults enter fresh water and begin their upward migration to the spawning grounds. It is an important practical question whether or not it is necessary to breed from fish of the spring run in order to produce the spring-run fish, which are more desired than the fall-run fish. The evidence of the marking experiments gives some indication that spring-run fish will be derived from spring-run parents and fall-run fish from fall-run parents.

A comprehensive program of experiment has been planned to extend over a period of several years. Two new marking experiments have been started on the Columbia River in cooperation with the Oregon Fish and Game Commission, nearly 100,000 young chinooks having been marked at Little White Salmon station and the State hatchery at Bonneville.

SALMON INVESTIGATION IN YUKON RIVER.[3]

During 1920, from May until September, Prof. Charles H. Gilbert, temporary investigator, and Henry O'Malley, field assistant in charge of Pacific coast work, conducted an investigation in Yukon River with reference to the runs of salmon, the commercial packs in and near the mouths of the rivers, and the requirements of the natives and others dependent on the runs of salmon in the Yukon River system. Data were secured for a comparison of conditions prevailing in 1919 and 1920. The primary object was to determine whether or not commercial fishing for export should be allowed in the Yukon River and its tributaries.

While all five of the Pacific coast species of salmon make their appearance at the mouth of the Yukon, only three species have sub-

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[3] Cooperative investigation by Divisions of Fish Culture, Alaska Fisheries, and Scientific Inquiry. Only the biological data are summarized here. The full report is published on pp. 128–154 *in* Alaska Fishery and Fur-Seal Industries in 1920, by Ward T. Bower, Appendix VI, Report of the U. S. Commissioner of Fisheries for 1921, B. F. Doc. No. 909.

stantial runs in the Yukon River (king, chum, and coho), and of these king and chum are of the greatest importance by far. The few reds or sockeyes taken near the mouth of the river are perhaps strays, for no breeding has yet been reported from any part of the Yukon Basin. Humpbacks appear at the mouth of the river more numerously than the red salmon, but never in sufficient numbers to constitute a run even of small dimensions. As they were far advanced toward spawning in July, it was evidently impossible that they could ascend the river far with their spawning period so close at hand. The coho runs more or less numerously than the king or chum salmon and in addition is the latest to appear, often not presenting itself in any numbers in the middle and upper reaches of the river until the ice is forming in the fall.

The king salmon begins running in the last week of May or the early days of June. The run culminates quickly and then almost as quickly declines. The rate of migration was found to be remarkably high, the average rate of travel from Tanana to Dawson being slightly less than 45 miles per day, and from Pilot station to Dawson, involving practically the entire length of the river below Dawson, the average rate was 57 miles per day. No record of any other river approaches this in completeness, nor in the high rate of travel indicated. This unexampled speed with which salmon ascend the Yukon is doubtless associated with the great distances to be traversed before reaching their upper spawning areas, taken in connection with the shortness of the summer season.

The most important natural enemies of the king salmon are the white whales, or belugas, and the lamprey eels, the former being undoubtedly exceedingly destructive, while the latter, though causing scars on the fish in much greater abundance than in any other river, as observed by investigators, do not appear to effect serious injury to the fish.

The chum salmon, which is the principal food product of the Yukon River, made its appearance but a few days later than the advent of the king salmon, the rate of migration being approximately the same as that of the king.

Two phases in the development of the chum salmon are distinguished by the natives under the names of "dog salmon" and "silver salmon," the dog salmon comprising the individuals furthest advanced toward spawning. In general the "dog salmon" along any stretch of the river consist of those individuals which will turn into some adjacent tributary to spawn, while the "silvers" are on their way to the upper reaches of the river, show relatively little of the sexual changes they will exhibit on their spawning beds, and are still richly provided with the oil which serves as fuel and the principal source of nourishment during the long journey still before them.

"Dogs" and "silvers" were in general keeping apart from each other and following distinct migration routes, the "dogs" predominating on the right and the "silvers" on the left side of the stream. Heavier runs of kings and cohos were found in company with the "silvers" along the left limit of the river. It appears, therefore, that there is a prevailing use of the left shore by those fish which are found in the upper reaches of the river. This may have connection with the fact that the majority of the tributaries of the lower river enter on the right bank.

Fishermen recognize the succession of phases in the run—the chums which accompany the king salmon being of relatively small size and poor quality, after which there is a run of bright fish of good quality, but inferior size ("silvers"), and finally the last run of "silvers" of a bright rich form and of distinctly larger size. This last run of "silvers" is ordinarily of short duration and furnishes the most highly prized fish of the season. A further more detailed study of the characteristics of the chums at different times and in different localities and the distribution of the various strains to their respective spawning areas would offer results of importance from the biological and equally from the strictly practical points of view.

The investigators record their opinion that the king salmon of the Yukon is the richest in oil of any known king salmon, and express the same view with even greater emphasis regarding the Yukon chums. In this connection it is remarked that in other river basins the chums do not travel far from the sea, but enter late in the season to seek spawning beds not far inland, while the best of the Yukon chums travel 1,000 to 2,000 miles up a river known for its consistently rapid current.

Consideration was given to the passage through which the salmon enter the river, and the investigators considered it not beyond the bounds of probability that nine-tenths of the salmon run enter by the Kwikluak Pass and its subsidiary channel, the Kwiguk.

CHEMICAL STUDIES OF SALMON.

Without expense to the Bureau, Prof. C. W. Greene, of the University of Missouri, has continued his chemical studies of material collected several years ago to determine the changes in salmon ovaries and tissues during the period of migration from sea to breeding grounds. The results of such studies can at first be given only technical expression, but they are none the less likely to yield in the end data of direct economic value.

The chemistry of the king salmon ovaries during their development in the migration period followed in the year 1908 on a series of samples collected on the Columbia River and its tributaries has been tabulated and prepared for publication.

These studies show the following major points: First, the growth of the ovary takes place primarily during the migration while the salmon is fasting. The average increase in weight is from about 135 to 150 grams at the end of the feeding period to 2,000 to 2,500 grams at maturity. In short, about 90 per cent or more of the development takes place during the prolonged fast of the migration.

Chemical analyses of developing ovaries show that between the 500-gram stage and the mature-egg stage there is a remarkable uniformity of chemical composition. The proteins are high, averaging from 29.38 to 31.16 per cent. This is undoubtedly all stored protein. The neutral fats decrease with the development and migration, from an average of 14.15 per cent at the mouth of the river to 10.83 per cent at the spawning. Phospholipins average 4.78 at the mouth of the river and 2.85 at the spawning, showing a decrease with development. The phospholipins are much lower than in the yolk of bird eggs. the hen's egg averaging 11 per cent. The water-soluble organic extractives and the ash are both remarkably uniform, the extractives averaging 1.87 to 1.65. the ash 0.66 to 0.81 per cent. The organic extractives and ash are both low in comparison with other salmon tissues, but compare favorably with their percentages in the yolk of other eggs.

The salient points in this study are found in the showing of high protein storage in the salmon-egg yolk, the relatively low percentage of neutral fats and of phospholipins, and the decrease of neutral fats and phospholipins during development. Since in other eggs these fatty contituents are higher and tend to increase with development, it is probable that in the salmon the decrease is due to the extreme drain on the fatty deposits for the production of dynamic energy during the migration.

Determination of carbohydrate content of certain tissues of the king salmon during the spawning migration was undertaken as an accessory test. The gross samples were preserved in alcohol, and in the final analysis all glycogen was converted to glucose and the determination made in that form. The results show a very low glucose content of all organs and tissues. Glucose was present in all the tissues of the feeding salmon, Monterey Bay and Bolinus Bay specimens, but was absent or in reduced amount in the migrating and spawning salmon, with the exception of one tissue, the ovaries. In the ovaries, the percentage of glucose was practically constant throughout the migration.

LIFE HISTORIES OF MARINE FISHES.

During July and August, 1920, studies of the life histories of fishes of the middle Atlantic coast were carried on by W. W. Welsh, scientific assistant, aided by C. M. Breder, at a temporary station on Young's Pier, Atlantic City, N. J. Through the courtesy of Capt. J. L. Young, owner of the pier, a serviceable two-room building, formerly used as a wireless telegraph office, was adapted for use as a laboratory. A small hatchery, equipped with tidal box and Chester jars, was set up and supplied with filtered salt water from the pier aquarium. A great variety of material was obtained from the two pound nets operated under the pier. Eggs of several species, obtained from fish taken in these nets, were hatched in Chester jars, and the fry carried on as long as possible for study. Series of scale samples for the determination of age and growth were also taken.

Among the species studied were northern and southern king whiting (*Menticirrhus saxatilis* and *M. americanus*), squeteague (*Cynoscion regalis*). spot (*Leiostomus xanthurus*), croaker (*Micropogon undulatus*), silver perch (*Bairdiella chrysura*), menhaden (*Brevoortia tyrannus*), and puffer (*Spheroides maculatus*).

Although the facilities generously furnished by Capt. Young could hardly have been improved upon, the work was greatly handicapped by the abnormally cold water which prevailed throughout the summer. Water temperatures ranged from 53 to 65° F. and averaged about 57° F. This low temperature is believed to be the cause of the scarcity or entire absence of a number of species which it was hoped could be obtained and studied.

The same investigators completed during the year a valuable report on the life histories of fishes of the family Sciænidæ of the Atlantic and Gulf coasts. The family includes some of the most important food fishes, the annual catch on these coasts approximating $3,000,000 in value. No less than 37½ per cent of the fish landed at the municipal fish wharf, Washington, D. C., in 1919 were of this family; the principal species were the squeteague, or weakfish, often erroneously called sea trout, the highly esteemed king whiting, the red drum, or channel bass, the croaker, spot, and silver perch.

How can we act intelligently with reference to the exploitation of such resources or determine wisely how to preserve them for all time if we do not know the life histories of the fishes, when and where they breed, their migrations in summer and in winter, the rate of growth, and the food they require? The present report not only brings together the fragmentary data hitherto available but adds materially to existing knowledge by embodying the results of years of researches, particularly those of the senior author, whose death unfortunately preceded the final completion of the paper.

The report also serves the valuable purpose of making evident the gaps in existing knowledge, revealing the need of additional observations, and showing plainly the directions which further studies should follow. As similar work is done for other families of fishes we shall come nearer to realizing the practical value of applying science to the study of fishes.

Mr. Welsh also completed descriptions of seven new species of marine fishes (Malacopterygii) taken during the explorations of the United States Coast and Geodetic Survey steamer *Bache*, conducted in 1914 under the direction of the United States Bureau of Fisheries. The fish were taken at various stations in the vicinities, respectively, of Cape Hatteras, the Bermudas, and Bahama Islands. After Mr. Welsh's death the descriptions were prepared for publication by C. M. Breder. The report has been accepted for publication by the United States National Museum.

Both assistants have been lost to the Bureau during the year, the one by untimely death, the other by resignation.

FRESH-WATER FISHES.

WHITEFISHES OF THE GREAT LAKES.

There is scarcely a sadder feature of the history of American fisheries than the progressive depletion of the important resources of the Great Lakes, notably in respect to the whitefishes. We may have overestimated the possibilities of exploitation, we may have been shortsighted in the fishery policies we pursued, or we may not have propagated them with proper energy or efficiency. But the simple fact is that no one has had enough knowledge of the distribution, habits, and requirements of whitefishes to give proper advice. The best intentions can not save a situation when founded upon ignorance. If the whitefish fisheries of the Great Lakes are to be preserved to the future or perhaps restored in part to their earlier rank, we must study the fishes and ascertain the condition of their existence.

Therefore, for several years the Bureau has had a skilled assistant devote exclusive attention to the whitefishes and related species. This investigation, pursued by Walter Koelz, scientific assistant, is not all that is required, but it will surely provide a fund of information for more intelligent guidance in future.

The investigation of the systematic relationships and habits of the coregonines was conducted in the year 1920 on Lake Michigan. Forms allied to those which the investigations of the previous year disclosed in Lake Huron, and in addition two undescribed species, of which at least one is now known to occur also in Huron, were obtained. Diagnoses of the species have been prepared from over 2,000 preserved specimens. Data have been collected bearing on the distribution in the lake and on the spawning habits of the various forms. To avoid dissemination of premature conclusions a report will not be published until work is done upon other lakes.

These studies have been supplemented by microscopic examination of the scales and systematic investigation of the food, conducted, respectively, by John Van Oosten and Carl L. Hubbs, temporary investigators, under the direction of Prof. Jacob Reighard.

Mr. Van Oosten first determined that the scale characters of the lake herring (*Coregonus artedi*) are so well defined as to permit the determination from them of the age of individuals and the rate of growth of the species. The variations in the scales of individuals were found to be within specific limits. But scales from different parts of the body of an individual are so unlike that for comparison of individuals or species it is necessary to use scales from the same body region.

The scales of 10 specimens of each of the 10 Lake Huron forms recognized by Koelz were next compared, and it was found that 8 of them (including the two races) are discriminable. Further study will probably enable discrimination of the two other forms. It appeared that in one of these forms (*Coregonus artedi*) there are probably two geographic races which differ in rate of growth, but the matter needs further study.

Through the courtesy of Dr. C. H. Townsend, director of the New York Aquarium, it was possible to secure specimens of whitefish (*Coregonus clupeaformis*) hatched and reared at the aquarium and therefore of known age (7 years). The 10 specimens studied show that there is one annulus for each year of age. This, so far as known, is the first demonstration of this fact and enables the determination of the age of coregonine fish from scale characters to be undertaken with confidence. Two individuals of the 7-year-old whitefish were segregated at the New York Aquarium and kept living, while scales were removed at intervals of a month. A study of these scales shows that the annuli are formed in winter, fixes the time of formation, and indicates temperature change as one of the factors. It is believed that a continuation of these studies will add materially to our knowledge of age and rate of growth of coregonine fishes, aid in their systematic grouping, and lead to the discovery of local races in some of the forms.

The food of the whitefish, lake herring, and allied species of Lake Huron coregonines in the Koelz collection was investigated by a volumetric method by Carl L. Hubbs, of the Museum of Zoology, University of Michigan. The deep-water forms, as the blackfin (*Leucichthys nigripinnis*), were found to feed almost exclusively upon the crustacean *Mysis relicta*, probably the only available food. The deep-water race of the bloater (*Leucichthys hoyi*) feeds chiefly on Mysis, while a 30-fathom race eats for the most part another lake crustacean, *Pontoporeia hoyi*. The food of the shallow-water forms is much more varied. The pilot or menominee (*Prosopium quadrilaterale*) is strictly a bottom feeder, subsisting on mollusks, insect larvæ, crayfishes, etc. The whitefish (*Coregonus clupeaformis*) is also a bottom feeder, but its food is, on the average, not so coarse as that of the pilot, consisting largely of insect larvæ, as those of the mayflies Hexagenia and Ephemera. The lake herring feeds in part upon the same animals, in part upon the minute Crustacea of the plankton. In reference to their available food supply the deep-water forms are absolutely competitive (more so perhaps than any other group of fishes), while the shallow-water forms are only in part competitive. It is probable, however, in view of the former greater abundance of these fishes, that sufficient food exists in the lakes to support a larger population of all the species of whitefishes.

FISHES OF WISCONSIN LAKES.

The food and distribution of the fishes in certain Wisconsin lakes have been studied by Dr. A. S. Pearse.[4] The results indicate that in summer fishes are generally more abundant as conditions approach those in swamps and are fewest when the environment is most like that in rivers. When food is present in quantity and when other conditions are favorable, there are more fishes per unit area in certain inland lakes than in the Mississippi River or in Lake Michigan. Lakes produce considerable food supplies within themselves, while rivers are more dependent on swamps, ponds, and other tributaries. The factors of importance in limiting the distribution of fishes are discussed (shores, turbidity, depth, bottom, height of water, currents, etc.). An abundant supply of food and vegetation permits many fishes to *exist* in a lake, but other favorable conditions must be present in order that they may grow to large size.

A statistical study of the infection of fishes by parasites has been made, the Mississippi and St. Lawrence drainage systems being compared, and various types of lakes studied. The results are now being tabulated and will soon be ready for publication. A short paper on the habits of the mud puppy, in which its relations to fishes are discussed, has been published.[5]

In order to secure information on the rate of growth of cold-blooded animals in natural conditions, attempts are being made to recover the fishes and turtles tagged and released in Lake Mendota during the summer of 1919. Some specimens have already been secured.

Studies on the metabolism of fishes are being continued. In this connection quantitative analyses are being made to show the water, ash, nitrogen, and ether extractives of fishes at various stages of growth.

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[4] Pearse, A. S.: The Distribution and Food of the Fishes of Three Wisconsin Lakes in Summer. University of Wisconsin Studies in Science, No. 3, June, 1921, 60 p. Madison.

[5] Pearse, A. S.: Habits of the Mud-Puppy Necturus, an Enemy of Food Fishes. Bureau of Fisheries, Economic Circular No. 49, issued May 16, 1921, 8 p. Washington.

THE PADDLEFISH.

The study of the natural history and artificial propagation of the paddlefish in Bayou Pierre at Westdale, La., was continued by Dr. A. D. Howard, scientific assistant, with the cooperation of the Louisiana Conservation Commission. During March good catches of egg-bearing females and sufficiently ripe males were obtained, but no females were ripe enough to allow of fertilization of eggs. Late in the month heavy rains flooded the Red River and Bayou Pierre and prevented the capture of fish in sufficient numbers to continue the investigation.

There are few added data regarding the breeding grounds of the fish and the time and manner of spawning. Some information of minor importance was obtained regarding certain habits of the species. Bottoms suspected of being the breeding grounds of the paddlefish were dredged for the purpose of obtaining eggs, but without success.

POISONOUS ACTION OF GAR ROE.

In a previous year experimental attempts to produce caviar of gar roe were made by Prof. C. W. Greene, temporary investigator. Out of this work it developed that the pigment in the gar roe is not a melanin as in the sturgeon roe, but a form of pigment that changes color under various chemical treatments of the roe. The pigment color is changed to an orange red on boiling the gar eggs, on treatment with alcohol or ether, and on salting. This changes the commercial quality of the product and gives easy methods for detecting the adulteration of sturgeon roe by gar roe.

The important observation, however, was the demonstration of an active physiological principle of a toxic nature present in gar roe. It is apparently this principle that gives the unpleasant acrid taste to gar-roe caviar. When tested biologically by the method of feeding the natural product the following points were made: (1) Gar roe is poisonous to the chicken and to the rat; (2) it paralyzes the neuromuscular mechanism of the chicken crop; (3) it produces in the rat an intestinal irritation with active diarrhea.

During the summer of 1920 a series of experiments were made to chemically separate and biologically test the unknown toxic substance. It was shown that (1) extracts in boiling water free from coagulable protein and (2) similar alcoholic extracts contained an active principle toxic to the heart of the frog; (3) globulin fractions made by the method of salting out, centrifuging, and purifying by dialysis were sharply toxic to the heart; (4) the globulin fractions fed to a young rat produced extreme diarrhea and death in about 20 hours, effects comparable to feeding the entire fresh ovary; (5) the effect on the chicken's crop was positively toxic; (6) not only was the crop paralyzed but an acute diarrhea occurred in the chicken through some alimentary canal poisoning; (7) these effects also occurred after feeding the purified globulin.

Attempts to isolate and identify the individual chemicals, of which at least two classes are present, have thus far not been brought to a successful issue. Further experiments are planned.

FISHES OF THE PANAMA REGION.

The Bureau of Fisheries, late in 1910, entered into an agreement with the Smithsonian Institution and the Field Museum of Natural History for a cooperative study of the fishes of the Panama Canal Zone. The work was carried on under the auspices of the Smithsonian Biological Survey of the Panama Canal Zone. The field work was done by Dr. Seth E. Meek, of the Field Museum, and Samuel F. Hildebrand, of the Bureau of Fisheries, during two expeditions made to the Canal Zone, from January to June, 1911, and January to March, 1912, respectively. The study of the collections which were sent to the National Museum was begun during the interval between the two expeditions and continued after the second visit to Panama by the collectors. After two small preliminary papers containing descriptions of new species of fresh-water fishes had been written, and a majority of the forms had been roughly identified and separated, Dr. Meek was obliged to withdraw from the work because of an illness from which he never recovered. The completion of the work was then left to Mr. Hildebrand. As other duties were necessarily assigned to Mr. Hildebrand from time to time, the completion of the study of the collections was greatly delayed. The final report on the fresh-water fishes, however, was completed and published in 1916, but the study of the marine forms was not completed until the spring of 1921. In the last months of the work the author was assisted by W. C. Schroeder.

The total number of species recorded from the coasts of Panama, either taken by Messrs. Meek and Hildebrand, or previous collectors, or both, is 640. The remainder of the species included in the paper were discussed because their known range of distribution is such that they may be expected on the coasts of the Isthmus. The fishes on the Pacific coast run larger than those on the Atlantic and are more numerous both as to species and individuals. Much more collecting, however, has been done on the Pacific side than on the Atlantic, which undoubtedly accounts in part for the large difference in the number of species recorded. The total number of species listed as common to both coasts of Panama is 72, but of these 48 are more or less cosmopolitan in their distribution, that is, they are not confined to American waters. A very large number of species considered distinct are, however, very closely related, differing only slightly but in apparently constant characters.

It was pointed out in the report on the fresh-water species that the fishes of the opposite slopes of Panama are very closely related, some of them remaining identical. This close relationship indicates that the fishes of the two slopes had not long been separated. Since the opening of the Canal they, of course, can again freely intermingle in those streams which are connected with the Canal. The close parallelism of the marine species of the opposite coasts is evidence of a comparatively recent passageway from ocean to ocean, even for salt-water forms. The genera of many families have representatives on both coasts, and if they do not include identical species they at least have very closely related forms on the opposite coasts. A few families, however, deviate from this general rule in having many more representatives on one coast than on the other. The reasons for this may be found by consideration of the habits of the species of those families which do not conform to the usual rule. The Siluridæ (including the catfishes), for example, are very much more numerous on the Pacific coast than on the Atlantic. The Scaridæ (including the parrot fishes and viejas), on the other hand, are much more numerous on the Atlantic than on the Pacific. It is well known that most catfishes frequent water with soft or muddy bottom. The Pacific coast of Panama has many large mud flats partly or wholly exposed at low tide but flooded during high water. The Scaridæ prefer rocky bottom, and especially coral reefs, which are large and extensive on the Atlantic side. These conditions undoubtedly prevailed, in part at least, before the last passageway between the two oceans was closed, and it is probable that these families had already sought out regions best suited to their particular needs.

The commercial fisheries of Panama are still largely undeveloped. The possibilities for profitable fisheries appear to be especially good on the Pacific coast, but apparently less promising on the Atlantic side of the Isthmus. The people of the Isthmus are less wasteful of fishes than the people of the United States, as nearly all species of fish taken, including sharks and skates, are utilized as food.

PACIFIC HERRING.

During the year the Bureau issued a memorandum dealing with the distribution, migrations, sizes, and spawning times and places of the Pacific herring in southeast Alaska and British Columbia, based upon the observations of D. R. Crawford, scientific assistant.

There are apparently two races of herring (*Clupea pallasii*), one of which resides in the bays and inner waterways along the coast from Puget Sound northward to British Columbia and southeast Alaska. The other, which is composed of larger individuals, passes along the outer coasts where it is taken off Vancouver Island in June, July, and August.

The smaller race of herring is found to be sexually mature in the summer, but no milt or roe is found during the winter. Sexually mature individuals vary in size from 6 to 10 inches. The probable spawning time is late summer or early fall. The larger race of herring reaches sexual maturity in the fall and winter, the individuals varying in size from 9 to 12 inches or longer. The probable spawning time is winter or early spring.

USE OF FISH IN COMBATING MALARIA.

COOPERATION IN ANTIMALARIA CAMPAIGN.

Investigations of fishes in relation to mosquito control were conducted during the mosquito-breeding season of 1920 by Samuel F. Hildebrand, scientific assistant, working in cooperation with the United States Public Health Service. In the spring and early part of the summer Mr. Hildebrand inspected various localities in 12 Southern States where malaria-control work was to be undertaken. Suggestions were offered concerning the employment of fish for the control of the mosquito, and the waters suitable for fish control were pointed out to the officers in charge. The result of these inspections was that the top minnow, *Gambusia affinis*, was very widely employed as an agent in the control of malaria. A report of observations made by Mr. Hildebrand during this campaign has been published by the Public Health Service.[6]

The latter part of the season was devoted to investigations at Savannah, Ga., where a special effort was made to determine the relative value as eradicators of mosquito larvæ of two other American viviparous species of fishes, *Heterandria formosa* and *Mollienisia latipinna*, both of which are abundant at Savannah. It was demonstrated that *Heterandria formosa* is of real value and is well worth careful consideration wherever it occurs. *Mollienisia latipinna*, on the other hand, appeared to be practically worthless.

The antimalaria campaigns in the various States were brought to a close early in November, in which month the annual meeting of the National Malaria Committee and the conference of sanitary engineers engaged in antimalaria work took place in Louisville, Ky., where the outcome of the past season's campaign was reported and discussed. The subject of mosquito control by the use of top minnows received extended discussion, and the fact was brought out that nearly every sanitary engineer had made use of *Gambusia affinis* as an agent in malaria control with excellent results. The saving of large sums of money was reported, because fish control replaced other methods at much less expense.

Similar advisory work was done by Mr. Hildebrand in the spring of 1921 before establishing headquarters at Augusta, Ga., for further investigations to determine more fully the conditions of effectiveness in the employment of fish for destruction of disease-bearing mosquitoes.

CONDITIONS GOVERNING ABUNDANCE OF MOSQUITO-DESTROYING FISH.

R. L. Barney and Barry Anson have continued the organization and summarizing of data collected at Mound, La., where investigations of the use of fish for control of mosquito breeding were previously conducted in cooperation with the Bureau of Entomology.

Reports[7] printed outside the Bureau's publications demonstrate the varying seasonal frequency of Gambusia, the mosquito-eating fish; the seasonal variation in the proportions of the sexes and its bearing on the abundance of the species in nature; the effect of environment on the abundance of the species; and the relation of plants of varying habits of growth to oxygen supply and to the capacity of small ponds to support the top-minnow Gambusia. Further observations have been made on the seasonal abundance of Gambusia, especially in relation to the fecundity of the species. Appropriate consideration has been given certain points concerning the anatomy of the female reproductive organs of this fish.

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[6] Hildebrand, Samuel F.: Top Minnows in Relation to Malaria Control, With Notes on Their Habits and Distribution. Treasury Department, Public Health Bulletin No. 114, May, 1921, 34 p. Washington.

[7] Barney, R. L., and Anson, B. J.: Relation of Certain Aquatic Plants to Oxygen Supply and to Capacity of Small Ponds to Support the Top-minnow (*Gambusia affinis*). Transactions, American Fisheries Society, 1920, pp. 268–278.

———. Abundance of the Mosquito Destroying Top-minnow *Gambusia affinis*, Especially in Relation to Male Frequency. Ecology, Vol. II, No. 1, January, 1921, pp. 53–69.

The study of the natural history and ecology of the pigmy sunfish, *Elassoma zonatum*, has been concluded and given publication.[8] It appears that this fish, under certain conditions, may have some value in eradicating immature mosquitoes.

MOSQUITO CONTROL IN NORTHERN WATERS.

While in northern States mosquitoes have a less acute relation to public health than in regions where malaria is prevalent, they nevertheless constitute there a distinct menace to health and efficiency, besides being effective in causing a material reduction of property values, especially in regions which are normally resorted to for purposes of recreation and recuperation of vigor. During the year Prof. J. P. Moore, temporary investigator, has completed a report upon his observations of the use of fish and other aquatic animals for the control of mosquito breeding in northeastern States. His conclusions and suggestions may be summarized.

Although no fish to which mosquitoes are more than an incidental item of the diet has been found in the fresh waters of the northeastern States, nevertheless several species of small fishes and the young of some large ones native to these waters eat mosquito larvæ, pupæ, and eggs more or less habitually. The most important of these mosquito repressors are the common sunfish, the mud minnow, and the common killifish.

Fishes are found to be far more detrimental to culicine than to anophelene mosquitoes. While in the aggregate they destroy vast numbers of eggs, larvæ, and pupæ, and (along with other enemies) probably prevent mosquitoes from becoming everywhere an intolerable nuisance, the destruction is never complete. Some breeding of mosquitoes continues in nearly all bodies of fresh water even when well stocked with mosquito-eating fishes. This imperfect suppression arises through conditions limiting the efficacy of the fishes, most important of which are (1) the barriers that almost all natural bodies of water afford and which prevent the fishes from finding the young mosquitoes, and (2) the abundance of other food for the fishes. Most native mosquito-eating fishes will not thrive in water contaminated by excess of decaying vegetation or otherwise.

The most prevalent of the barriers is the shallow water and marginal vegetation. In ponds formed by dams provided with head gates a simple, effective, and economical method of controlling and reducing marginal vegetation is by lowering and raising the water level periodically, thus alternately drying and drowning the plants. In ponds and lakes of fixed level mechanical means of clearing the margins must be employed.

The most practical method of keeping the per capita food supply low is by overstocking with a variety of small fishes. Reduction of the vegetation also diminishes the supply of fish food.

The common sunfish (*Eupomotis gibbosus*) is the most useful species for ponds and lakes generally. With it may be associated the long-eared sunfish (*Lepomis auritus*), roach (*Abramis chrysoleucus*), some of the smaller minnows, black bass, etc. If there is much

[8] Barney, R. L., and Anson, B. J.: Life History and Ecology of the Pigmy Sunfish (*Elassoma zonatum*). Ecology, Vol. 1, No. 4, October, 1920, pp. 241–256.

aquatic vegetation the blue-spotted sunfish will prove a valuable addition, and if very shallow or swampy areas occur, the mud minnow. The common killifish is very effective in fresh and brackish tidal marshes, and the translucent killifish is useful in upland creeks and dams. Rapid multiplication of small fishes should be encouraged by providing suitable nesting sites and protection for the fry.

Gambusia, the favored top minnow of southern waters, has not survived the northern winters but multiplies so rapidly that it may be used effectively against both Culex and Anopheles in small ponds and water gardens by planting a small number each spring. Small goldfishes are useful in fountain basins and small ponds with clean sides, and, for use in rain barrels and tanks, are preferable to Gambusia.

FISH-CULTURAL EXPERIMENT WORK.

EXPERIMENTS IN PROPAGATING AND REARING FISH IN PONDS.

The Fairport station has continued its valuable experimental work in reference to the propagation and rearing of fishes in ponds. Certain observations were made on the value of fertilizing ponds with chemicals and manure, but data obtained to date are inconclusive. Further study will be directed toward this problem.

The small pond, which for several years has been handled as a farm pond with minimum care and expense, has yielded valuable information. Originally it was stocked with bluegill sunfish. Occasionally, when necessary, the pond has been wintered out. There has been no manipulation of the pond in any respect other than the control of the number of bluegills of various ages in it. During the past year the actual production of fish meat in the ponds has been 333 pounds per acre. Of this, however, fishes of edible size represented about 33 per cent of the total fish-meat production. In this connection it may be well to note that the average annual production of beef per acre on untilled meadowland is said to be 125 pounds; that for hogs is 225 pounds.

Buffalofish, *Ictiobus cyprinella*, artificially reared in the station ponds, reached maturity and produced young for the first time at the age of 4 years. They averaged 13.6 inches in length and approximately 2 pounds in weight. The small-mouth buffalofish, *Ictiobus bubalus*, which in previous years had failed to spawn in the experimental ponds unless an artificial rise in the level of the pond was produced, spawned this year in a pond in which the rise did not occur. While the production of fry of this species does not appear to be as numerous as for those fish held in the pond with artificial rise, the occurrence indicates that the rise is not entirely necessary, though it may be advantageous.

The channel catfish, *Ictalurus punctatus*, for which this station showed the feasibility of pond culture, has continued to spawn in the experimental ponds. Certain 4-year-old offspring of wild stock came to sexual maturity during the year and produced the first brood of truly domestic fish. The adaptability of this species to pond culture is suggested by the fact that the catfish has spawned in certain of the smallest ponds on the reservation, one of which has a water-surface area, when completely full, of only 3,485 square feet (less than one-twelfth of an acre).

WATER BEETLES IN RELATION TO POND CULTURE.

The home fishpond is a subject of continued interest among farmers and others who value the additional table food made available or the means of recreation provided. There must be a great deal in a pond besides fish; otherwise the fish would starve. There must be small animals which serve as food to fish and still smaller animals and plants which serve as food for them. Some things in a pond are desirable, others objectionable in varying degree. The fishpond is, indeed, not a simple thing, but a very elaborate complex, the scientific unraveling of which is necessary before the best plans of pond management can be known. The unraveling of the complex can be accomplished eventually only by tracing particular threads, that is, by centering attention at one time upon a particular group or species of the inhabitants of the water. An instance of such special studies carried through to a point where helpful practical conclusions are derived is afforded by the investigation of water beetles conducted at the Fairport station.

Dr. C. B. Wilson has made a comprehensive study of the rôle beetles play in pondfish culture. He has found that larvæ and adults of the three beetle genera, Hydrophilus, Dytiscus, and Cybister, destroy small fish under normal conditions. The larvæ of Dineutes are known to have killed and eaten fish fry under certain abnormal conditions. The larvæ of three other genera (Acilius, Graphoderes, and Hydrocharis) are suspected of being capable of committing similar depredation.

On the other hand, both beetle larvæ and adults are eaten freely by the young of nearly all our common food and game fishes after the latter attain a length of 25 to 40 millimeters. This is just as true of the seven genera mentioned above as of the others that are harmless.

Practically speaking, only the young fish of the year are menaced by beetles. Fish a year or more old are large enough to feed on the beetles and are almost never attacked by the latter. Consequently beetles are really harmful only in breeding ponds, and even in those places, as everywhere else, they contribute materially to the available food supply for the fish.

Adult beetles migrate and travel so constantly that every fishpond is sure to be stocked with them as soon as it is completed, and yet the beetles of two ponds side by side are likely to differ radically in numbers and variety. If they occasion trouble in one pond, the temporary removal of the fish to another pond will usually prove an effectual remedy. Beetles may also be kept in check by abruptly raising and lowering the water in the pond at intervals of a week or 10 days during their breeding season in July and August.

STUDIES OF SALMONIDÆ IN RELATION TO FISH CULTURE.

In a previous report reference in detail was made to the investigations by Dr. W. C. Kendall of rainbow and steelhead trout and of some hitherto unrecognized anatomical characters of trout which seemed to have a direct bearing upon fish-cultural practices. It is worthy of note that the results of the latter investigation were deemed of such value by independent persons that the report upon them was awarded a prize by the American Fisheries Society as the most important contribution in the application of biological science to the advancement of fish culture. A series of practical experiments based upon these results was conducted during the winter at one of the fish-cultural stations of the Bureau. Just before the close of the year they were transferred to another station where more adequate facilities were available, and it is planned to continue them during the coming fiscal year that definite results may be obtained.

MINNOWS IN RELATION TO FISH CULTURE.

The smaller members of the minnow family are important to fish culture since they represent a primary source of food for more than 20 of the larger food and game fishes. The success of the introduction of game fish into streams or ponds necessarily depends to no small extent upon the suitability of the stream or pond for the support of minnows. Hence the budget of knowledge requisite for efficient fish culture includes information regarding the food and other requirements of minnows. Therefore, while the study of minnows by C. M. Breder and D. R. Crawford, scientific assistants, was conducted almost entirely outside of office hours and represents a by-product as it were, the results gained are of practical value.

They studied six common species in the vicinity of the District of Columbia; chub minnow, *Semotilus bullaris;* red-bellied dace, *Leuciscus vandorsalis; Notropis procne;* shiner or red fin, *Notropis cornutus;* black-nosed dace, *Rhinichthys atronasus;* cutlip, *Exoglossum maxillingua.* All were found to be predominantly carnivorous, insects forming the bulk of the food taken, although two species, *Notropis procne* and *Exoglossum maxillingua*, consumed much vegetable matter. Various worms, filamentous algæ, and diatoms entered into the food in considerable quantities. These minnows are, therefore, in direct competition with the young of important game fish and may even prey upon the fry of them. It is suggested, therefore, that if minnows are introduced into ponds as food for game fish, discretion should be exercised regarding the use of larger and more rapidly growing minnows, such as the chub minnow and red fin, which may outstrip young trout in growth and under some circumstances become a menace rather than a benefit.

In all cases the suitability of the introduction depends both upon the species of minnow and upon the species of fish which is to be fostered, as well as upon other conditions prevailing in the water and upon the degree to which the various factors are under the control of the fish culturist. Minnows seem to thrive best in streams or ponds where the banks bear overhanging vegetation that supports an abundance of insect life. Where this condition prevails there is probably less likelihood that the minnows will prey upon the eggs or young of other fishes.

A NEW FORM OF POND OUTLET.

Practical success in fish culture depends in no little measure upon economy in construction and operation of the pond and upon the convenience with which it can be drained for removal of brood stock or young, elimination of enemies, cleaning the bottom, or removing obnoxious plants. The concrete-box outlets commonly used are not only expensive, but they are also frequently a subsequent source of annoyance, expense, and loss of fish, when damaged as the result of freezing and thawing. It is worthy of special comment, therefore, that H. L. Canfield, superintendent of fish culture at the Fisheries biological station, Fairport, Iowa, has devised a type of pond outlet which has been found, after long trial, to be both relatively inexpensive of installation and convenient and enduring in operation. The Canfield L outlet, here described and illustrated, provides both for all ordinary overflow and for draining the pond as easily and quickly as with the concrete outlet.

The outlet consists of two pieces of threaded pipe of required length screwed hand-tight into an elbow. When connected for service one pipe is joined to the drainage line, and the other, the elbow acting as a hinge, becomes a movable standpipe, the raising and lowering of which controls the depth of the water in the pond. A pipe stop about 2 feet high is arranged back of the elbow to stay the standpipe from passing the center.

Two or three cement blocks about 2 by 2 by 2 feet are set about the drainage line to anchor it and to give protection to the embankment against animals and water seepage leading into it along the line. These blocks serve also as couplings for the joining of the pipe to the drainage line and for other connections in the line as desired. When a kettle is used one block joins a side of it, anchoring the pipe connection with the drainage line and serving as a base for a walk support. A second block is placed about the drainage line approximately beneath the top and inside edge of the embankment. This is usually a drainage line connection block. If the drainage line passes entirely through the embankment a third block should be placed around it several feet into the embankment from the outside.

The outlet screen consists of a half coupling (whole coupling if desired) with a quarter-inch groove around it 2 inches below its top, to which is attached, by means of galvanized wire, a covered cylindrical screen of desired mesh, 1 foot high. This is screwed to the outlet pipe. A cylindrical or square screen of large proportion may be installed about the standpipe if maximum screen area is needed, although for general use this will not be required.

A cement kettle 12 by 6 by 1 feet set parallel to the embankment, and within this kettle a small kettle about 15 inches wide, 3 inches deep, and about 7 feet long (long enough and wide enough to admit the standpipe with screen, when down level) are used at Fairport with the L outlet. The drainpipe enters the side of the main kettle about 6 inches from the elbow and 1 foot from the end. The bottom of the inner kettle is made level with the base of the outlet pipe when it is down level in position to drain, and provision is made for the removal of the elbow by cupping out the cement beneath it and filling the space with clay, to prevent the trapping of fish when the pond is drained. The main kettle has a slight rise from the inner kettle to the sides to provide drainage.

A walk of 2-inch plank supported by 2 by 4 inch stringers is made to extend from the embankment to within a foot of the outlet screen, the stringers resting about 6 inches above the top of the outlet pipe when erect. This walk rests on two pipe supports which extend from the cement blocks in the drainage line.

The standpipe is chained to the sides of the outer walk support by a piece of galvanized pump chain the length of the distance the pipe travels. This chain passes through a loop eye in the post and is provided with a ring larger than the eye, so that the end of the chain can not be drawn through. By means of this chain the standpipe may be raised and lowered and the level of the water in the ponds adjusted and held as desired. An ordinary lock, or an iron bolt may be used to secure the chain in the loop.

Malleable iron pipe is excellent material for the outlet, but ordinary black steel pipe is cheaper and gives good service. One piece of pipe of required length for the standpipe, threaded both ends, an elbow, and about 2 to 2½ feet of pipe threaded one end, to serve as connecting pipe with the drainage line, are all the materials required for the outlet. It is recommended, however, that metal pipe be provided from the elbow well into the embankment for the better protection of the drainage line. Eight-inch pipe is recommended for ponds of 1 acre in area and proportionately smaller pipe for smaller ponds.

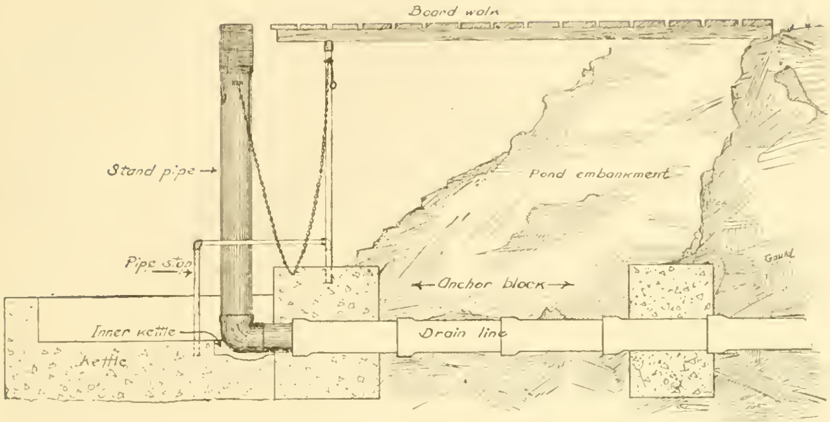

FIG. 1.—The Canfield pond outlet, side view.

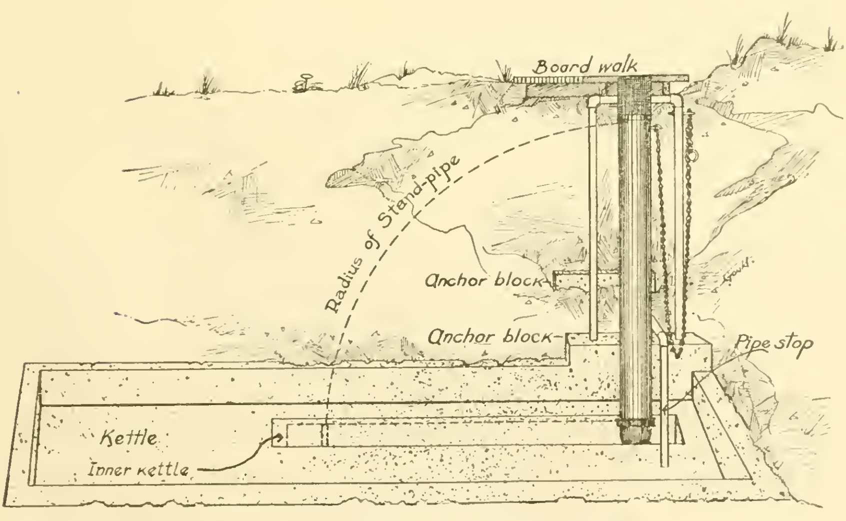

FIG. 2.—The Canfield pond outlet, end view.

It is well to paint the pipes with waterproof paint, and a mixture of graphite and oil is recommended for use in the elbow and coupling threads. Pipe threads should penetrate elbow 1 inch, hand screwed. When the drainage line is to be of terra cotta its joints should be sealed with cement throughout the line rather than laid partly open, as is sometimes done.

The elbow and two pieces of threaded pipe comprising the outlet proper and modifications as to size and detail of the L outlet and appurtenances may be made to suit requirements and material available. If it is necessary to reduce expense, the kettles may be reduced or omitted entirely, but the installation of a kettle, even though of small size, is recommended because of its usefulness when drawing the pond and sorting the fish. The cement blocks, the chief use of which is to protect the outlet drainage line against water working an opening about it, and which also prevents animals such as crayfish and muskrats following it through the embankment, must not be omitted because without the blocks to protect and stay the drainage line leakage is certain to occur. The depth of these blocks should not be reduced, but in unfavorable soil may be increased to advantage.

All surfaces over which embankments are to be laid should be plowed before the fill is commenced, so that the earth will bind satisfactorily, and all foreign matter such as brush, rock, etc., should be excluded from the fill dirt.

The outlet is placed at the drain point and stayed as described, after which the fill is laid over it, the outlet being ready for service as soon as the fill is started. Pipe 4 to 6 inches in diameter is sufficiently large for ponds of less than 1 acre in area. It is always better to have the outlet pipe too large rather than too small.

Many of the spillways and outlets in general use give more or less trouble through leakage, and those of cement construction often freeze and crack, or settle and crack, causing serious trouble and considerable expense. Many of the outlets in use are built into the embankment, thereby weakening and subjecting the embankment to the danger of washouts. Loss of fishes often arises from screens below the water surface becoming damaged, and many outlets, when the pond is being drawn, have too much suction for the good of the little fish. These and other troubles have been eliminated in the L outlet, some favorable features of which are enumerated below:

The action of the outlet is quick and easy.

Leakage and freezing difficulties have been overcome.

The outlet operating from the surface provides minimum suction, which works to the benefit of small fish.

The screen is visible, therefore safe, and easily cleaned.

The outlet does not weaken the pond embankment.

The outlet may be assembled, installed, and maintained at low cost, and is so simple of construction that any "handy man" can build and install it.

ERADICATION OF SOME OBJECTIONABLE PLANTS.

The rank growth of cat-tails in ponds and lakes, particularly at fish-cultural stations, has often become a serious nuisance, causing a substantial reduction in the effective area of the pond. Hitherto there has been no inexpensive or practicable method of combating them, since removal by cutting alone is quite ineffectual. Superintendent Canfield has devised and demonstrated the efficacy of a method of elimination of these plants, based upon the necessity of areation through contact of the plant or its landward roots with the air.

The water level in the pond is lowered below the limit of growth of the cat-tails, which should then be mowed as low as practicable. With spade or plow a ditch is made below the normal water line and between the cat-tails and the shore. The ditch must be sufficiently deep to sever the roots that connect the plants in the pond with the shore or with any plants that are allowed to remain above the ditch. In this way the air supply from the land roots is completely cut off. The pond should then be immediately flooded and the water level continuously maintained above the stubble for a week or 10 days, when the cat-tails will have been killed out. It is essential to flood the stubble immediately after mowing in order to get ahead of the rapid growth of the cat-tails. If in consequence of stored oxygen in the severed roots a few weakling shoots should appear above the water surface, they should be pulled out; when this is done a few times the plants will not reappear.

STUDIES OF FISH DISEASE.

The position of fish pathologist in the Bureau was vacant during the last half of the fiscal year, the last incumbent having left the service at the end of December after a year's service. Some studies of diseases and parasites were also conducted by other investigators principally in temporary employ.

MORTALITY IN PIKE-PERCH EGGS.

The great losses in the hatching of pike-perch eggs have made this phase of fish culture a ground of repeated inquiry, although as yet no investigation has been carried to a conclusion revealing the exact causes of the high death rate. Further observations during the past fiscal year were made by Dr. Franz Schrader, who inquired into the practices of handling fish and eggs and investigated the actual changes taking place within the abnormally developing eggs. His observations point to the conclusion that the original cause of abnormal development and mortality of eggs is to be sought in physiological injuries sustained by the parent fish while held in captivity before spawn can be taken. The penning of fishes prior to spawning is a practice of long standing in the artificial propagation of pike perch and other species of fish. Some species withstand the confinement very well, while others manifest such ill-effects as hardening of ovaries, wateriness of milt, and low percentage of hatched fry—in short, degeneration of eggs and sperms. The general inference of the investigator finds some confirmation in the investigations reported in the next paragraph and also in the experiences of several superintendents who have observed that the mortality of pike-perch eggs is proportional to the length of time the fish have been retained in pens, and conversely, that the percentage of hatch is greater in the case of eggs from fish stripped as taken from the nets than in the case of eggs taken from fish that have been held in pens.

ABNORMAL CONDITIONS OF FISH OVARIES.

Dr. Schrader also conducted inquiries into ovarial conditions in fishes with the purpose of throwing light upon various difficulties arising in hatcheries, including the loss of spawning fishes, ovarian diseases, and failure of fertilized eggs to hatch, troubles which possibly have some relation to abnormal conditions of confinement, handling, or stripping. Observations were made upon developing immature eggs of the scup, the retention of eggs beyond the normal period of spawning, the reabsorption of retained eggs, and the hardening of ovaries. Abnormally retained eggs show signs of degeneration in course of one or two weeks. Reabsorption takes place through invading cells, but is not always successfully accomplished; it apparently makes a demand upon the body of the fish, which, if excessive, may lead to death.

DISEASE OF RESCUED FISH.

Dr. H. S. Davis, temporary investigator at the Fairport biological station, has found that a high mortality may occur among rescued fishes immediately after the handling incident to rescue operations. This heavy death rate is especially characteristic of the crappies, buffalofish, and bluegills, when taken in warm weather, the first-named species being the weakest. While the mortality may be founded in part upon "shock" sustained during the seining and handling operations, it is due more directly to bacterial infection following slight injuries and gaining headway from the weakened condition of the fish. Immersion for one minute in a solution of copper sulphate in 1 to 1,000 dilution reduces the loss among rescued fishes to a minimum.

In certain experiments 75 to 100 per cent of the crappies rescued from inland sloughs and untreated were lost through death. Under similar conditions, except for a one-minute treatment with 1/1,000 copper-sulphate solution after the fish were allowed to remain a short time in fresh clean water, this experimental loss was reduced to 30 or 40 per cent. The necessity and practicability of the treatment depend upon the conditions attending work in particular fields and at particular times. It is believed that frequent tests should be made in connection with rescue operations and the prophylactic measures taken wherever a substantial mortality rate is to be expected. Dipping in a simple disinfectant can not be very expensive and will be worth while if it will increase appreciably the percentage of survivors.

Dr. Davis's experiments not only point out the possibilities of loss and the means of prevention, but they also emphasize the necessity for great care in handling rescued fish. Rough methods, including the throwing of fishes into receptacles and the abrasion of the fishes' bodies by seines, hands, or débris are the main causes of a high death rate.

PARASITIC FLATWORMS OF FRESH-WATER FISHES.

The parasitic flatworms which infest the body surface and gills of fishes (ectoparasites) may be more of a nuisance to fish culture in ponds, tanks, or aquaria than those which live within the body of the fish. The endoparasites generally can not complete the life cycle without passing different stages in two or more hosts, which are likely to be animals of widely different groups. Therefore, as regards these parasites, fish can not directly infect fish. With external parasites it is otherwise; there being no alternation of hosts, infection may proceed from fish to fish and thus multiply in such abundance as to cause extreme weakness or death of the fish. Such a parasite is *Gyrodactylus fairporti*, a new species described by Dr. H. J. Van Cleave from bullhead and carp of certain ponds at the Fairport (Iowa) station. These flatworms are very small, usually less than half a millimeter in length, and so translucent that one may easily overlook them.

Some bullheads removed from a quarry pond near the Mississippi River died within 24 hours after being placed in an aquarium of running water. The early death of these usually most hardy fish could be explained only on the supposition that their vitality had been greatly diminished by the small and abundant trematodes (Gyrodactylus) scattered over the entire surface of the body. Possibly many fish in the river are unfavorably affected by these worms.

Dr Van Cleave found a species of another genus of parasitic flatworms upon the gills of sunfish, black bass, and channel catfish, but it is believed that worms of this genus (Ancyrocephalus) do not cause dangerous infestations.

Very little study has been devoted to the ectoparasitic flatworms on this continent, and previously but four species have been reported from fresh-water fishes. Much attention has been given them in connection with fish culture in Europe. Treatments which European writers have recommended are: (1) A one-fourth of 1 per cent solution of salicylic acid, in which the fish remains half an hour (Hübner); and (2) a solution of 1 part of potassium permanganate to 100,000 parts of water. The treatments may require modification for our species of fish and of parasites.

Dr. Van Cleave has also described a new genus of trematodes based upon specimens taken from the white bass, *Roccus chrysops*, collected in Iowa, Illinois, and Minnesota. The parasites were found only in the digestive tract and at present are ascribed no economic significance. The parasites are not found in *Morone interrupta*, although that species is a close relative of the white bass. He finds, indeed, that the trematode parasites of the yellow bass are entirely distinct from those of the white bass, although the two related species display marked similarity in range, local preference, feeding habits, and food.

TREATMENT OF ICHTHYOPHTHIRIUS DISEASE.

One of the most troublesome external parasitic affections of fresh-water fishes in aquaria and ponds is due to a microscopic protozoan (Ichthyophthirius), which becomes embedded in the skin and sets up a violent irritation. H. L. Canfield, superintendent of fish culture at the Fairport station, who has conducted experiments in the treatment of channel catfish heavily infected with the protozoan parasite, reports that commercial carbonate of soda in the form of sal soda (washing soda) is effective in alleviating the trouble.

Using a receptacle other than metal to hold the solution, 150 g. of sal soda are placed in 4,000 c. c. of water, in which solution the affected fish are dipped. The diseased fish are held in troughs of lively running water, which aids in the treatment and facilitates handling. Before each treatment the fish are forced to the lower half of the trough, where they are separated from the upper half by means of a cross screen. The diseased fish are caught in a hand net, immersed in the solution until they show signs of discomfort (darting about), and then placed in the fresh water at the upper end of the trough. This process is continued until a material reduction in parasites is noticed (usually about six days), after which the treatment is given once a day for about 10 days, which is usually sufficient to rid the fish of the parasites.

The effect of the sal-soda solution is to cause the parasites to shrink and wrinkle as they die. It is apparent that the solution kills the free swimmers, the young just attached to the fish, and all but the larger and more thoroughly embedded parasites. These last leave the fish in the natural process of development, and their offspring are killed with others after they attack the fish and before they attain their maturity. Thus in time the parasites are entirely exterminated.

The channel catfish were fed, as usual, ground liver three times a day while the treatment was in progress, and the usual care was given the fish and troughs as to cleanliness.

OCEANOGRAPHIC AND LIMNOLOGICAL STUDIES.

INVESTIGATIONS IN THE ATLANTIC.

Because of deficiency in funds and personnel the *Albatross* has not been at sea during the year.

Some brief cruises to complete the field work of the hydrographic and biological survey of the Gulf of Maine were made by the small Fisheries steamer *Halcyon* under the direction of Dr. H. B. Bigelow. The preparation of the report upon all the data gathered at different times during a period of years is now in progress, although its completion has been delayed by the death of William W. Welsh, who was giving special attention to the portion of the report dealing with the occurrence, distribution, and life histories of the fishes.

By joint action of the Governments of the United States, Canada, and Newfoundland there has been formed during the year an International Committee on Marine Fishery Investigations, with the object of bringing about a better correlation of the activities of the several Governments in fishery investigations in which two or more of the countries are directly interested. Knowledge of the cod and the conditions of its perpetual conservation, for example, possesses the same interest to Canada and Newfoundland as to the United States. No formal cooperative effort is contemplated, but it is believed that progress will be attained more rapidly and economically by regular interchange of data and counsel than by entirely detached endeavor on the part of each nation. The members of the committee are as follows: For Canada, Mr. William A. Found, Assistant Deputy Minister of Fisheries; Dr. A. G. Huntsman, member of the Biological Board of Canada, and Mr. Loring C. Christie, legal adviser, Department of External Affairs, Ottawa; for Newfoundland, Mr. D. James Davies, chemist to the Newfoundland Government; for the United States, Dr. H. F. Moore, Deputy Commissioner of Fisheries, Dr. R. E. Coker, assistant in charge, scientific inquiry, Bureau of Fisheries, and Dr. H. B. Bigelow, consulting oceanographer, Bureau of Fisheries.

The first meeting of the committee was held in Montreal, June 23, 1920, when, after full discussion, agreement was reached as to correlation and interchange of statistical data with regard to particular fishes, uniformity in methods of plankton study, and concentration of attention upon certain species.

SURVEY OF CHESAPEAKE BAY.

The biological and hydrographic survey of Chesapeake Bay has been continued by Dr. R. P. Cowles, temporary investigator, during the past year, and a large series of data on salinity, temperature, current velocity, and current direction has been accumulated, together with qualitative and quantitative collections of plankton, bottom samples, and many specimens of the larger animals and plants. The observations made and samples collected have not been confined merely to the surface nor to the bottom but have been obtained at definite depths, equal intervals apart, from the surface to the bottom. Probably the most valuable characteristic of the work is the fact that the observations have been made about every sixth week during the year at fixed stations arranged in lines across the bay, these lines being so placed as to adequately cover the bay from the region of Baltimore to the Capes. The Fisheries steamer *Fish Hawk* has been employed in the work on the bay.

During the year preliminary work has been undertaken to determine the hydrogen ion concentration of the sea water by colorimetry. This method has now been perfected, and the tests made on the so-called 24-hour stations, where observations are taken every 1½ hours at definite intervals from the surface to the bottom for a period of 24 hours, have shown some very interesting conditions.

The coming year will be devoted to working over the data and material, with possibly an occasional cruise on the bay to collect information that may be lacking. The general purpose of the investigation is to gather and record the data that are necessary for the interpretation of the seasonal and irregular movements of fishes, for the solution of practical problems that arise from time to time regarding fish and shellfish, and for the conservation and development of the important fisheries of the bay.

This general survey is being supplemented by a special investigation of fishes of the Chesapeake Bay, conducted by S. F. Hildebrand and W. C. Schroeder. While many fishes, especially the younger examples of several species, have been collected in connection with the general survey, the supplemental field work on fishes was undertaken only in the last months of the fiscal year.

SURVEY OF SELECTED AREAS IN MISSISSIPPI RIVER.

In an investigation to determine the distribution of fresh-water mussels, Dr. A. D. Howard made a somewhat detailed study of the entire bottom in a portion of the Mississippi River, the area selected being 3 miles in length and situated in Andalusia Chute, one of the channels of the river in the vicinity of Fairport, Iowa. The river in this section is comparatively straight and of rather uniform character as to gradient and depth, passing over soil of clay, sand, and sedimentary rock (mostly limestone).

The life on the bottom was found to have a rather definite distribution with reference to physiographic features of the river. In general it was restricted to a zone 200 feet wide along each shore. Where islands occurred a narrower zone was found along the shores of the islands. The distribution had apparently no particular relation to depth of water, for the middle area of the stream (about 500 feet wide) was not deeper than the 200-foot strips alongshore. The zones near shore are by no means equally productive throughout, the more densely populated portions manifesting definite relations to the position of the channel and to other features of the stream, especially those that affect the stability of the bottom. Productive areas usually occur in parts of the shore strips that are bathed by the current, or where the channel approaches the shore. Character of bottom soil is a significant feature, but this is often controlled by current, topography, and other conditions.

Keokuk Lake, formed in the Mississippi River above the dam at Keokuk, has been examined some years after its formation to determine some of the effects of the changed conditions. A report of the observations is in process of preparation.

STUDIES OF INLAND LAKES.

The Bureau has continued to cooperate with the Geological and Natural History Survey of Wisconsin in biological and chemical investigations directed at the fundamental problems of the capacity of inclosed waters for support of fish life. As has hitherto been stated, the Bureau bears only a relatively small proportion of the expense of the investigation. Substantial progress has been made, as is indicated by the following outline submitted by President Edward A. Birge and Chancey Juday representing the State Survey:

1. The bulletin dealing with the quantity and chemical composition of the plankton of the lakes situated in the vicinity of Madison is now ready for the press. During this investigation 481 observations have been made on the net plankton and 182 on the nannoplankton of these lakes, making a total of 663 catches. These catches were combined into 374 samples for the chemical analyses. About 2,500 separate chemical and ash determinations have been made on these samples and 52 samples of special material obtained during the progress of this work.

The quantity of dry organic matter in the total plankton of Lake Mendota (net plankton plus nannoplankton) varied from a minimum of 230 pounds per acre in February to a maximum of 521 pounds per acre in December in the area situated within the 20-meter contour line. When the surface of the entire lake and the volume are taken into account the range is from 126 pounds per acre in February to 256 pounds in December. The live weight of the organic matter is 10 times as much as the dry weight.

Of the dry organic matter an average of 44.5 per cent consisted of crude protein, 7.5 per cent ether extract, and 5.3 per cent crude fiber, leaving 42.7 per cent to be designated as nitrogen free extract (chiefly carbohydrates). The pentosans were the only carbohydrates studied, and they constituted an average of 4.6 per cent of the organic matter.

Lakes Monona and Waubesa yielded larger quantities of total plankton. The amount in the former varied from a minimum of 276 pounds per acre in July to a maximum of 1,063 pounds of dry organic matter in October in the area bounded by the 20-meter contour. For the entire lake the range was from 111 pounds to 426 pounds per acre of surface. The maximum crop of plankton in Lake Waubesa yielded 862 pounds of dry organic matter per acre in the area bounded by the 10-meter contour, or 415 pounds per acre for the entire lake; the average for 16 samples is 216 pounds of dry organic matter per acre.

The dry organic matter in the total plankton of Lake Monona contained 57.5 per cent of crude protein, 4.8 per cent of ether extract, 4.7 per cent of pentosans, and 4.4 per cent of crude fiber. The total plankton of Lake Waubesa yielded an average of 48.6 per cent of crude protein, 4.6 per cent of ether extract, 5.8 per cent of pentosans, and 4.4 per cent of crude fiber.

2. Mr. Wilson's numerical results for the bacteria of Lake Mendota show that the average number from surface to bottom in 23.5 meters of water was 3,000 per c. c. of water in July and August, 1919; in the following autumn and

winter the number fell to 1,500 per c. c. In the spring and early summer of 1920 the number rose steadily to a maximum average of about 30,000 per c. c. from the latter part of June to the end of August. During the autumn and early winter the number gradually declined to an average of 2,000 bacteria per c. c. of water.

Many of the bacteria represent chromogenic forms, and various colors are found in the plate cultures. There seem to be some denitrifying individuals present, but conclusive evidence of the presence of lime-precipitating forms has not been obtained yet. The average size of these bacteria has been obtained so that it will be possible to estimate their live weight and dry weight as well as the organic matter in them.

3. Several reports are now in press in the Transactions of the Wisconsin Academy which deal with investigations in which the Bureau of Fisheries has cooperated. The following may be listed here: "A survey of the larger aquatic plants of Lake Mendota," by R. H. Denniston; "A quantitative study of the larger aquatic plants of Lake Mendota," by H. W. Rickett; "A quantitative study of the bottom fauna in the deeper water of Lake Mendota," by C. Juday.

Some chemical analyses of the larger aquatic plants from Lake Mendota have also been made, but this has been done independently by the Wisconsin Survey.

4. Various analyses have shown that the quantity of organic nitrogen in the lake water itself amounts to five or six times as much as that in the total plankton, and Dr. Schuette has been trying to work out a method for the determination of this dissolved organic nitrogen which will give results that are more satisfactory than the present methods of nitrogen determination. The quantities are so small that the methods now used by chemists do not always give consistent results. So far no other method has been found which will give better results than the standard methods.

AGAR-AGAR AND OTHER GELATINS FROM SEAWEED.

It is obviously unfortunate that the United States should be dependent upon other countries for its supply of a vital necessity. Agar-agar is the commercial name applied to a gelatinous product which has been imported from Japan, China, and other places, the importations in 1919 amounting to nearly half a million dollars. The importance of the material is not, however, measured by its strictly commercial value. While it is used in making food and confections, agar-agar is primarily important because it is a necessary medium for bacteriological work, and is therefore essential to medical laboratories and hospitals. It is a requisite for certain industries, for the maintenance of health, and for national security.

Marine algæ or seaweed have long been used in this country for the preparation of gelatins for particular purposes, but only the recent investigations, conducted for the Bureau by Dr. Irving A. Field,[9] have revealed the fact that we have possible sources of supply for the most valuable gelatin of all in certain species of seaweed on the west coast. In the report for the preceding year reference was made to Dr. Field's preparation of a gelatin suitable for use in preserving fish, and to experiments in producing a substitute for agar from Atlantic coast seaweed. These experiments were not successful, but it was later ascertained that at least one species of the west coast yields agar of the best quality. Agar prepared by Dr. Field and tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar. Another species yielded a product apparently of like quality. The investigation should be followed by a field survey for the purpose of definitely locating the

[9] Field, I. A.: Sources, Preparation, and Properties of Some Algal Gelatines. Bureau of Fisheries, Economic Circular No. 51, issued Oct. 10. 1921, 7 p. Washington.

sources of supply. It was a serious misfortune that Dr. Field died shortly after completing and reporting upon his laboratory investigations.

THE OYSTER.

INVESTIGATIONS OF OYSTER CULTURE.

The investigation of oyster problems of Great South Bay and Long Island Sound was continued according to the general plan of the year before. The work was begun by Dr. E. P. Churchill, assisted by J. S. Gutsell, but Dr. Churchill left the service in August and thereafter Mr. Gutsell continued it alone. Quantitative collections and studies were made with the aid of the pumping equipment and selective screens developed by the Bureau investigators.

At Great South Bay the plan comprised chiefly an intensive study of the distribution, life, and setting of the oyster larvæ. At fixed stations located over a considerable area of the best oyster grounds in the bay quantitative collections were made as in 1919. In that year it had been found that certain of these stations were almost uniformly superior to others in their yield of larvæ, and that the set at these stations was correspondingly more abundant. The work in 1920 was planned to check up and enlarge on this evidence, to see if the general distribution of larvæ was much the same year after year. Addition to our knowledge in other aspects was, of course, to be included.

Unfortunately the season was a poor one. Oyster larvæ until after mid-July occurred scatteringly, at best in small numbers. The conditions indicated a very light set indeed. The one station which showed decided superiority was not located over oyster beds and offered no opportunity of determining a set. A return visit with inadequate apparatus late in August showed young oyster larvæ in apparently fair abundance and indicated an unusually late spawning and a possible late set.

In accordance with the scarcity of larvæ, a very light set was found in the fall; and corresponding apparently to the late spawning, a set was found in the spring which had not attained sufficient size in the fall to be noticeable. In general these sets were so light as to be commercial only to the extent of having sufficient value to repay shifting.

Thus support was given the hypothesis that a relation can be found between the observable abundance of larvæ and the amount of set, and that consequently a scarcity of larvæ indicates that the great expense of "shelling" should be avoided.

In Long Island Sound, where the oysters spawn later than in Great South Bay, the work was curtailed by the reduced personnel and was limited chiefly to the region between Milford and Bridgeport. Collecting was poor indeed except for a time in August, when moderate numbers of larvæ were obtained, particularly about Bridgeport. Something of a set was later reported there. Thus in the Sound, as in Great South Bay, there was little opportunity that season to obtain other than negative evidence as to the relation of the occurrence of oyster larvæ and the abundance and location of set.

The study, made in cooperation with the Bureau of Chemistry, of the trade-waste problem in its relation to oyster culture was continued. Before he left the Bureau Dr. Churchill performed experiments with various dilutions of standard solutions of chemicals known to occur in or to be discharged into water near oyster beds. He found the larvæ very sensitive, certain chemicals being fatal even in great dilutions. In Bridgeport Harbor late in the season samples were collected for the determination of the distribution of injurious wastes, particularly the heavy metals. As a result of the study of this harbor and of the efforts of the two bureaus, the company, which discharged much the greatest amounts of copper, was persuaded to install an electrolytic recovery process, which has given great promise both as a money saver and as a means of improving harbor conditions.

In June, 1921, the spawning of oysters in Great South Bay has been found to begin in earnest almost a month earlier than in previous years of our experience and to occur at decidedly lower temperatures. The work is being so carried on as to check up the data obtained in 1919, and already the larvæ have been found to be much more widely distributed in good numbers. In addition, as opportunity permits, data are being gathered to test out the hypothesis advanced by Dr. T. C. Nelson that oyster larvæ of the larger sizes keep from being washed to sea by sinking with the ebb tide and rising with the flood.

The study of the development and distribution of the larvæ is of interest to local oystermen and has, it is believed, influenced them in determining the times, places, and extent of planting shells for set. The immediate purpose of the Bureau, it must be understood, is to determine the possibilities of the method of larvæ survey in obtaining best results and effecting economies in planting and in the prevention of costly wastes from planting in seasons when a set is not obtainable. Once a satisfactory demonstration is obtained, the method can be applied in other localities as well as at the places where the experiments have been conducted.

EFFECT OF POLLUTIONS UPON PROPAGATION OF OYSTERS.

Pollutions may affect oyster eggs and larvæ, either directly, by the toxic effect of certain chemicals upon the young oysters, or indirectly, through the exhaustion of the oxygen supply and partial or complete suffocation of the larvæ. The latter aspect of the problem was given attention by Dr. P. H. Mitchell, director of the Woods Hole (Mass.) Fisheries laboratory.

In experiments on the effect of oxygen deprivation on oyster larvæ Dr. Mitchell found that while the embryos are sensitive to diminished oxygen supply a number of factors affect the lower limit of the oxygen content of water compatible with life of the larvæ. The factors noted were: (*a*) The previous history of the eggs from which the larvæ were hatched, for example, ripeness at the time of artificial fertilization and previous exposure to pollution; (*b*) the age of the larvæ: (*c*) the carbon-dioxide content of the water; (*d*) the hydrogen ion concentration of the water; and (*e*) the temperature.

Development of a satisfactory technique for handling such unusually sensitive and perishable material as oyster larvæ, in the manipulations required for this experiment, consumed much time. Consequently the end of the breeding season for oysters came before there was opportunity to work out the relations of all these factors in an entirely quantitative manner.

Results may be summarized as follows:

With regard to the condition of the eggs, it was observed that embryos from eggs of which 50 per cent or more developed quickly to a free swimming stage withstood deprivation of oxygen better than those from eggs of which only a small proportion developed.

With respect to age, it appeared that younger larvæ endured comparative oxygen deprivation slightly longer than older ones, but the experiments were not conclusive.

It was found that embryos show some effect of oxygen lack in water containing 25 per cent of saturation of oxygen at 24° C. and a markedly increased mortality in 10 per cent of saturation. Killing time varied from 12 to 30 hours according to extent of oxygen depletion. At 28 to 30° C. embryos die much more rapidly from oxygen starvation than at 22 to 24° C.

Carbon dioxide seems to have a toxic effect other than that due to hydrogen ion concentration. Embryos died earlier in water containing sufficient oxygen but excessive CO_2 than in water of the same oxygen content and with the same P_H obtained by adding lactic acid.

Investigation of the effect of pollution on satisfactory development of eggs in gonads was also conducted. Results showed that from oysters, kept 7 to 10 days in water polluted so as to markedly lower its oxygen content, only an abnormally small proportion of eggs could be made to develop after artificial fertilization, conducted according to standardized technique, and that the embryos so obtained did not develop as far as controls.

An incidental observation proved of considerable interest. Oysters which had been in cold storage 24 days for the purpose of studying greening were found to have very full gonads. Eggs fertilized with sperm from some of the same lot of oysters developed satisfactorily, and many of the embryos reached the primitive shell stage. Some of them, indeed, were used in oxygen-requirement tests.

Observations on the cause of copper greening confirmed previous conclusions by showing that not only the amount of copper obtainable by the oysters, but also conditions of habitat determine whether or not visible green spots occur. Marked appearance of greenness after one or more weeks in cold storage was observed. It has been twice noted that with gonads filled a smaller proportion of oysters become green during storage than in other conditions. Two-year-old spent oysters, set and reared in Wareham River, did not become green during four weeks in cold storage. This is in contrast to oysters which at some time during their previous history have been in waters known to produce greenness (near Bridgeport and New Haven).

Experiments both in the laboratory and in the field indicated a positive influence of diminished oxygen supply in causing the appearance of green spots. Repeated observations of marked greening of oysters in polluted tanks of sea water were also made, thus confirming the similar results obtained during the previous summer in the Seekonk River.

FRESH-WATER MUSSELS.

PROPAGATION OF MUSSELS.

The Fisheries biological station at Fairport, Iowa, continued its practical propagation of fresh-water mussels in the Mississippi drainage at Lake Pepin and Lake Pokegama, Minn.; at New Boston, Oquawka, and Dallas City, Ill.; at Fairport, Iowa; at Hannibal and Clarksville, Mo.; and in cooperation with rescue crews along the Mississippi in Wisconsin and Minnesota. The total number of glochidia infected upon fish and liberated in public waters during the year was approximately 648,445,000, including 478,705,000 infected upon rescued fish by cooperative agents working in connection with rescue crews of the division of fish culture.

With a view to demonstrating the possibilities of mussel propagation in connection with the rescuing of food fishes, the National Association of Button Manufacturers offered to cooperate with the Bureau by providing men to accompany each rescue crew on the upper river and to inoculate all fishes with the glochidia of the Lake Pepin mucket, the most important of the local mussels. Seven agents of the button manufacturers cooperated with seven crews working under the direction of Supt. Culler, of the Homer (Minn.) station, and during October and November inoculated nearly 6,000,000 fish with glochidia.

The localities in which the work was done and the number of fish subjected to infection in each locality were as follows:

Lynxville, Wis	2,025,200
Genoa, Wis	1,214,900
Ferryville, Wis	907,340
Fountain City, Wis	86,510
North McGregor, Iowa	676,100
Bellevue, Iowa	931,500
Total	5,841,550

Material cooperation of this nature by an association of business men is a source of gratification to the Bureau, not only as evidence of a cordial spirit, but as evidence of faith in the practical value of the service rendered in the propagation of river mussels.

PROTECTION OF MUSSELS.

A prominent feature of the work of the Fairport station for several years has been the part which it has played in bringing about a strong sentiment for the protection of fresh-water mussels and the cooperation it has extended to the several States in giving aid, when solicited, in selecting the areas for closure to mussel fishing. Additional closures of streams or parts of streams has followed the beginning made in the past by Minnesota and Wisconsin. Minnesota in April closed for a period of five years parts of the Minnesota River, and the entire Cannon and Straight Rivers. Iowa, in the same month, closed for a similar period parts of the Iowa, Cedar, and Des Moines Rivers, and the entire Shellrock River.

MUSSEL SURVEY IN UPPER MISSISSIPPI RIVER.

During the months of July and August, 1920, the Bureau of Fisheries made a study and appraisal of the mussel resources in a portion of the upper Mississippi River, beginning at a point about 5 miles above Red Wing, Minn., and extending down through Lake Pepin, a distance of about 80 miles, to Lamoille, Minn. The work was undertaken with reference to recent administrative action on the part of the States of Wisconsin and Minnesota providing for the closure of certain areas for the protection of the fresh-water mussels while permitting the fishery to continue in alternate open areas. The data acquired in this investigation are expected to establish a basis for comparison of conditions before and after a period of protection. The investigation was conducted under the Fairport biological station by Dr. N. M. Grier, with two assistants. Observations were made in five open and five closed areas.

Many data were secured regarding the depletion of formerly productive areas of mussel fishery, the diminution in abundance of mussels in different beds being attributed variously to the indirect effects of the construction of wing dams as aids to navigation, to excessive fishery, and perhaps in some cases to the dumping of rubbish in the river in the vicinity of cities.

The information gained will serve also as an aid to the Bureau in the conduct of mussel propagation for the rehabilitation of depleted and protected areas.

EXPERIMENTS RELATING TO MUSSEL PROPAGATION.

Experiments in retaining in inclosures fish artificially infected with glochidia of the Lake Pepin mucket, *Lampsilis luteola*, have been continued in Lake Pepin by Roy S. Corwin, scientific assistant. It was found in certain experiments that pike perch infected as late as August 19 carried glochidia until the following May, and that mussels during the second year of growth will thrive in an inclosure with a density of 18 mussels to the square foot. Third-year mussels with eight to the square foot flourished and showed an average increase in length of more than 100 per cent in one year.

Artificial infections of the Lake Pepin mucket on pike perch retained in a fine-meshed inclosure in the lake yielded an average of 833 juvenile mussels per fish. Assuming that these fish bore the usual infection of about 3,000 glochidia per fish, the yield of young mussels was 27.4 per cent. This is a much higher percentage than has ever been assumed to result from practical operations in artificial propagation of mussels.

Dr. L. B. Arey continued his study of the encystment of the glochidia of the fresh-water mussel. It has been established that the tactile response of the glochidium alone is adequate to insure attachment. The view that glochidia regularly attached to the host through a chemical activation by blood, derived from gill hemorrhages, appears to be untenable. Cyst formation is not initiated or controlled by any vital influence of the glochidium. It has been induced by the application of tiny metallic clips to a gill filament.

INVESTIGATIONS IN THE KENTUCKY RIVER.

Prior to 1919 the Kentucky River was an unworked and practically unknown mussel stream. In the summer and autumn of 1919 and the summer of 1920 the upper part of the river was investigated by Ernest Danglade, temporary assistant. Preliminary tests were made in the summer of 1919 which indicated that good marketable shells were to be found in the headwaters, and encouragement was offered to various people who had expressed a desire to engage in mussel fishing. As a result, by the middle of July, 1919, two mussel camps were established in the upper courses.

The river was examined from near its source down to Beattyville, Ky., below which place the stream contains many locks and dams and is unsuitable for mussel fishing. In the upper parts of the stream, in the north and middle forks, numerous but small beds were encountered. Fourteen were investigated and are described in some detail in a report on file with the Bureau. Forty species of mussels were obtained, of which 22 have commercial value, the mucket being the most important. Upper Twin Shoals is remarkable for the abundance of young muckets.

THE BIOLOGICAL LABORATORIES.

The Woods Hole (Mass.) laboratory, Dr. P. H. Mitchell, director, was in operation with a limited staff during the summer of 1920. Previous mention has been made of the investigation relating to oysters and the preparation of commercial gelatins from seaweeds. Prof. Edwin Linton continued investigations of the food and parasites of fishes, and Prof. William W. Browne was engaged in completing his report upon the nature and causes of the reddening of salt fish. Because of the unavoidable limitation of the Bureau's activities, it was found impracticable to open the laboratory for the summer of 1921.

Beaufort (N. C.) laboratory has been virtually closed during nearly the entire fiscal year. Since the director, R. L. Barney, was necessarily transferred early in the year to another station, the laboratory has been without scientific direction. Mr. Barney has, however, completed a general report on the natural history and culture of the diamond-back terrapin, embodying the information available from observations and experiments as relating to growth and reproduction of wild and domestic stock, care of young and adults, feeding, housing, and hybridization. Further attention has been given to the study of the bacterial disease which has been the only serious disease affecting winter-fed terrapin. Under the superintendence of Charles Hatsel, terrapin experiments have been continued, the grounds of the station have been kept in good condition, and the buildings in such repair as was possible with the available funds.

At the Fairport (Iowa) biological station the new laboratory building was completed and occupied early in September, and shortly thereafter R. L. Barney was appointed director of the station. In response to an outside demand, the laboratory building was formally dedicated October 7. A large number of prominent persons, including scientists representing the leading universities of the country, participated both in the exercises of dedication and in the conference on the following day, which gave consideration to the natural resources of interior waters and the possibilities of their utilization and conservation.

The interest manifested in that conference and the demonstration it afforded of the possibility of bringing about better cooperation in the conservation of aquatic resources led to a call by the Secretary of Commerce of a conference of more extended duration to meet at the station June 8 to 10, 1921. On this occasion there were in attendance about 125 persons, including biologists, chemists, sanitarians, fishermen, manufacturers, fish-culturists, game wardens, engineers, and others. During the three days of the conference there was free and informal discussion related to the three major topics suggested in the call for the gathering, viz: The depletion of aquatic resources, causes, and remedial measures; the value of swamp and shore areas and their best utilization; and a constructive program of conservation. Interest was sustained throughout, and the conference adjourned only after recording a request that a similar meeting be called the following year.

The special activities of the Fairport station have been treated under several preceding heads; investigation of the paddlefish, fish-cultural experiment work, studies of fish disease, survey of selected areas in the Mississippi River, and fresh-water mussels. The station frequently also performs services of value to fishing clubs, private hatcheries, and individual owners of lakes and ponds, furnishing advice regarding the stocking and control of ponds and aiding in the solution of such troublesome conditions as may arise. The value of these advisory services is founded upon the scientific research conducted at the station and the experience gained in propagating and rearing fish under conditions of control.

The Key West (Fla.) biological station has been without a director from the beginning of the fiscal year until within a few days of the close of the year, when the services of a competent scientist were secured for a temporary period. During the greater part of the year the station has been in the hands of a caretaker. No further constructions have been undertaken, but the grounds have been suitably fenced for protection, and some plantings of appropriate vegetation have been made.

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES, 1921.

REPORT OF THE DIVISION OF FISH CULTURE FOR THE FISCAL YEAR 1921.[1]

By Glen C. Leach, *Assistant in Charge of Fish Culture.*

CONTENTS.

[1] Appendix IX to the Report of the United States Commissioner of Fisheries for 1921. B. F. Doc. No. 912.

INTRODUCTION.

In considering the value of any branch of governmental work it is clearly just to take cognizance of the progress made, as evidenced by an increased volume of work, but improved methods and lower costs of producing and distributing the output are, in the case of fish culture, of more importance, as indicating efficiency and sustained interest in the work.

For a number of years there has been no increase in the funds provided for the propagation and distribution of food fishes, and only the very inadequate increase in compensation of faithful employees as provided by the so-called bonus of $240 per annum. In the face of this condition and the fact that the cost of all commodities, labor, and railroad rates increased many fold during the period of the World War, it is particularly gratifying to note that the bureau maintained its fish-cultural establishment, if not intact, still at a point of efficiency where it handled an increased volume of work without material increase in the cost of production or distribution.

The value of modern fish culture is so generally accepted by those having knowledge of the facts as to need no defense and is shown by the action of many States in providing funds for such work, by the numbers of fish-cultural plants financed by commercial interests, and by individuals who are interested only in maintaining the fish supply in a given locality.

The bureau's fish-cultural division is probably more completely organized and equipped than any similar institution in the world. It has been built up through a long period of years and represents the thoughtful and painstaking effort of many persons. It has reached a point in its history where its movement must either advance or retrograde. To longer maintain the present magnitude of the work with the funds provided is manifestly impracticable. On the other hand, the opportunities for its continued enlargement and extension are restricted only by the facilities available.

During the fiscal year ended June 30, 1921, 62 per cent of the appropriation provided by Congress for the propagation and distribution of food fishes was expended in the maintenance and development of the commercial fisheries.[2] The remaining portion of the fund was devoted to the equally important, though less extensive, work of producing and disseminating in the interior waters of the country various species of trout and the so-called warm-water fishes, including the black basses, crappies, and sunfish. The widely extended and rapidly increasing use of the automobile has opened to tourists and sportsmen numerous trout and bass waters which were formerly inaccessible, with the result that interior streams and lakes in all parts of the country have been heavily overfished. Of all fishermen concerned automobilists as a class are perhaps the most law-abiding, but their rapidly increasing numbers and their habit of camping near a promising body of water and fishing it for an extended period—sometimes for several days—has constituted a drain which it will not be easy to make good. A most serious aspect of the situation is that it threatens the resources of waters which have never heretofore required any appreciable effort on the part of either Federal or State agencies to maintain. The greatest danger in this respect lies in the Western mountain States, in New England, and in other parts of the country which abound in natural scenic beauty.

The situation is a grave one, and if not given proper and immediate attention by the States concerned and by the Federal Government there is imminent danger of the total depletion of fish life in many valuable waters which have heretofore yielded an abundant supply. The advantages of keeping the interior waters of the country well stocked with the game and food fishes adapted to them are many and obvious. By such means a cheap and very desirable food supply is afforded to a certain class of people who would otherwise be unable to enjoy it. Vast numbers of people are inspired by the lure of good fishing to seek the great out-of-doors, with very beneficial results to their health, aside from the recreation afforded. Certain of the State authorities who are not able to cope with the difficulty have applied to the Bureau of Fisheries for aid, but in most instances it could not be given, the bureau's resources having been already greatly overtaxed in the effort to maintain the scope of its work along previously established lines.

The bureau's efforts in fish culture are directed chiefly toward the maintenance of the existing fisheries of the country and toward the development of new and profitable sources of fish supply by extending its operations over a wider territory in fields contiguous to the present stations. Five important functions are involved in this work, namely, the collections of eggs from various species of fish of economic value, the incubation of the eggs in properly equipped hatcheries, the rearing and feeding of the young of certain species, the rescue of stranded fishes from overflow waters in the Mississippi Valley, and the distribution of fish and fish eggs in suitable waters.

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[2] The expenditures involved in distributing the output of the hatcheries represents approximately 17 per cent of the total appropriation, and 30 per cent of this amount represents the expenditures in connection with the commercial species.

Part 1.—FISH PROPAGATION AND RESCUE.

Summary of Operations.

SPECIES OF FISHES HANDLED.

During the fiscal year ended June 30, 1921, the bureau propagated and distributed some 48 species of fishes, as shown in the following list. Fishes rescued from overflowed lands in the Mississippi Basin and restored to original waters or distributed in other sections of the United States are included.

LIST OF SPECIES HANDLED.

THE CATFISHES (SILURIDÆ):
- Horned pout, bullhead (*Ameiurus nebulosus*).
- Marbled catfish (*Ameiurus nebulosus marmoratus*).
- Mississippi catfish (*Ameiurus lacustris*).
- Spotted catfish, channel catfish (*Ictalurus punctatus*).
- Yellow catfish (*Leptops olivaris*).

THE SUCKERS (CATOSTOMIDÆ):
- Mongrel buffalofish (*Ictiobus urus*).
- Common buffalofish (*Ictiobus cyprinella*).
- Smallmouth buffalofish (*Ictiobus bubalus*).

THE CARPS (CYPRINIDÆ):
- Asiatic carp (*Cyprinus carpio*).

THE SHADS AND HERRINGS (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus aestivalis*).
- Skipjack (*Pomolubus chrysochloris*).

THE SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):
- Common whitefishes (*Coregonus albus* and *C. clupeaformis*).
- Cisco (chiefly *Leucichthys artedi*).
- Chinook salmon, king salmon, quinnat salmon (*Oncorhynchus tschawytscha*).
- Chum salmon, dog salmon (*Oncorhynchus keta*).
- Humpback salmon, pink salmon (*Oncorhynchus gorbuscha*).
- Silver salmon, coho salmon (*Oncorhynchus kisutch*).
- Sockeye salmon, blueback salmon, redfish (*Oncorhynchus nerka*).
- Steelhead salmon (*Salmo gairdneri*).
- Atlantic salmon (*Salmo salar*).
- Landlocked salmon (*Salmo sebago*).
- Rainbow trout (*Salmo shasta*).
- Blackspotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Cristivomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).

THE GRAYLINGS (THYMALLIDÆ):
- Montana grayling (*Thymallus montanus*).

THE SMELTS (OSMERIDÆ):
- Smelt (*Osmerus mordax*).

THE PIKES (LUCIIDÆ):
- Little pickerel (*Lucius vermiculatus*).
- Common pickerel (*Lucius lucius*).

THE SUNFISHES, BLACK BASSES, AND CRAPPIES (CENTRARCHIDÆ):
- Crappies (*Pomoxis annularis* and *P. sparoides*).
- Largemouth black bass (*Micropterus salmoides*).
- Smallmouth black bass (*Micropterus dolomieu*).
- Rock bass (*Ambloplites rupestris*).
- Warmouth bass, goggle-eye (*Chænobryttus gulosus*).
- Bluegill sunfish (*Lepomis pallidus*).
- Common sunfish (*Eupomotis gibbosus*).

THE PERCHES (PERCIDÆ):
- Pike perch (*Stizostedion vitreum*).
- Yellow perch (*Perca flavescens*).

THE BASSES (SERRANIDÆ):
- Striped bass, rockfish (*Roccus lineatus*).
- White bass (*Roccus chrysops*).
- White perch (*Morone americana*).

THE DRUMS (SCIAENIDÆ):
- Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

THE CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglefinus*).
- Pollock (*Pollachius virens*).

THE FLOUNDERS (PLEURONECTIDÆ):
- Winter flounder, American flatfish (*Pseudopleuronectes americanus*).
- Pole flounder (*Glyptocephalus cynoglossus*).

SUMMARY OF OUTPUT.

During the fiscal year 1921 the bureau's efforts in fish propagation and rescue of stranded fishes resulted in a gross output of 4,962,-583,555 fish and fish eggs for distribution, 93 per cent of which was made up of the important commercial species and 7 per cent of the species used in stocking interior waters. Losses due to transportation amounted to 94,150, making a net product of fish and fish eggs actually distributed of 4,962,489,405. A summary of this net output, shown by species, is given in the following table:

SUMMARY, BY SPECIES, OF NET OUTPUT OF FISH AND FISH EGGS, FISCAL YEAR 1921.

Species.	Eggs.	Fry.	Fingerlings.	Total.
Catfish			35,257,070	35,257,070
Buffalofish		108,307,000	1,645,835	109,952,835
Carp		106,043,000	3,918,580	109,961,580
Shad		32,792,275		32,792,275
Glut herring		43,815,000		43,815,000
Whitefish	181,650,000	238,800,000		420,450,000
Cisco	186,510,000	89,800,000		276,310,000
Chinook salmon	6,780,000		32,780,765	39,560,765
Chum salmon		7,000,000	19,436,400	26,436,400
Silver salmon		600,000	6,486,150	7,086,150
Sockeye salmon	350,000	38,778,500	30,434,500	69,563,000
Steelhead salmon	493,000	38,810	2,928,915	3,460,725
Atlantic salmon		1,387,000	280	1,387,280
Landlocked salmon	575,000	208,115	124,250	907,365
Rainbow trout	2,553,240	414,100	3,872,225	6,839,565
Blackspotted trout	820,000	3,899,100	1,000,300	5,719,400
Loch Leven trout			64,000	64,000
Lake trout	2,824,000	16,563,300	208,500	19,595,800
Brook trout	856,890	3,642,330	7,559,625	12,058,845
Grayling		1,400,000		1,400,000
Smelt	600,000	7,000,000		7,600,000
Pike and pickerel			540,510	540,510
Crappie			37,303,900	37,303,900
Largemouth black bass		585,050	1,221,905	1,806,955
Smallmouth black bass		303,700	54,590	358,290
Rock bass			108,305	108,305
Warmouth bass			100	100
Sunfish			30,371,475	30,371,475
Pike perch	296,475,000	57,385,000	108,515	353,968,515
Yellow perch	12,000,000	176,369,450	6,166,435	194,535,885
Striped bass		20,184,000		20,184,000
White bass			27,170	27,170
Freshwater drum			34,080	34,080
Cod	208,800,000	175,341,000		384,141,000
Haddock	188,940,000	271,880,000		460,820,000
Pollock		455,066,000		455,066,000
Winter flounder		1,768,660,000		1,768,660,000
Pole flounder	19,410,000			19,410,000
Miscellaneous fishes			4,935,165	4,935,165
Total	1,109,637,130	3,626,262,730	226,589,545	4,962,489,405

SUMMARY OF EGG COLLECTIONS.

Eggs are obtained by several methods, but the principal source of supply is the commercial fisheries, where, were it not for the bureau's activities, vast numbers of eggs would be sent to market in the fish and become a total loss. In the case of certain species, notably but not exclusively the salmons of the Pacific coast, where commercial fishing does not extend to or is not permitted on the spawning areas, employees of the bureau capture the spawning fish either in seines or in traps and artificially incubate in its hatcheries the eggs thus obtained. The object of this work is to bring about a higher percentage of fertility in the eggs than is possible in natural reproduction and to afford the eggs and the resulting young fish protection from their natural enemies. Eggs in appreciable numbers are also obtained from domesticated fish, which are maintained in ponds at fish-cultural stations from year to year under more or less artificial conditions.

A decrease of approximately 121,000,000 in the aggregate egg collections occurred this season as compared with last year, as is indicated by the accompanying table, and the same causes that were operative to the detriment of the work then were again in evidence. However, in any line of enterprise where results are dependent to a large extent upon weather conditions, as is the case in all of our egg-collecting fields, a comparison of one season's work with that of another will indicate a considerable fluctuation in total results, and it is only by comparing the results over a period of years that the actual trend of the work may be traced with any degree of accuracy.

The most noticeable variations in the egg collections of 1921 as compared with 1920 are increased collections of eggs of chum salmon, cisco, rainbow trout, blackspotted trout, whitefish, pike perch, yellow perch, striped bass, carp, haddock, and glut herring, and decreased collections of eggs of the chinook, silver, sockeye, humpback, and steelhead salmon, landlocked salmon, lake and brook trout, shad, buffalofish, cod, pollock, and other species of less importance. It is to be noted that while a decrease occurred in the number of eggs collected during 1921, as compared with the previous year, there was an increase of approximately 179,000,000 in the aggregate output of the stations in eggs, fry, and fingerlings. This apparent discrepancy in figures is accounted for by the better quality of the eggs handled during the year and the higher percentage of fry produced; also to an increase in the numbers of eggs fertilized and planted on the spawning grounds.

COMPARISON OF EGG COLLECTIONS, 1920 AND 1921.

Species.	Fiscal year 1920	Fiscal year 1921.	Species.	Fiscal year 1920.	Fiscal year 1921.
Buffalo fish	236,400,000	163,267,000	Blackspotted trout	2,617,600	5,993,600
Carp	47,250,000	117,218,000	Loch Leven trout	85,000	94,220
Shad	65,667,000	37,549,000	Lake trout	53,753,000	44,247,500
Glut herring	....	55,130,000	Brook trout	19,947,900	16,110,810
Alewife	130,000	....	Grayling	700,000	....
Whitefish	422,769,000	540,776,000	Smelt	....	8,000,000
Cisco	181,150,000	317,200,000	Pike perch	416,100,000	508,942,000
Chinook salmon	51,793,000	43,829,820	Yellow perch	175,398,000	218,333,750
Chum salmon	15,417,000	28,182,000	Striped bass	19,358,000	24,600,000
Humpback salmon	579,300	....	Cod	912,417,000	482,012,000
Silver salmon	10,079 000	8,273,000	Haddock	406,235,000	635,950,000
Sockeye salmon	108,115,000	76,012,500	Pollock	954,800,000	650,850,000
Steelhead salmon	4,006,609	1,603,000	Winter flounder	1,805,167,000	1,980,291,000
Atlantic salmon	797,600	911,720	Pole flounder	....	19,410,000
Landlocked salmon	2,026,800	1,063,200			
Rainbow trout	9,631,200	10,994,750	Total	6,121,390,009	5,996.844,870

SUMMARY OF FISH-RESCUE WORK.

That part of the net output for the fiscal year 1921 derived from the rescue of stranded fishes is shown in the following table, which gives for each point from which the rescue work was conducted the total number of each species salvaged, the portion of that total restored to the original waters and the portion deliverd to applicants; and for each species the total number rescued, the portion of that total restored to the original waters, and the portion delivered to applicants.

For a discussion of the rescue operations and suggestions for the enlargement of their scope, see page 78.

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, FISCAL YEAR 1921.

Station.	Species.	Delivered to applicants.	Restored to original waters.	Total.
Bellevue, Iowa	Buffalofish	150	313,865	314,015
	Carp	434	138,325	138,759
	Catfish	64,390	2,147,350	2,211,740
	Crappie	7,565	4,780,935	4,788,500
	Drum		2,295	2,295
	Largemouth black bass	30,510	27,400	57,910
	Pike and pickerel	410	19,185	19,595
	Pike perch		250	250
	Sunfish	35,120	3,595,630	3,630,750
	White bass	175	9,410	9,585
	Yellow perch	5,900	5,100	11,000
	Miscellaneous		2,698,600	2,698,600
Total		144,654	13,738,345	13,882,999
Cairo, Ill	Buffalofish		107,350	107,350
	Carp		44,715	44,715
	Catfish		670,800	670,800
	Crappie		170,800	170,800
	Largemouth black bass		2,600	2,600
	Pike and pickerel		4,900	4,900
	Sunfish		55,250	55,250
	White bass		800	800
Total			1,057,215	1,057,215
Fairport (Iowa) and auxiliaries.	Buffalofish		104,473	104,473
	Carp		53,757	53,757
	Catfish		1,013,826	1,013,826
	Crappie	4,000	166,827	170,827
	Drum		420	420
	Largemouth black bass	1,450	4,838	6,288
	Pike and pickerel	150	321	471
	Sunfish	8,300	71,711	80,011
	White bass		3,176	3,176
	Miscellaneous		5,872	5,872
Total		13,900	1,425,221	1,439,121
Homer, Minn	Buffalofish		30,165	30,165
	Carp	57	1,190,303	1,190,360
	Catfish	42,178	10,727,650	10,769,828
	Crappie	39,835	15,919,625	15,959,460
	Drum		19,405	19,405
	Largemouth black bass	30,770	139,045	169,815
	Pike and pickerel		175,040	175,040
	Pike perch		108,265	108,265
	Sunfish	39,135	11,716,580	11,755,715
	White bass		6,990	6,990
	Yellow perch	12,635	4,980,187	4,992,822
	Miscellaneous		527,080	527,080
Total		164,610	45,540,335	45,704,945

NUMBER AND DISPOSITION OF FISH RESCUED FROM OVERFLOWED LANDS, ETC.—Con.

Station.	Species.	Delivered to applicants.	Restored to original waters.	Total.
La Crosse, Wis	Buffalofish	1,020	799,510	800,530
	Carp	25	2,059,164	2,059,189
	Catfish	33,300	18,560,800	18,594,100
	Crappie	16,625	14,455,540	14,472,165
	Drum		11,960	11,960
	Largemouth black bass	132,180	103,985	236,165
	Pike and pickerel		322,130	322,130
	Sunfish	15,050	12,678,660	12,693,710
	White bass		6,620	6,620
	Yellow perch	1,805	1,011,000	1,012,805
	Miscellaneous		904,110	904,110
Total		200,005	50,913,479	51,113,484
Marquette, Iowa	Buffalofish		243,000	243,000
	Carp	85	340,515	340,600
	Catfish	19,650	1,098,350	1,118,000
	Crappie	5,650	1,620,250	1,625,900
	Largemouth black bass	33,940	5,990	39,930
	Pike and pickerel		18,375	18,375
	Rock bass	75		75
	Sunfish	11,800	1,627,100	1,638,900
	Yellow perch	5,800	211,625	217,425
	Miscellaneous		788,500	788,500
Total		77,000	5,953,705	6,030,705
Quincy, Ill	Buffalofish		46,300	46,300
	Carp		91,200	91,200
	Catfish	14,975	785,200	800,175
	Crappie	400	92,900	93,300
	Largemouth black bass	35,790	1,800	37,590
	Sunfish	5,740	139,560	145,300
	Yellow perch	150	50	200
	Miscellaneous		11,000	11,000
Total		57,055	1,168,010	1,225,065
San Marcos, Tex	Catfish		70,000	70,000
	Largemouth black bass	2,886	60,000	62,886
	Sunfish		70,000	70,000
Total		2,886	200,000	202,886
Total of all stations	Buffalofish	1,170	1,644,663	1,645,833
	Carp	601	3,917,979	3,918,580
	Catfish	174,493	35,073,976	35,248,469
	Crappie	74,075	37,206,877	37,280,952
	Drum		34,080	34,080
	Largemouth black bass	267,526	345,658	613,184
	Pike and pickerel	560	539,951	540,511
	Pike perch		108,515	108,515
	Rock bass	75		75
	Sunfish	115,145	29,954,491	30,069,636
	White bass	175	26,996	27,171
	Yellow perch	26,290	6,207,962	6,234,252
	Miscellaneous		4,935,162	4,935,162
Grand total		660,110	119,996,310	120,656,420

STATIONS AND SUBSTATIONS OPERATED AND OUTPUT OF EACH.

During the fiscal year 1921 fish-cultural work was conducted from 37 main stations, 32 substations, and approximately 60 egg-collecting or auxiliary stations. The following table gives the main fish-cultural stations, in alphabetical order, and the substations operative during the year, the period of operation of each, and the number of fish and eggs, by species, furnished for distribution by each station through propagation, through collections from auxiliary stations, and through rescue of fish from overflowed lands of the Mississippi Basin. It will be noted that transfers of fish and eggs from station to station are frequent. (For table of egg transfers, see p. 15.) Such transfers are made in the interest of economy and convenience where the shipments consist of eggs and give advantageous distribution centers in the case of young fish.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Afognak, Alaska: * Entire year	Sockeye salmon	(*)	30,211,000	17,597,000	47,808,000
Baird, Calif.: Entire year	Chinook salmon			1,465,000	1,465,000
Battle Creek, Calif.*— Entire year	do	(*)		1,781,000	1,781,000
Mill Creek, Calif.— Entire year	do	3,000,000		1,347,400	4,347,400
Baker Lake, Wash.: Entire year	Sockeye salmon		7,050,000		7,050,000
Birdsview, Wash.*— Entire year	Blackspotted trout		23,700		23,700
	Chinook salmon			973,865	973,865
	Chum salmon			1,536,000	1,536,000
	Silver salmon		600,000	2,176,000	2,776,000
	Sockeye salmon	(*)		9,000	9,000
	Steelhead salmon	* 85,000		128,250	213,250
Brinnon, Wash.— November–June	Chum salmon		1,500,000	575,000	2,075,000
	Steelhead salmon	100,000			100,000
Duckabush, Wash.— Entire year	Chum salmon		5,500,000	5,682,000	11,182,000
	Silver salmon			50,000	50,000
	Steelhead salmon			1,095,000	1,095,000
Quilcene, Wash.— Entire year	Chum salmon			6,575,500	6,575,500
	Silver salmon			470,800	470,800
	Steelhead salmon	85,000		303,500	388,500
Quinault, Wash.— Entire year	Chinook salmon			24,800	24,800
	Silver salmon			1,398,000	1,398,000
	Sockeye salmon		950,000	3,448,000	4,398,000
Sultan, Wash.— Entire year	Chinook salmon			303,300	303,300
	Silver salmon			1,974,300	1,974,300
	Steelhead salmon			76,800	76,800
Berkshire, Mass.: Entire year	Brook trout			296,825	296,825
	Rainbow trout			41,900	41,900
Boothbay Harbor, Me.: Entire year	Flounder		811,235,000		841,235,000
	Pollock		11,906,000		11,906,000
Bozeman, Mont.: * Entire year	Blackspotted trout		912,500	152,500	1,065,000
	Brook trout			546,950	546,950
	Rainbow trout	* 325,000	[1] 250,000	798,000	1,373,000
Glacier Park, Mont.— March–June	Blackspotted trout			420,000	420,000
	Brook trout			30,000	30,000
	Grayling		1,400,000		1,400,000
	Rainbow trout			185,000	185,000
Yellowstone, Wyo.*— July–September	Blackspotted trout	* 820,000	2,012,400		2,832,400
Cape Vincent, N. Y.: * Entire year	Brook trout		397,000		397,000
	Cisco	* 186,510,000	89,400,000		275,910,000
	Lake trout	39,000	450,000		489,000
	Pike perch		7,970,000		7,970,000
	Rainbow trout		66,100		66,100
	Whitefish	* 89,650,000	40,300,000		129,950,000
	Yellow perch		11,000,000	2,150	11,002,150
Central Station, Washington, D. C.: Entire year	Brook trout			36,200	36,200
	Chinook salmon			12,500	12,500
	Cisco		400,000		400,000
	Pike perch		1,500,000		1,500,000
	Rainbow trout			20,400	20,400
	Shad		800,000		800,000
	Whitefish		800,000		800,000
	Yellow perch		500,000		500,000
Bryans Point, Md.— February–May	Shad		13,639,175		13,639,175
	Yellow perch		158,819,450		158,819,450

[1] Fry produced at Meadow Creek auxiliary station.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Clackamas, Oreg.:					
Entire year	Blackspotted trout			95,000	95,000
	Brook trout			4,000	4,000
	Chinook salmon	130,000		4,362,000	4,492,000
Applegate, Oreg.—					
Entire year	do			77,400	77,400
	Silver salmon			35,150	35,150
	Steelhead salmon			450,000	450,000
Big White Salmon, Wash.—					
Entire year	Chinook salmon			4,000,000	4,000,000
Little White Salmon, Wash.—					
Entire year	do	950,000		12,190,000	13,140,000
	Chum salmon			5,067,900	5,067,900
Rogue River, Oreg.—					
Entire year	Blackspotted trout			47,500	47,500
	Chinook salmon			4,308,000	4,308,000
	Rainbow trout			189,500	189,500
	Silver salmon			381,900	381,900
	Steelhead salmon			866,000	866,000
Salmon, Idaho—					
July–September	Chinook salmon	2,700,000			2,700,000
Upper Clackamas, Oreg.—					
Entire year	do			1,935,500	1,935,500
Washougal, Wash.—					
April–June	Steelhead salmon	223,000	15,000		238,000
Willamette, Oreg.—					
July–June	Shad		2,347,100		2,347,100
Cold Springs, Ga.:					
Entire year	Catfish			4,120	4,120
	Crappie			1,550	1,550
	Largemouth black bass		144,750	67,805	212,555
	Sunfish			61,350	61,350
	Warmouth bass			100	100
Craig Brook, Me.:					
Entire year	Atlantic salmon		1,387,000	280	1,387,280
	Brook trout		1,085,000	23,625	1,108,625
	Landlocked salmon		8,395	35,150	43,545
	Sockeye solmon		17,500		17,500
Duluth, Minn.: *					
Entire year	Brook trout			110,000	110,000
	Lake trout	*100,000	6,057,000	147,500	6,304,500
	Pike perch		8,500,000		8,500,000
	Rainbow trout			20,500	20,500
	Whitefish		9,600,000		9,600,000
Edenton, N. C.:					
Entire year	Glut herring		43,815,000		43,815,000
	Largemouth black bass.			23,085	23,085
	Shad		16,006,000		16,006,000
	Sunfish			9,905	9,905
Weldon, N. C.—					
April–May	Striped bass		20,184,000		20,184,000
Erwin, Tenn.:					
Entire year	Brook trout			300,435	300,435
	Crappie			400	400
	Largemouth black bass.		33,000	32,980	65,980
	Rainbow trout	55,000		700,100	755,100
	Rock bass			17,200	17,200
	Smallmouth black bass.			5,165	5,165
	Sunfish			20,350	20,350
Fairport, Iowa, and substations:					
Entire year	Buffalofish			104,473	104,473
	Carp			53,757	53,757
	Catfish			1,013,826	1,013,826
	Crappie			170,827	170,827
	Drum			420	420
	Largemouth black bass.			6,288	6,288
	Pike and pickerel			471	471
	Sunfish			80,011	80,011
	White bass			3,176	3,176
	Miscellaneous			5,872	5,872

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Gloucester, Mass.: * Entire year	Cod	[1] 208,800,000	50,900,000		259,700,000
	Flounder (pole)	19,410,000			19,410,000
	Flounder (winter)		132,070,000		132,070,000
	Haddock	188,940,000	271,880,000		460,820,000
	Pollock	(*)	443,160,000		443,160,000
Green Lake, Me.: Entire year	Brook trout		608,050		608,050
	Landlocked salmon	495,000	144,720		639,720
	Rainbow trout		26,000		26,000
	Smelt	600,000	7,000,000		7,600,000
Grand Lake Stream, Me.*— Entire year	Brook trout		47,880		47,880
	Landlocked salmon	* 80,000	55,000	79,100	214,100
Homer, Minn.: Entire year	Buffalofish			30,165	30,165
	Carp			1,190,360	1,190,360
	Catfish			10,769,828	10,769,828
	Crappie			15,959,460	15,959,460
	Drum			19,405	19,405
	Largemouth black bass			169,815	169,815
	Pike and pickerel			175,040	175,010
	Pike perch			108,265	108,265
	Rock bass			3,300	3,300
	Sunfish			11,755,715	11,755,715
	White bass			6,990	6,990
	Yellow perch			4,992,822	4,992,822
	Miscellaneous			527,080	527,080
Atchafalaya, La.— February-April	Buffalofish		40,040,000		40,040,000
Bellevue, Iowa— July-November	Buffalofish		68,267,000	314,015	68,581,015
	Carp		42,718,000	138,759	42,856,759
	Catfish			2,211,740	2,211,740
	Crappie			4,788,500	4,788,500
	Drum			2,295	2,295
	Largemouth black bass			57,910	57,910
	Pike and pickerel			19,595	19,595
	Pike perch			250	250
	Sunfish			3,630,750	3,630,750
	White bass			9,585	9,585
	Yellow perch			11,000	11,000
	Miscellaneous			2,698,605	2,698,605
La Crosse, Wis.— Entire year	Brook trout		107,000	316,050	423,050
	Buffalofish			800,530	800,530
	Carp			2,059,189	2,059,189
	Catfish			18,594,100	18,594,100
	Crappie			14,472,165	14,472,165
	Drum			11,960	11,960
	Largemouth black bass			236,165	236,165
	Pike and pickerel			322,130	322,130
	Rainbow trout		30,000	23,690	53,690
	Sunfish			12,693,710	12,693,710
	White bass			6,620	6,620
	Yellow perch			1,012,805	1,012,805
	Miscellaneous			904,110	904,110
Marquette, Iowa—July-November	Buffalofish			243,000	243,000
	Carp			340,600	340,600
	Catfish			1,118,000	1,118,000
	Crappie			1,625,900	1,625,900
	Largemouth black bass			39,930	39,930
	Pike and pickerel			18,375	18,375
	Rock bass			75	75
	Sunfish			1,638,900	1,638,900
	Yellow perch			217,425	217,425
	Miscellaneous			788,500	788,500
Meredosia, Ill.— July-November	Buffalofish			46,300	46,300
	Carp			91,200	91,200
	Catfish			800,175	800,175
	Crappie			93,300	93,300
	Largemouth black bass			37,590	37,590
	Sunfish			145,300	145,300
	Yellow perch			200	200
	Miscellaneous			11,000	11,000

[1] Represents eggs fertilized and planted on spawning grounds.

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p. 15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Leadville, Colo.:*					
Entire year	Blackspotted trout		950,500		950,500
	Brook trout	*500,000		2,706,000	3,206,000
	Lake trout			24,000	24,000
	Loch Leven trout			34,000	34,000
	Rainbow trout			99,500	99,500
Louisville, Ky.:					
Entire year	Largemouth black bass		32,000	1,100	33,100
	Rock bass			4,500	4,500
	Smallmouth black bass		146,000	10,700	156,700
	Sunfish			76,150	76,150
	Yellow perch		750,000		750,000
Cairo, Ill.—					
July–October	Buffalofish			107,350	107,350
	Carp			44,715	44,715
	Catfish			670,800	670,800
	Crappie			170,800	170,800
	Largemouth black bass			2,600	2,600
	Pike and pickerel			4,900	4,900
	Sunfish			55,250	55,250
	White bass			800	800
Mammoth Spring, Ark.:					
Entire year	Largemouth black bass			1,400	1,400
	Rock bass			4,725	4,725
	Smallmouth black bass		24,000	2,200	26,200
Manchester, Iowa:*					
Entire year	Brook trout			466,225	466,225
	Rainbow trout	*65,500		155,950	221,450
	Rock bass			53,910	53,910
	Smallmouth black bass			2,500	2,500
Nashua, N. H.:					
Entire year	Brook trout			735,600	735,600
	Pike perch		1,175,000		1,175,000
	Rainbow trout			42,000	42,000
	Smallmouth black bass		31,700		31,700
Neosho, Mo.:*					
Entire year	Catfish			3,000	3,000
	Crappie			13,222	13,222
	Largemouth black bass			20,175	20,175
	Rainbow trout	*100,000		167,965	267,965
	Rock bass			10,040	10,040
	Smallmouth black bass		1,500	2,701	4,201
	Sunfish			31,680	31,680
	Yellow perch			58	58
Northville, Mich.:					
Entire year	Brook trout		321,000	148,225	469,225
	Rainbow trout		42,000	51,575	93,575
	Smallmouth black bass			31,200	31,200
Bay City, Mich.—					
April–May	Pike perch	277,250,000	7,040,000		284,290,000
Charlevoix, Mich.*—					
Entire year	Lake trout	*2,685,000	10,000,000		12,685,000
	Steelhead salmon		23,810		23,810
	Whitefish	15,000,000	20,000,000		35,000,000
Orangeburg, S. C.:					
Entire year	Crappie			300	300
	Largemouth black bass			204,675	204,675
	Rock bass			500	500
	Sunfish			14,200	14,200
Put in Bay, Ohio:*					
Entire year	Carp		63,325,000		63,325,000
	Pike perch		12,600,000		12,600,000
	Whitefish	*77,000,000	167,500,000		244,500,000
St. Johnsbury, Vt.:					
Entire year	Brook trout	256,890	931,900	85,800	1,274,590
	Lake trout		37,000		37,000
	Landlocked salmon			10,000	10,000
	Steelhead salmon			5,875	5,875
Holden, Vt.—					
Entire year	Brook trout		144,500	29,200	173,700
	Lake trout		19,300	12,350	31,650
	Rainbow trout			400	400
	Steelhead salmon			3,490	3,490
Swanton, Vt.*—					
March–May	Pike perch	*19,225,000	18,100,000		37,325,000
	Yellow perch	12,000,000	5,300,000		17,300,000

STATIONS AND SUBSTATIONS OPERATED, AND OUTPUT OF EACH, FISCAL YEAR 1921—Continued.

[Asterisk (*) denotes transfer of eggs. See table, p.15.]

Station and period of operation.	Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
San Marcos, Tex.: Entire year	Black bass			257,715	257,715
	Catfish			70,000	70,000
	Crappie			5,904	5,904
	Rock bass			320	320
	Sunfish			74,872	74,872
Saratoga, Wyo.:* Entire year	Blackspotted trout			194,000	194,000
	Brook trout	100,000		129,000	229,000
	Rainbow trout	* 1,297,740		145,000	1,442,740
Spearfish, S. Dak.: Entire year	Brook trout			530,000	530,000
	Lake trout			29,900	29,900
	Loch Leven trout			34,000	34,000
	Rainbow trout			126,945	126,945
Springville, Utah:* Entire year	Blackspotted trout			91,300	91,300
	Brook trout	(*)		200,300	200,300
	Catfish			2,000	2,000
	Rainbow trout	* 350,000		172,000	522,000
Paris, Idaho—March–April	Whitefish		600,000		600,000
Tupelo, Miss.: Entire year	Crappie			1,280	1,280
	Largemouth black bass.		351,000	54,500	405,500
	Sunfish			73,005	73,005
White Sulphur Springs, W. Va.:* Entire year	Brook trout			857,400	857,400
	Crappie			550	550
	Largemouth black bass.		25,800	600	26,400
	Rainbow trout	* 250,000		663,151	913,151
	Rock bass			175	175
	Smallmouth black bass.		100,500	125	100,625
Woods Hole, Mass.:* Entire year	Cod	(*)	124,441,000		124,441,000
	Flounder		795,355,000		795,355,000
Wytheville, Va.:* Entire year	Brook trout			40,900	40,900
	Crappie			160	160
	Largemouth black bass.			9,423	9,423
	Pike perch		500,000		500,000
	Rainbow trout	* 110,000		315,550	425,550
	Rock bass			14,060	14,060
	Smallmouth black bass.			100	100
	Sunfish			10,325	10,325
Yes Bay, Alaska: Entire year	Sockeye salmon	350,000	550,000	9,380,500	10,280,500
Gross output		1,109,637,130	3,626,264,230	226,682,195	4,962,583,555
Loss in transit			1,500	92,650	94,150
Net output		1,109,637,130	3,626,262,730	226,589,545	4,962,489,405

EGG-COLLECTING OR AUXILIARY STATIONS.

The eggs hatched at the main stations and substations listed in the foregoing table are in many cases obtained from auxiliary sources, usually temporary stations occupied during the season only or, in some instances, mere camps, which are shifted from year to year. In the Great Lakes and off the New England coast collections are made by the bureau's vessels or boats in favorable localities. The following stations and egg-collecting points, operative for the periods indicated, furnished eggs of the given species for the main hatcheries during 1921.

EGG-COLLECTING STATIONS AND SPECIES HANDLED, FISCAL YEAR 1921.

Stations.	Period of operation.	Species handled.
Bozeman, Mont.:		
Meadow Creek, Mont	April to June	Rainbow trout.
Yellowstone Park, Wyo	July to September	Blackspotted trout.
Clear Creek	do	Do.
Columbine Creek	do	Do.
Cub Creek	do	Do.
Thumb Creek	do	Do.
Cape Vincent, N. Y.:		
Bygotts Point, N. Y	November	Cisco, whitefish.
Chaumont Bay, N. Y	November and December	Do.
Deseronte, Canada	do	Do.
Fair Haven Bay, N. Y	do	Do.
Grass Bay, N. Y	May	Yellow perch.
Pigeon Island, Canada	October and November	Lake trout.
Sodus Bay, N. Y	November and December	Cisco.
South Bay, Canada	do	Whitefish.
Stony Island, N. Y	October and November	Lake trout.
Duluth, Minn.:		
Boy River, Minn	April	Pike perch.
Briesburg, Minn	do	Do.
Grand Marais, Mich	October and November	Lake trout.
Keystone, Mich	do	Do.
Lac La Belle, Mich	do	Do.
Manitou Island, Mich	do	Do.
Marquette, Mich	do	Do.
Munising, Mich	do	Do.
Ontonagon, Mich	do	Do.
Portage, Mich	do	Do.
Washington Harbor, Mich	do	Do.
Green Lake, Me.: Fish River Lake, Me	November	Landlocked salmon.
Leadville, Colo.:		
Carroll Lake, Colo	October and November	Brook trout.
Crystal Lake, Colo	do	Do.
Engelbrecht Lake, Colo	do	Do.
Evergreen Lake, Colo	do	Do.
Hen and Ford Lakes, Colo	do	Do.
Musgrove Lake, Colo	do	Do.
Northfield, Colo	do	Do.
Turquoise Lake, Colo	do	Brook and Loch Leven trouts.
Northville, Mich:		
Alpena, Mich	November	Lake trout, white fish.
Cheboygan, Mich	do	Do.
Detour, Mich	do	Do.
Frankfort, Mich	do	Do.
Leland, Mich	do	Do.
Manistique, Mich	do	Do.
Northport, Mich	do	Do.
St. Ignace, Mich	do	Do.
St. James, Mich	do	Do.
St. Joseph, Mich	do	Do.
Scotts Point, Mich	do	Whitefish.
Put in Bay, Ohio:		
Catawba Island, Ohio	November and December	Do.
Isle St. George, Ohio	do	Do.
Port Clinton, Ohio	November and December, April to June.	Whitefish, carp, pike perch.
Toledo, Ohio	November and December, April.	Whitefish, pike, perch.
St. Johnsbury, Vt.:		
Darling Pond, Vt	September to December	Brook trout.
Lake Mitchell, Vt	September to November	Do.
Margalloway River, Me	do	Do.
Saratoga, Wyo.:		
Canon Creek, Wyo	April to June	Rainbow trout.
Lost Creek, Wyo	do	Do.
Sage Creek, Wyo	do	Do.
Spearfish, S. Dak.:		
Crow Creek, S. Dak	October to December	Brook and Loch Leven trouts.
Schmid Ponds, S. Dak	do	Do.
Springville, Utah: Fish Lake, Utah	October and November, April and May.	Brook and rainbow trouts.
Woods Hole, Mass.:		
Quissett, Mass	February and March	Winter flounder.
Waquoit, Mass	do	Do.
Wickford, R. I	March	Do.

TRANSFERS OF EGGS.

For the convenient reference of persons interested in the results of the frequent interchange of fish eggs between the various stations of the bureau this table is prepared, indicating all such transfers of eggs during the fiscal year 1921. It is the intention to include a similar table in all future reports.

TRANSFERS OF EGGS, FISCAL YEAR 1921.

Species.	Number of eggs.	From—	To—	Final disposition of fry or fingerlings.
Blackspotted trout.[2]	50,000	Yellowstone Park.	Birdsview, Wash...	Washington waters.
	25,000	.....do............	Clackamas, Oreg....	Oregon waters.
	1,000,000	.....do............	Leadville, Colo......	Colorado waters.
	200,000	.....do............	Saratoga, Wyo......	Wyoming waters.
Brook trout[2]...	800,000	Leadville, Colo....	Bozeman, Mont.....	Two Medicine Lake and Grinnel Creek, Glacier Park, and other Montana waters.
	350,000	Springville, Utah.	.....do...............	Do.
	200,000	.....do............	Clackamas, Oreg....	Oregon waters.
	452,800	.....do............	Saratoga, Wyo......	Wyoming waters.
	200,000	.....do............	Spearfish, S. Dak...	South Dakota waters.
Chinook salmon	[1] 20,000	Battle Creek, Calif.	Central station, Washington, D. C.	Pennsylvania waters.
Cisco..........	1,000,000	Cape Vincent, N.Y.	.....do...............	Cayuga Lake, N. Y.
Cod............	8,700,000	Woods Hole, Mass.	Gloucester, Mass....	Atlantic Ocean.
Lake trout.....	25,000	Charlevoix, Mich..	Leadville, Colo......	Twin Lakes, Colo.
	25,000	.....do............	St. Johnsbury, Vt...	Averill Lakes and Lowell Lake, Vt.; Silver Lake, Taylors Pond, and Winnesquam Lake, N. H.
	25,000	Duluth, Minn.....	Spearfish, S. Dak...	Reclamation Reservoir, S. Dak.; Big Wind River, Wyo.
Landlocked salmon.[2]	10,000	Grand Lake Stream, Me.	Craig Brook, Me....	Pleasant Lake and Toddy Pond, Me.
	25,000	.....do............	St. Johnsbury, Vt...	Lake St. Catherine, Vt.; Lake George, N. Y.
Pike perch.....	8,000,000	Swanton, Vt......	Cape Vincent, N. Y.	Lake Ontario, N. Y.
	2,025,000	.....do............	Central station, Washington, D. C.	Perkiomen Creek, Lake Sheridan, Paupack River, and other Pennsylvania waters.
	2,000,000	.....do............	Nashua, N. H.......	Merrimack River and tributaries, N. H.
	500,000	.....do............	Wytheville, Va.....	New River, Va.
Pollock........	24,350,000	Gloucester, Mass..	Boothbay Harbor, Me.	Boothbay Harbor, Me.
Rainbow trout.	[2] 50,000	Bozeman: Meadow Creek, Mont.	Duluth, Minn.......	Clearwater River, tributary of, Minn.
	[2] 25,000	.....do............	Manchester, Iowa...	Reserved for brood stock.
	[2] 50,000	.....do............	Spearfish, S. Dak...	Spearfish Creek and tributaries, S. Dak.
	[3] 60,000	Manchester, Iowa.	La Crosse, Wis......	Spring Valley Creek and tributaries, and other Wisconsin waters.
	[3] 98,991	Neosho, Mo.......	Erwin, Tenn........	Pigeon River and North Indian Creek, Tenn.
	[2] 105,000	Saratoga: Sage Creek, Wyo.	Leadville, Colo......	Platte River, Rifle Creek, and other Colorado waters.
	[2] 100,000	Springville: Fish Lake, Utah.	Clackamas, Oreg....	Alder Creek and Clackamas and Molalla Rivers, Oreg.
	[2] 50,000	.....do............	Duluth, Minn.......	French and Sucker Rivers, Minn.
	[2] 25,000	.....do............	Leadville, Colo......	Platte River, Rifle Creek, and other Colorado waters.
	[2] 100,000	.....do............	Spearfish, S. Dak...	Bear Butte, Horse, and Castle Creeks, S. Dak.
	[3] 50,000	White Sulphur Springs, W. Va.	Berkshire: Hartsville, Mass.	Housatonic and Westfield Rivers, Mass.
	[3] 25,000	.....do............	Central station, Washington, D. C.	Potomac and Beaverdam Rivers, Md.
	[3] 57,000	.....do............	Northville, Mich....	Au Sable and Pere Marquette Rivers, Mich.
	[3] 50,000	.....do............	St. Johnsbury, Vt...	Crescent Pond, N. Y.
	[3] 150,000	Wytheville, Va...	Cape Vincent, N. Y.	Horseshoe Pond, Salmon Creek, and Neversink River, N. Y.
	[3] 20,000	.....do............	Central station, Washington, D. C.	Potomac and Beaverdam Rivers, Md.
	[3] 50,000	.....do............	Green Lake, Me.....	Great Brook and Beaver Pond, Me.
	[3] 50,000	.....do............	Nashua, N. H.......	Cold and Nashua Rivers, N. H.
	[3] 100,000	.....do............	White Sulphur Springs, W. Va.	Cheat and Cranberry Rivers and tributaries and other West Virginia waters.

TRANSFERS OF EGGS, FISCAL YEAR 1921—Continued.

Species.	Number of eggs.	From—	To—	Final disposition of fry or fingerlings.
Sockeye salmon	3,000,000	Afognak, Alaska	Quinault, Wash	Quinault Lake, Wash.
	5,000,000	do	Yes Bay, Alaska	McDonald Lake, Alaska.
	30,000	Birdsview, Wash.	Clackamas, Oreg	Columbia River, Oreg.
	[4] 20,000	do	Craig Brook, Me	Pleasant River, Me.
Steelhead salmon.[3]	25,000	do	Charlevoix, Mich	Hortons Creek, Mich.
	10,000	do	Erwin, Tenn	Reserved for brood stock.
	25,500	do	Manchester, Iowa	Do.
	58,000	do	St. Johnsbury, Vt	Lake Tarleton, N. H.; Cayuga Lake, N. Y.; and Peacham Pond, Vt.
Whitefish	750,000	Cape Vincent, N. Y.	Central station, Washington, D.C.	Cayuga Lake, N. Y
	750,000	Put in Bay, Ohio	do	Do.
	59,120,000	do	Charlevoix, Mich	Lake Michigan.
	10,000,000	do	Duluth, Minn	Lake Superior.

[1] For exhibit—fingerlings delivered to Pennsylvania Fish and Game Commission.
[2] Eggs from wild stock.
[3] Eggs from domesticated stock.
[4] This transfer was due to a misunderstanding of orders.

Propagation of Commercial Fishes.

The more important commercial fishes propagated by the bureau are the salmons of the Pacific coast, the whitefish, cisco (lake herring), lake trout, pike perch, and yellow perch of the Great Lakes, the yellow perch of the Potomac, the carp in the Portage River section of Ohio, the marine species—including the cod, haddock, pollock, winter and pole flounders—the buffalofish in Louisiana, and the anadromous fishes of the Atlantic coast—the shad, glut herring, alewife, striped bass, and Atlantic salmon. A discussion of the propagation of these fishes at the various stations during the fiscal year 1921 follows. Data concerning the spawning seasons for the species at the different stations are assembled in the table on page 72, and the amount and cost of fish food used at the Pacific salmon stations are given in the table on page 75.

PACIFIC SALMON CULTURE.

With the recent increase in the cost of all labor and materials the bureau has found it impossible to maintain the former magnitude of its Pacific salmon operations or to keep pace with the work done along that line by the various State commissions. The Yes Bay (Alaska) station was temporarily closed in order that its allotment of funds might be used to rebuild the water-supply line and make repairs to the hatchery and its equipment, such action being essential to prevent complete deterioration of valuable Government property. In the following pages is given a brief review of the work of the hatcheries on the Pacific coast.

AFOGNAK (ALASKA) STATION.

[EDWIN WENTWORTH, Superintendent.]

There was another excellent run of sockeye salmon in Letnik Lake, and during the active spawning season, extending from July 31 to September 24, 62,300,000 eggs were laid down in the hatchery. This is the fourth consecutive year that the egg collections have exceeded 50,000,000, and it would seem to indicate the permanency of the reestablished run, which was practically destroyed by the volcanic eruption of 1912. In none of these years do the egg collections afford an accurate index to the numbers of fish entering the lake, as it is the exceptional season when conditions are such as to permit active fishing throughout the spawning season. Thus, many of the fish annually escape to perform the spawning function under natural conditions. During the fiscal year 1920 upward of 79,000,000 eggs were taken, after which the racks were removed from the spawning streams. It was estimated that not more than 50 per cent of the spawning salmon entering the lake were used. During the season of 1921 the egg collections did not fill the hatchery, as floods during August prevented successful fishing.

Of the eggs collected 10,000,000 were transferred to other points, 5,000,000 going to the Yes Bay (Alaska) station, 2,000,000 to Quinault, Wash., and 3,000,000 to the State fish hatchery at Bonneville, Oreg., in continuance of an effort to restock the Columbia River with the species. The eggs retained at the station were incubated with a loss of 6½ per cent. In view of the excellent run of sockeye salmon that has entered Letnik River during the past four years, it may not be amiss to consider the opening of Letnik Bay to commercial fishing for the species after it has been ascertained that a sufficient number of fish has entered the lake to insure a satisfactory number of eggs for artificial incubation. This would involve the installation of a rack, making it possible to count the salmon passing through. It is believed the same rack would be useful in excluding Dolly Varden trout and silver salmon from the lake should this be considered advisable. The water temperature at the beginning of the spawning period registered 52° F.; at its close, 40°.

YES BAY (ALASKA) STATION.

[C. H. Van Atta, Superintendent.]

Fish-cultural work at this station was confined to the incubation of the sockeye-salmon eggs transferred from the Afognak station, 4,025,000 fingerlings resulting from the 5,000,000 eggs received. During December 350,000 of the eyed eggs were planted in three local lakes, which have been designated as Cannery Lake, Round Lake, and Lake No. 2. These bodies of water do not at present support a run of salmon, though they appear to be suited to the purpose. A rather casual inspection of the lakes on May 17 disclosed several schools of sockeye-salmon fingerlings from 1 to 1½ inches long. Each school was estimated to contain from 25 to 75 fish.

In view of the extensive repair work in hand it was not possible to take up fish-cultural operations on the usual scale. The repairs were essential to prevent complete deterioration of valuable property and were made from the funds usually allotted for propagation, the special appropriation requested by Congress for the purpose having been refused. The main features of the work consisted in the installation of a new water supply and extensive repairs to the hatchery building, including new foundation piling, new floors, and a complete set of 240 hatching troughs. The water supply required approximately 4,000 feet of 18-inch and 16-inch wood stave pipe, which was carried on a trestle from 1 foot to 24 feet high, and 1,250 feet of 6-inch pipe to provide water for domestic use and for fire protection. The trestle is made to accommodate a tramcar and makes available for station use an excellent supply of firewood and lumber, also, after the station has been equipped with a sawmill. The work also included repairs to other station buildings and the construction of a new launch. The station is now on an operating basis again, and fish-cultural work will be resumed during 1922.

During the fiscal year 1920 a system of feeding young salmon that had been in successful operation in the Washington field for some time was tried at the Yes Bay station. An arm of McDonald Lake, locally known as McDonald Slough, was temporarily screened, and a considerable number of young sockeye salmon were placed therein. The fish were fed regularly on salted salmon and made a very excellent growth. The results of the experiment were so satisfactory that piling has been driven to make the feeding inclosure a permanent feature of the station's work.

BAKER LAKE (WASH.) STATION AND SUBSTATIONS.

[J. R. RUSSELL, Superintendent.]

Necessity for economy has compelled the suspension of fish-cultural operations at three of the field stations in the Washington group in the past two years, and this has tended to reduce the output in that region. The combined output of the Washington stations for the fiscal year 1921, exclusive of Quinault, is 36,873,015, against 33,086,750 for the preceding year, 20,393,315 of the 1921 figures representing fingerlings, as opposed to a production of 9,842,350 fingerlings in 1921.

BAKER LAKE (WASH.) STATION.

Of particular interest in connection with the fish-cultural work in this field was the excellent run of sockeye salmon at Baker Lake. The run began on July 1, when 115 adult fish were taken, and continued to August 13, the peak of the run occurring between July 20 and 24. A total of 7,850 spawning fish were taken. The spawning period extended from October 10 to November 30. About 46 per cent of the total brood stock, or 3,645 fish, proved to be gravid females and yielded 11,750,000 eggs. This is the largest collection of sockeye-salmon eggs obtained at Baker Lake, exceeding last year's record collection by 600,000. The incubation period was unusually protracted, the first fry appearing on April 1, nearly three months later than in the preceding year, and hatching operations were not completed until May 31. The long incubation season was attributable to low water temperatures, brought about by cold spring weather and late snowstorms in the mountains. Apparently there were no ill effects to either eggs or fry, as the loss of eggs amounted to only 3.6 per cent, while the fry hatched seemed to possess the usual vigor.

Though it has not been possible to replace all equipment destroyed by the fire of last year, all of the fry produced were retained in the hatchery troughs to the end of the sac stage, this being effected through the use of the stacked-tray system. There remained on hand at the close of the fiscal year 4,000,000 of these young salmon, which will be reared to a larger size before liberating. In connection with its rearing operations the bureau is indebted to the fish and game authorities of the State of Washington, which furnished without charge 1,000 cases of canned salmon "do-overs" to be utilized as food for the fish.

The improved run of sockeye salmon in Baker Lake seems especially noteworthy from the fact that for more than 20 years the maintenance of the run of this species has depended almost exclusively on artificial propagation. It has been the custom at this point to trap all fish as they enter Baker Lake from the river and transfer them to an inclosure near the head of the lake, where they are held until ready to spawn. Thus, only the comparatively few fish which occasionally escape the trap during high-water periods spawn naturally in the lake.

In addition to the sockeye-salmon operations 700,000 silver-salmon eggs were taken between November 17 and December 15. In pursuance of the adopted policy of reserving Baker Lake so far as possible for the propagation of sockeye salmon, these eggs were transferred to the Birdsview hatchery immediately after being eyed.

BIRDSVIEW (WASH.) SUBSTATION.

The work of the Birdsview substation, on the Skagit River, was also successful. Its output of chinook salmon was larger than in any previous year, and the collections of silver and steelhead salmon eggs were above the average. This substation is now dependent on the fish that enter Grandy Creek for its egg collections. The trap in Phinney Creek, formerly a valuable egg-producing stream, was destroyed by floods two years ago, and since that time funds for its replacement have not been available. The success of the work at this point is attributed largely to the favorable water stages which prevailed throughout the spawning season. The streams in this locality are subject to sudden and violent fluctuation, and not infrequently at the spawning season the water is at such a low stage as to make the ascent of fish difficult, if not impossible. Of passing interest is the collection of 13,500 sockeye-salmon eggs from fish taken in Grandy Creek, the result, apparently, of plants of that species made by the bureau in Grandy Lake.

BRINNON, DUCKABUSH, AND QUILCENE (WASH.) SUBSTATIONS.

The propagation of chum salmon at the three substations on Hood Canal—Brinnon, Duckabush, and Quilcene—was unusually successful from the standpoint of egg collections and numbers of fry produced. Thirteen million eggs of this species, taken in Walcotts Slough, at the Brinnon substation, represented the largest number of eggs taken in that region. The egg collections do not accurately represent the numbers of spawning fish in the streams, since many escaped during the high-water stages, which were frequent during the spawning period and adversely affected the work at all points on the canal.

There are two distinct runs of chum salmon in the tributaries of Hood Canal. The spawning of the first, or summer run, occurs in September, while the late or winter run spawns from early November to well into January. A peculiarity of this species is that the fish in most instances are in spawning condition when they leave salt water to enter the streams, and most of the eggs collected in the Washington field are obtained in tidewaters. The increased collections of chum-salmon eggs within the past two years may be attributed to the lessened activity of commercial fishermen, the low prices prevailing offering but little inducement to fish.

There was a satisfactory run of silver salmon at the Hood Canal substations, though egg collections fell below those of the preceding year because the run occurred at a time when floods prevented the successful operation of traps or seines, a condition that continued to prevail throughout the spring spawning season of the steelhead salmon.

QUINAULT (WASH.) SUBSTATION.

[PHILO B. HAWLEY, Foreman in Charge.]

The fish-cultural work at this substation during the year was less successful than usual, the aggregate output amounting to only 5,820,800 as compared with 15,908,600 in 1920. Eggs at this point are obtained from fish taken in traps or by other means in the tributaries of Quinault Lake, which, like most streams in a mountainous country, react quickly to climatic conditions, a heavy rain producing flood conditions almost immediately. The waters rapidly subside on the cessation of rain, while even a short period of dry weather causes low water stages at all points. Fishing operations are conducted in the streams at some distance from the hatchery, the eggs being transported by canoe. Every season there are times when the water stages in the upper Quinault and Big Creek, the principal spawning streams, are so low that it is difficult to operate a canoe, while at other times the water is so high that all traps are submerged to a depth of 1 to 5 feet.

As it is characteristic of salmon to ascend the streams in the greatest numbers during high-water stages, it is not surprising that the egg collections should be subject to material fluctuation from year to year. Thus, the number of eggs of any species taken is not necessarily a just criterion of the number of salmon available at spawning time. The remedy for this situation, from a fish-cultural standpoint, is the construction of a trap at the lake outlet similar to the one used at the Baker Lake station, whereby all the fish are taken as they enter and are held in an inclosure until they are ready to spawn.

The first sockeye-salmon eggs were taken November 3, and between that date and November 20 the entire egg collections for the season, amounting to 1,750,000, were obtained. From November 20 to the time that efforts at spawn taking were abandoned, on December 15, high-water stages precluded all possibility of seining or fishing by other methods. Local collections of this species were augmented by the receipt of 2,000,000 eggs from the Afognak station. The run of silver salmon appeared to be larger than usual, and during the spawning season of that species, which is coincident with that of the sockeye, 1,565,000 eggs were secured. A small number of chinook-salmon eggs was also taken. The run of chinooks, which was apparently not large, was earlier than usual.

The output consisted of 950,000 fry and 3,448,000 fingerlings of the sockeye salmon, including 1,500,000 fingerlings carried over from the preceding year, 1,398,000 silver salmon, and 24,800 chinook fingerlings, with 1,000,000 sockeyes remaining on hand at the close of the fiscal year.

From time to time there has been some criticism regarding the bureau's work at Quinault, particularly on the part of the Quinault Indians. The substation is located on the Quinault Indian Reservation, and salmon fishing is the principal means of support for the Indians. Following the passage of regulations that had the effect of restricting salmon fishing to some extent in the Quinault River, a petition was submitted to the Commissioner of Indian Affairs, expressing the belief of the petitioners that the work of the hatchery had been detrimental rather than beneficial to the fishery of the river. The statement appeared to be founded on prejudice rather than on fact. The results of artificial propagation at other points do not bear out the contention, and in Quinault waters the fish taken for artificial propagation represent but a small part of the fish reaching the spawning grounds, probably not more than 10 per cent in any season. Furthermore, for several years considerable numbers of sockeye-salmon eggs transferred from the Alaska stations have been incubated in the Quinault hatchery and the resulting fingerlings planted in Quinault Lake or its tributaries.

Notwithstanding these facts, it was decided to try an experiment, which it was hoped would furnish reasonably reliable data on the results of artificial propagation as compared with natural reproduction. The plan suggesting itself was to take an accurate census of the sockeye salmon entering Quinault River and Quinault Lake for a period of years and by checking the returns from each year involved to secure at the proper time the desired figures for comparison. During the first two years of this period no artificial propagation of the sockeye salmon was to be conducted, and all fish of that species entering the lake were to be permitted to seek their natural spawning grounds for natural reproduction, this period to be followed by two years of artificial propagation.

Conditions in Quinault Lake and Quinault River are particularly favorable for the conduct of an experiment of this character. A fairly accurate record of the number of fish taken by the Indians as a commercial venture each season is available, and it remained only to obtain a count of the fish escaping the fishing operations in the river as they entered the lake on their way to the spawning grounds. To accomplish this a row of piling was driven across the outlet of the lake, approximately 700 feet at the site selected. Four-inch mesh cotton webbing was attached to the piling in such a manner as to prevent the fish from entering the lake except by way of a 16-foot entrance provided in the weir at the point of deepest water. This entrance was so arranged that the fish were forced to pass near the surface of the water over a strip of white canvas, making them plainly visible to the attendant located in a small building on the piling above. Provison was also made for closing the entrance at times when the observer was not present. The first count was made on April 14, when three sockeyes passed over the counting entrance, and was continued to June 10. The results of the census are indicated in the following table:

Date.[1]	Number of fish.	Date.[1]	Number of fish.
April 14	3	May 16	118
15	1	17	405
16	16	18	30
17	1	19	19
18	3	20	255
19	3	21	11
20	23	22	788
21	0	23	103
22	9	24	65
23	2	25	171
24	23	26	129
26	3	27	228
27	2	28	962
28	1	29	299
29	44	30	606
May 1	4	31	610
2	51	June 1	649
5	96	2	1,685
6	1	3	563
7	20	4	208
8	151	5	13
9	18	6	853
10	11	7	186
11	246	8	826
12	421	9	164
13	230	10	90
14	82		
15	286	Total	11,788

[1] No count made on dates omitted.

The count was discontinued and the webbing removed from the piling on June 10 because of the increasing numbers of fish that "gilled" in the 4-inch mesh. This trouble was not anticipated, as the webbing was of the same quality and mesh as that used at the Baker Lake station for a long period of years with entire success, and the 4-inch mesh is in general use for fish traps on Puget Sound. An estimate of the fish entering the lake after the removal of the webbing placed the number at 8,000, or a total of approximately 20,000 for the season. Inasmuch as it was not possible to obtain a complete and accurate record, it was decided to postpone the experiment for another season and proceed with artificial propagation as usual. With slight changes the weir constructed for the purpose described will be of value in connection with fish-cultural work should it be found desirable to continue such work after the conclusion of the experiment. The number of sockeye salmon taken in the commercial fisheries conducted by the Indians in Quinault River during this period amounted to 28,608.

SULTAN (WASH.) SUBSTATION.

At the Sultan substation, on Elwell Creek, there was a falling off in the egg collections of all species as compared with those of the preceding year. This creek is a tributary of the Skykomish River, which joins the Snohomish River at tidewater, some 20 miles from its mouth. This 20-mile stretch of the Snohomish River is subjected to intensive gill-net fishing operations each year, and it is extremely doubtful if the fish which are able to escape the nets during the fishing season, together with those that are given free ascent of the stream during the closed season, are sufficient in number to maintain the run in the watershed.

CLACKAMAS (OREG.) STATION AND SUBSTATIONS.

[H. C. MITCHELL, Superintendent.]

Under this heading are included the four Federal fish-cultural stations in the State of Oregon, two located on the Washington side of the Columbia River, with one egg-collecting station on the Washougal River, also in the State of Washington, and another on the Snake River, near Salmon, Idaho. The aggregate egg collections during the fiscal year 1921 were 42,912,320, and though the chinook salmon predominates in the work all species of the Pacific salmons excepting the sockeye and including the steelhead are represented. The shad is also propagated at Willamette Falls, Oreg., and the output is further augmented by the incubation of eggs of other species obtained by transfer from various points, and the distribution of the resulting fish in Oregon, Washington, and Idaho waters. The species thus transferred consist of brook trout, rainbow trout, blackspotted trout, and sockeye salmon.

In line with the very general belief, which appears to be well substantiated by reliable investigators, that much greater returns may be expected from the planting of larger-sized fingerling fish, particularly in the case of the chinook salmon, it has been the policy to develop facilities as rapidly as possible for this purpose. The stations in the Oregon field have an excellent record in this respect. During the fiscal years 1919–20 and 1920–21, an aggregate of approximately 83,500,000 fish from 2 to 3½ inches long have been planted in suitable waters of the State. These consist largely of the chinook salmon, though, as mentioned before, smaller numbers of brook, rainbow, and blackspotted trouts and steelhead salmon are included.

In contrast with the conditions that obtained during the previous spawning season of the salmon, when low-water stages at all points handicapped the work, floods prevailed in most of the streams during the season covered by this report. While it was not possible to state with accuracy to what extent the operations were curtailed by the floods, there is reason to believe that with more nearly normal weather conditions the aggregate collection of eggs would have exceeded that of any preceding year and that at some points the eggs available would have been in excess of hatchery capacity.

CLACKAMAS (OREG.) STATION.

Though the racks installed in the Clackamas River in connection with operations at Clackamas station were of unusually substantial construction and remained intact through two severe freshets they were carried away on October 3, and the egg-collecting season ended on that date. Though a very fair number of chinook and silver salmon had collected between the racks prior to their destruction, conditions in the river were such as to render the laying out and operation of a seine impossible. Consequently, the egg collections were reduced very considerably, totaling only 360,000 of the chinook salmon. Shad culture at Willamette Falls during July resulted in the collection of 2,119,000 eggs of that species. Transfers of eggs from other points were made as follows: 3,166,000 chinook salmon from Snake River (Idaho) station, 100,000 chinook salmon from Little White Salmon (Wash.) station, 100,000 blackspotted trout from Montana Fish and Game Commission, 25,000 blackspotted trout from Yellowstone Park, and 197,000 brook trout and 96,000 rainbow trout from Springville (Utah) station.

UPPER CLACKAMAS (OREG.) SUBSTATION.

The spring run of chinook salmon in the Clackamas River was the largest for a number of years, and egg collections of that species at the Upper Clackamas substation exceeded the previous season's record collection by nearly 800,000. Racks were installed early in July and fishing operations continued until September 16, when high water permitted the escape of all remaining fish, probably two-thirds of all the fish intercepted by the racks getting away at this time. There has been a most decided improvement in the annual run of spring chinooks in this stream, and the station, though small, is of importance to the fisheries of the Clackamas River. Because of its exceptionally attractive and convenient location and its well-kept condition it is a point much favored by visitors. Unfortunately, the Clackamas River is difficult to protect against the poacher, and illegal fishing is prevalent.

LITTLE WHITE SALMON AND BIG WHITE SALMON (WASH.) SUBSTATIONS.

There was a lighter fall run of chinook salmon in the Columbia River in the fall of 1920 than has occurred for several previous years. To offset this there were not the intensive fishing operations witnessed throughout the period of the war, and the demand for chum and silver salmon was particularly light. As at all points in the Oregon field, the persistent high-water stages throughout the spawning period rendered the work of the spawn-taking crews difficult and hazardous, and at times the streams were quite beyond control. The run of chum salmon was of fair proportions, but it occurred at a time when it was possible to obtain only a limited number of eggs, and only a small proportion of the fish were obtained for propagation. During the run of silver salmon the floods were so severe as to make fishing impossible; therefore no eggs of this species were recorded.

The collections of fish eggs at the Little White Salmon substation for the year consisted of 16,950,000 chinook salmon (of which 2,000,000 were sent to the Big White Salmon substation and 1,100,000 to the Clackamas station) and 5,162,000 chum-salmon eggs. This substation also handled 30,000 sockeye-salmon eggs transferred from the Washington field. At the Big White Salmon substation 5,005,000 chinook-salmon eggs represent the total egg collections.

ROGUE RIVER (OREG.) SUBSTATION.

Operations at the Rogue River substation suffered less from the prevalent floods than at any other point in the field, and 4,438,000 chinook salmon, 506,000 silver salmon, and 121,500 steelhead salmon eggs were secured. There were on hand at the beginning of the year 49,500 blackspotted trout, 886,000 steelhead salmon, and 197,000 rainbow trout fry, all of which entered into the distribution from the station later in the year.

APPLEGATE (OREG.) SUBSTATION.

At the other substation in southern Oregon, on Applegate Creek, the rainfall was excessive, and while higher water stages are frequently witnessed in the stream than occurred at any time during the season of 1921 still the amount of water carried during the year was unusually large. Placer mining at points on the creek above the station has resulted in large deposits of gravel at the fish barrier which will necessitate some changes before the next spawning season. Egg collections were unusually light, as most of the spawning fish escaped over the racks. The results of the season's egg collections were 80,000 chinook salmon, 36,000 silver salmon, and 55,000 steelhead salmon.

WASHOUGAL RIVER (WASH.) SUBSTATION.

The substation on Washougal River was opened on April 15, and 359,000 eggs of the steelhead salmon were obtained. High water and the lumber work on the river were both sources of trouble and interfered with the egg-collecting work. From the collections shipments of eyed eggs were made to the New York Conservation Commission, to the Clarke County Game Commission at Vancouver, Wash., and to the Montana Fish and Game Commisison in exchange for blackspotted trout eggs.

Some unusual features have been observed in connection with the work at this point. Last season it was noted that the fish remained quietly in the pools below the dam, showing but little inclination to ascend the river. Furthermore, the eggs secured were of poor quality, only 29 per cent of them producing fry. It is doubted if eggs of first quality were obtained from any of the female fish handled. The cause of this unsatisfactory condition was not ascertained, but the theory was advanced that the newly erected dam which stops the fish many miles below their wonted spawning grounds was responsible. In view of the excellent quality of the steelhead eggs taken at other points under very similar conditions, this theory is not altogether tenable. During the season of 1921 the quality of the eggs obtained was much better, though a considerable number of fish were taken in which small undeveloped eggs were distinguishable. There was nothing in the appearance of the fish to lead one to suppose they would spawn during that season. It is a condition not previously observed at any point, and it is more or less perplexing. It may be analogous to recorded instances of Atlantic salmon seeking their spawning grounds in fresh-water streams a full year in advance of the time they were ready to perform the spawning function and remaining there until that purpose was accomplished.

SALMON (IDAHO) SUBSTATION.

The results of the season's work on the Snake River were very satisfactory. The racks were installed in Lemhi Creek before the end of the fiscal year 1920, and a good run of fish appeared early in July. Spawning began on August 14, and between that date and September 1, 6,000,000 eggs were secured, filling all available space in the eyeing station troughs. Immediately after this the racks were removed, and the fish remaining in the stream were permitted to ascend to their natural spawning grounds. It is probable that the numbers of fish thus released for natural spawning exceeded those involved in the egg collections. This substation is located within 10 miles of the "top" of the Rocky Mountains, in the State of Idaho, and to reach this mountain stream for the accomplishment of their supreme mission in life the salmon travel approximately 1,500 miles without food after entering the Columbia River at Astoria, Oreg. The conditions which were observed here in regard to the splendid spring run of chinook salmon were not confined to the Snake River. Similar conditions were observed in all tributaries of the Columbia River frequented by the so-called spring-run fish.

Very excellent results in the rearing of young salmon have been obtained from the use of a comparatively new article of fish food. This is the immature spawn of the salmon taken by the commercial fishermen. The spawn is purchased at a comparatively low cost and held in cold storage until needed. In commenting on its value in his annual report for 1920 the superintendent of the station states:

> The salmon fry fed on salmon spawn and beef spleen produced remarkably fine fingerlings. It is by far the most satisfactory food that has ever been used in this field. No trouble was experienced with the fish at any point where its use was adopted. They were uniformly sturdy and readily accepted it throughout the year.

While the expense involved in feeding fish on an extensive scale is considerable, in view of the quite general belief that the future supply of salmon in the Columbia and other rivers of the State is dependent very largely on the numbers of fingerling fish released from the hatcheries, the work is considered of first importance. Because of the long period during which so little is known of the life of the salmon—from the time of the seaward migration as a fingerling or yearling until its return for the reproduction of its kind—it is difficult to effect any positive check on the actual results of hatchery work. Nevertheless, the evidence in favor of the work at certain points, notably in the Columbia, Clackamas, and Rogue Rivers, is of a convincing nature, and it appears to fully warrant the expense necessary to continue the feeding and intelligent planting of fingerlings. Upward of 68,000 pounds of fish food was used at the stations in the Oregon field during the fiscal year 1921. The details are given in the table of fish food on page 75.

BAIRD (CALIF.) STATION AND SUBSTATIONS.

[W. K. HANCOCK, Superintendent.]

In this field are to be recorded a number of untoward circumstances resulting in a serious curtailment of the fish-cultural work. From the fall run of fish the aggregate egg collections for the entire field amounted to 7,910,000, as compared with 11,785,000 the preceding year, which included 1,349,700 eggs of the spring run chinook salmon taken in the McCloud River at Baird.

Racks were again installed in the McCloud River in time to intercept the spring run of chinooks, but no fish appeared. This is directly attributable to the dam erected in the Sacramento River at Redding for irrigation purposes. This dam had the effect of diverting into the irrigation ditches most of the water in the river during periods of low-water stages, and though an opening was left in the dam to permit the passage of fish it was never effective. The matter of providing a suitable fishway was taken up with the California Fish and Game Commission, and at the close of the year the case was pending in the courts.

There was a very large run of fall chinooks in the Sacramento River, and while the early fall was marked by low-water stages it was estimated on November 15 that there were enough fish impounded at the Battle Creek substation to yield not less than 15,000,000 eggs. At Mill Creek the run was even larger, and the egg collections for that substation were estimated at not less than 30,000,000. Beginning November 20 several days of heavy rains occurred, bringing about flood conditions of unusual severity. Many miles of territory, including railroads and highways, were under water. The retaining racks at all points were destroyed and spawning operations abruptly brought to a close.

At the Battle Creek substation 2,450,000 eggs were taken, of which 504,000 were transferred to Baird for incubation and 20,000 shipped to central station, Washington, D. C., for exhibition. The remainder were hatched successfully, and 1,781,000 fingerling fish were planted in Battle Creek. At the Mill Creek substation 5,460,000 eggs were secured, of which 1,000,000 were shipped to Baird and 3,000,000 to the State hatchery at Sisson. From the remainder 1,347,400 fingerling fish were produced at the station.

INVESTIGATIONS AND EXPERIMENTS.

FERTILIZATION OF SALMON EGGS IN NATURAL SPAWNING.

At many points on the Pacific coast certain species of salmon, notably the humpback and chum, spawn at or near the mouths of streams in tidewater. A rather general belief has existed that the results of such natural spawning were negative, and in order to obtain information on the subject the field superintendent in charge of the Pacific coast stations and the superintendent of the Baker Lake (Wash.) station were detailed to investigate these conditions in Puget Sound. The report of their findings follows:

In conformity with instructions relative to securing information on the percentage of fertilization of salmon eggs in natural spawning, with special reference to the eggs deposited in places over which the tide ebbs and flows, an investigation was made of Walcott Slough, at Brinnon, Wash., on March 5, 1920.

Walcott Slough runs through extensive tide flats, which at flood tide are completely covered with salt water. During ebb tide a good flow of fresh water, estimated at about 3,000 gallons per minute, passes through the slough, its source being spring seepage at the slough head. The fish—chum salmon with a few silver salmon—enter this slough to spawn, the entire slough bottom being composed of gravel suitable for the purpose. The bureau has a rack and trap installed at a favorable point in the slough, about 500 yards from salt water, where fish are captured for propagation. Below the rack some natural spawning occurs, and this occupied our attention. Several nests were investigated, all but two of which contained eggs. These two might possibly have been made last year, though they had the appearance of being used quite recently. Eight nests were examined, beginning with No. 1 (see table, p. 28) just below the trap, about 500 yards from salt water at low tide, and ending with No. 8, about 200 yards from the same water stage. During flood-tide periods salt water covered the nests from three to six and three-fourths hours to a depth of 1½ to 5½ feet. This will vary somewhat with higher or lower runs of tide.

The condition and character of the bottom wherever nests were found would indicate that the fish chose points where spring seepage occurs through gravel from 1 to 4 inches in diameter. Here the eggs were buried from approximately 8 to 16 inches deep. When the eggs were reached, the gravel was found to be absolutely clean, more especially where the good eggs were secured, with a coating of fine sediment on top, indicating a circulation of fresh spring seepage water at all times. Anticipating this condition, a common trough was installed in the slough, with a circulation of fresh water assured at a low tide, but which at flood periods would be covered from 1½ to 4 feet with salt water without any circulation. The trough was filled with gravel, through which about 25,000 eggs were carefully mixed. A tight cover was then fastened on the top, with sufficient space left at both ends for proper circulation. The eggs were placed in the gravel on December 18, 1919, immediately after being fertilized, and on examination, on March 5, 1920, they were found to have hatched with an estimated loss of about 30 per cent. The fry appeared to be extremely active and healthy. The bad eggs were nearly all decayed and broken but had the appearance of having been fertilized and the embryo partially developed.

This would lead us to believe that an entire salt-water supply, with as low a density as 1.010 for an extended period, is injurious but not absolutely fatal, and it strengthened our belief that where fish spawn naturally within tidewater area the eggs are deposited where they receive a circulation of fresh water, as before stated. Samples of eggs were taken from each nest, and, contrary to Mr. Robertson's theory and observations in hatching eggs in gravel, the infertile eggs were chalky white when first observed in the gravel. The alternating salt and fresh water may be a contributing cause, though where a continuous circulation of fresh water seeps through the gravel it would appear difficult for salt water to penetrate sufficiently to have much influence on the eggs.

Our observations led us to believe that the infertile eggs might be accounted for largely by a scarcity of male salmon. However, there is a possibility that spawning might have occurred wholly in salt water, which may prevent the action of the eggs necessary to proper fecundation. As all but a few of the fish entering the slough were taken in the trap, and as the males are usually the first to ascend, it is not improbable that most of the males entered the trap, thus reducing the possibility of successful natural spawning at the points where observations were made. The table would indicate enormous losses through natural spawning, but as conditions were not absolutely normal, we would not care to be too emphatic from this meager survey.

To obtain full information relative to the foregoing it would be necessary to extend observations over the entire spawning season. Each nest should be marked and accurate data produced as to the number of fish depositing in each nest, together with all natural and unusual occurrences noted.

RESULTS OF EXAMINATIONS OF FISH NESTS, WALCOTT SLOUGH, BRINNON, WASH., MARCH 5, 1920.

Nests.	Distance from salt water at mean low tide.	Height of tide over nest at mean high water.		Water density, high tide.	Vertical rise of tide on reaching nest.		Length of time tide covers nest.	Estimated number of eggs per nest.	Condition of eggs.	Remarks.
	Yds.	*Ft.*	*In.*		*Ft.*	*In.*	*Hrs.*			
No. 0 box [1]	550	1	7	1.018	7	8	3	[2] 25,000	Hatched...	Estimate 70 per cent hatched.
No. 1 [1,3]...	500	2	5	1.022	6	8	6	46	Good......	41 good; 5 dead.
No. 2 [1,3]...	450	2	1	1.022	7	0	4¾	100	Total loss.	Unfertile.
No. 3 [1,3]...	450	2	1	1.022	7	0	4¾	151	Perfect....	1 dead, but all fertile.
No. 4 [4].....	420	3	1	....	6	0	6½	500	Total loss.	Unfertile.
No. 5 [4].....	410	3	1	....	6	0	6½	200	...do.......	Do.
No. 6 [4].....	300	4	7	....	5	6	6¾	402	Very poor.	400 dead; 2 good (bad, unfertile).
No. 7 [4].....	250	4	7	....	5	6	6¾	....	....	Nest looked good, but contained no eggs.
No. 8 [4].....	200	5	7	....	3	6	8	....	....	Do.

[1] The salt water density was tested by pumping water from bottom over nests at flood tide and ranged from 1.018 at box location to 1.022 at nests Nos. 1, 2, and 3, and 1.025 natural sea water in Hood Canal.
[2] Planted.
[3] Nests 5 feet apart.
[4] Current swift and water badly discolored; numbers estimated from those seen in the water and caught in net and baskets set below the nests on the riffles when disturbing eggs; good eggs are not as buoyant as dead ones, and therefore some may have escaped our notice.

HATCHING EGGS IN GRAVEL.

At the Afognak (Alaska) station an experiment in hatching eggs in gravel after the so-called Robertson method was undertaken during the season of 1920. Eggs to the number of 5,500,000 were placed in two old hatching troughs, mixed thoroughly with gravel, and bedded in the bottom of the creek. The troughs were fitted with a cover and water was introduced through a 1-inch pipe leading from a small dam, so that there would be a gradual flow through each trough. The intake of this pipe was carefully protected by a screen.

On opening the troughs in the spring it was found that very few of the eggs had hatched. Though the winter was a mild one it is probable that the eggs had been frozen, as there had been a very light fall of snow, leaving the creek unprotected, and frost may have penetrated to a greater depth than in seasons of lower temperature. Eggs placed in gravel boxes patterned after the Robertson plan and held in the hatchery developed nicely, and the majority of the fry remained in the gravel until the yolk sac was absorbed.

SUGGESTIONS FOR POSSIBLE IMPROVEMENT AND ENLARGEMENT OF WORK.

Further extension of the feeding operations at all stations where chinook, sockeye, and silver salmons are handled is desirable. This would necessitate an increased allotment for the Pacific coast work, since at the present time there is not sufficient capacity or funds to feed all stock resulting from the eggs collected. In fact, it has been necessary to close certain substations and curtail expansion in all fields. The extension of operations in other fields is essential if the work is to be kept at its highest efficiency. The take of eggs at many of our stations has been reduced through extensive commercial fishing operations during the period of the war, when heavy demands were made for this class of food, and it will take many years to restore the streams to their former productiveness.

The small statutory salaries provided for the lower grades of the bureau's service and the consequent inability to maintain a trained and efficient personnel have been important factors in the declining output. Because of these conditions it has been necessary to employ and train new men at most points every season, and as competent men could not be secured or retained at the statutory wage provided station allotments have been drawn upon in many instances for the employment of temporary help at the prevailing high wages, thus greatly reducing the funds available for actual propagation work.

The returns from the marking of young salmon on the Columbia River and at other points have not been wholly satisfactory. One reason for the small returns from these experiments may be the fact that it has been the custom to hold the fish intended for marking for several months beyond the natural spring migration, and this may have had a serious effect on the life of the fish involved. The thought has occurred that better results might be secured if the fish used in the marking experiments are held over one year, or until the migration of the following spring. The results of the marking experiments also suggest the desirability of a more thorough study of the early life of the salmon, with the view of correcting any possible weaknesses in present methods of propagation and distribution. This is a phase of the work that is respectfully referred to the division of scientific inquiry.

One of the greatest needs in connection with Pacific salmon propagation is more adequate protection for the fisheries through the enactment and rigid enforcement of restrictive legislation. The regulations should provide (1) for the return to the waters uninjured of all immature fish that may be taken in nets or other fishing devices; (2) for a weekly closed season, thus assuring ascent to the natural spawning grounds of a certain proportion of the unripe fish; (3) for cessation of fishing operations after the canneries have put up a fixed number of cases, the limit of the pack to be determined by investigations in each locality, which must be such as will permit the escapement of a sufficient number of fish to insure continuation of the run in each locality; (4) for systematic destruction of Dolly Varden trout in salmon streams, these fish having been found to be among the greatest enemies of young salmon; (5) for setting aside natural lakes for use as salmon-rearing reservoirs; (6) for seeding of eyed salmon eggs in the more inaccessible lakes, in order that the young may pass the early stages of their existence in waters which are comparatively free from natural enemies. During periods of flood the fish in these lakes would pass from them over slight falls and through the intervening rapids, entailing little loss. In certain barren lakes the application of such a plan would necessitate the provision of a food supply. Work of this character has already been undertaken in a limited way in the vicinity of the Yes Bay (Alaska) station.

The tray system recently introduced in connection with the propagation of salmon at the western stations is proving a very important factor in the work. The eggs are carried in the regular baskets until within two or three weeks of the hatching period, when they are transferred to 14 by 16 inch trays, made of 1 by 1½ inch lumber and covered with wire cloth 14 to 16 meshes to the inch. From 3,500 to 4,000 sockeye-salmon eggs are placed on one of these trays. The trays are stacked from 6 to 8 deep in a trough compartment, thus increasing the holding capacity of a 16-foot trough from six to eight times and permitting the safe development of 300,000 to 400,000 fry in a space which was formerly required for 50,000. The fry are carried in dark, deep pockets, with the view of providing, so far as possible, the seclusion afforded in natural hatching, as it is believed they will develop under such conditions all the characteristics of gravel-hatched fry.

Another favorable feature is the more compact arrangement of the hatching apparatus, which permits of a much better control of the fry than under the basket and open-trough system. While it is entirely practicable to spread the green eggs on the trays directly and continue using them throughout the incubation period and up to the time the fry are ready to be fed, it has been found more satisfactory to carry the eggs in the baskets to the point of hatching and then transfer them to the trays, as such an arrangement permits of a thorough cleaning of all apparatus involved. Writing in regard to the use of this system, C. H. Van Atta, superintendent of the Yes Bay (Alaska) station, states:

> Sixty thousand sockeye-salmon fry were placed on 12 trays, each 13½ by 25 inches in dimensions. The trays were stacked in one regular basket com-

partment of the hatching trough and held thus from March 12 until the yolk sac had been completely absorbed, on June 7. The total loss of fry during this period was 180.

Without the trays only about 50,000 salmon fry can be safely carried in a standard 16-foot hatching trough through the sac stage. It would therefore appear that by the use of this system the fry capacity of each trough is increased by approximately 200 per cent. J. R. Russell, superintendent of the Baker Lake station and its auxiliaries, in the State of Washington, writes:

The stacked tray system for holding fry during the sac stage was tested this year for the first time, 1,000 of the trays being in use at the Baker Lake hatchery, with 11,000 fry to a tray and 4 trays in each basket compartment, making a total of 264,000 fry per trough. The system proved an entire success. The loss was small. The danger from smothering, which sometimes occurs when large numbers of fry are held on the trough bottoms, appeared to be entirely eliminated, and the "paddling" of the fry, which is essential in the trough, is rendered unnecessary.

From this statement the trough capacity appears to be even greater than was indicated by the experiment at the Yes Bay station. During a period of water scarcity at the Baird (Calif.) station the trays were successfully used to economize in space and water.

PROPAGATION OF FISHES OF THE GREAT LAKES.

The bureau's work in the propagation of the commercial species indigenous to the Great Lakes extends from the Rainy Lake region, in Minnesota, to Lake Champlain, in Vermont. Under existing conditions the work in this field fails of its fullest efficiency through a lack of adequate facilities. An example of this condition is suggested in the possibilities that exist in the propagation of pike perch. In the Rainy Lake field, where pike-perch propagation has been tried in a tentative way, arrangements may be concluded with the Minnesota Fish and Game Commission for the establishment of a small inexpensive hatchery, to be operated jointly by the bureau and the State as an adjunct of the Mississippi Valley work.

Another important pike-perch field awaiting development is in Saginaw Bay, Mich., this region offering greater returns for a given expenditure of funds than any other of which the bureau has knowledge. With an inexpensive but well-equipped hatchery, located in the lower section of the bay, the bureau would be in a position to save the immense numbers of eggs—estimated to be over a billion a year—which are now being sent to market in the fish and lost.

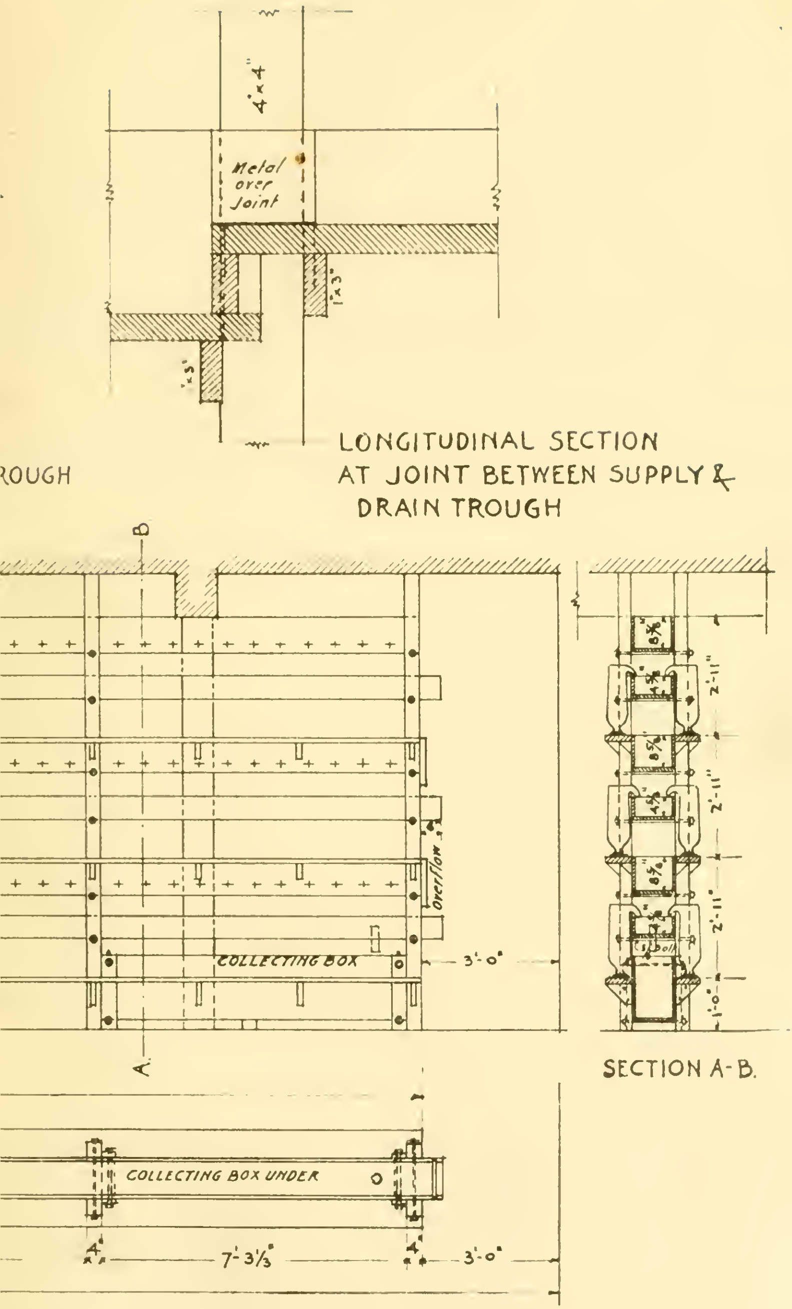
At the pike-perch substation located near the head of Lake Champlain, at Swanton, Vt., large numbers of pike-perch eggs are lost every spring because of inadequate facilities. Before any appreciable improvement can be expected at this station it will be necessary to provide an efficient penning system, so that the large numbers of partially ripe fish taken by commercial fishermen may be held under favorable conditions awaiting the full development of their eggs.

So far as the propagation of whitefish, lake trout, and cisco (lake herring) is concerned, there has been no notable change in recent years either in methods pursued or the fields occupied. Probably the greatest improvement in this branch of the work, both as regards equipment and extent of territory covered, has been in connection with the operations at the Cape Vincent (N. Y.) station. Within the past year the capacity of the hatchery at that point has been increased approximately 150 per cent without increasing the floor space, this being made possible by the construction of a new and compact type of battery for the glass jars used in the incubation of these eggs. A cut of the battery showing the placing of jars and other details is shown herewith in Figure 1. The scope of the station's field operations has been materially enlarged through close cooperation with the New York Conservation Commission and the Dominion and Provincial fisheries authorities of Canada. At the present time the most prolific field occupied is in the vicinity of the Bay of Quinte, on the Canadian side of Lake Ontario.

The great need in all branches of fish conservation is effective, stringently enforced protective legislation. Simple, easily understood, and easily remembered fishery laws are always desirable, but in the Great Lakes regions the fault probably lies not so much in the character or wording of present laws as in the lax enforcement of legislation now on the statute books. A close season, varying in length to meet local conditions, should be established for all species in the Great Lakes region, and no commercial fishing should be permitted until 40 per cent of the fish on the fishing grounds are in spawning condition, this fact to be determined by the use of set nets operated under supervision. The State laws should provide that commercial fishermen operating during the spawning period be required to turn over free of charge to designated agents of the bureau or the State the ripe eggs of all fish taken. In the framing of the laws more stress should be laid upon the legal size of fish than upon the size of the mesh of seines or nets, and a moderate percentage of small fish should be allowed. In connection with this feature of the work the importance of uniform laws governing all persons alike in a given locality is not to be overlooked. In order to bring about the greatest good, such laws must in their application be not only interstate but international.

The aggregate output of this group of stations, including the hatchery on Lake Champlain, where pike perch and yellow perch are propagated, amounted in round numbers to approximately 1,158,000,000 eggs, fry, and fingerlings, as against 886,000,000 in the preceding year. The increase may be attributed largely to more favorable weather conditions prevailing throughout the spawning seasons of the species handled. By way of contrast in climatic conditions as they affect fish culture, the work in the Great Lakes region during the spawning season of 1920 suffered generally from severe cold and violent storms. During the spawning season of 1921, while stormy weather was encountered at certain points, the work was interfered with principally by unseasonably warm weather, resulting in water temperatures too high for the best results in artificial incubation.

This branch of fish culture has for many years received the heartiest support of the interests most directly benefited by the work, and that these interests still have faith in the efficacy of artificial propagation is evidenced by the many letters received from them, commending the work and urging its extension. While the figures given for the output of the Great Lakes represent largely such commercial



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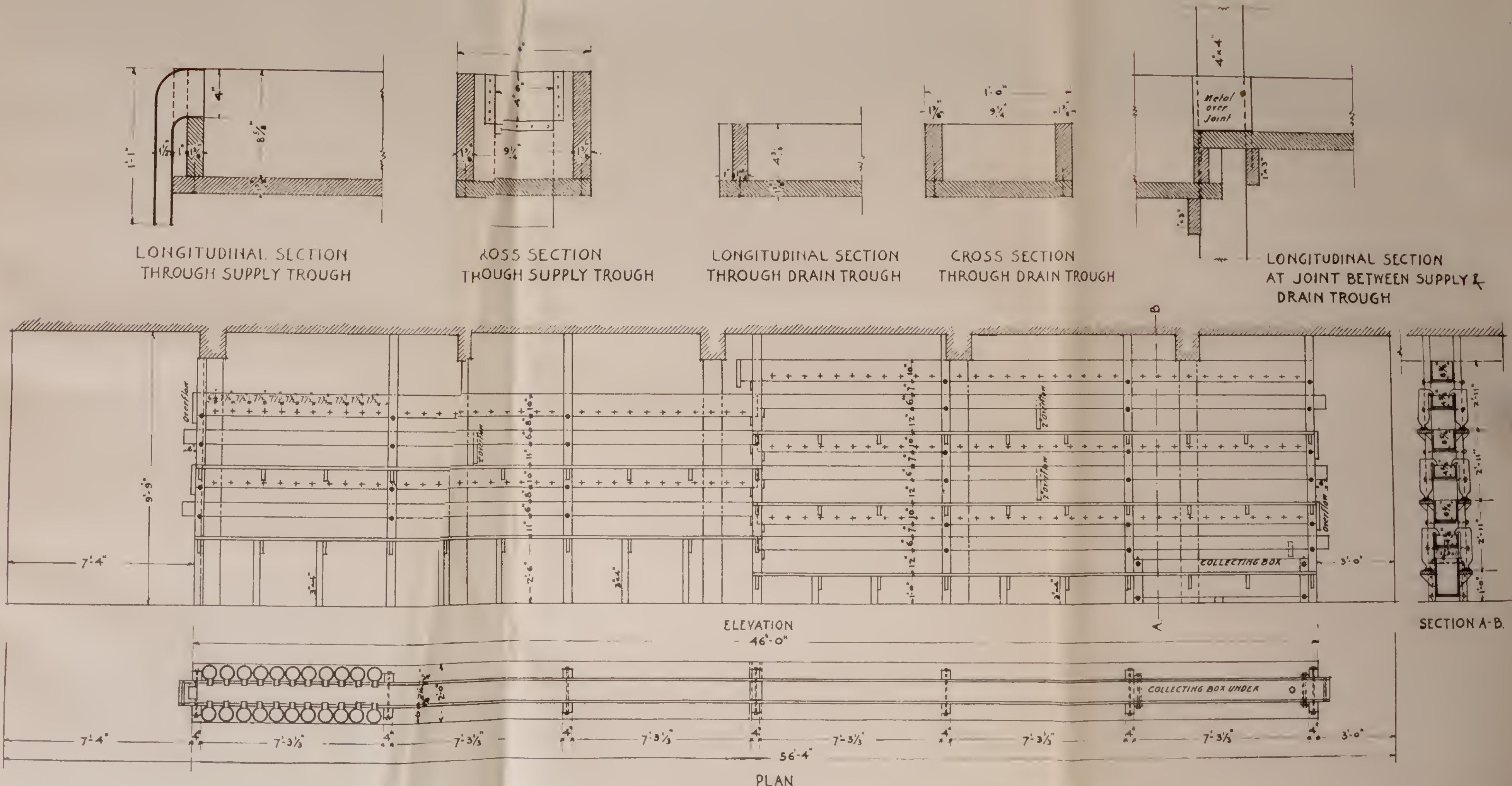

Fig. 1. Plan of hatching battery in use at the Cape Vincent (N. Y.) station for the incubation of whitefish and cisco eggs. (Designed by J. P. Snyder.)

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species as the whitefish, lake trout, cisco, pike perch, and yellow perch, they also include brook trout, rainbow trout, and smallmouth black bass, which species are produced in limited numbers at several of these stations.

DULUTH (MINN.) STATION.

[S. P. WIRES, Superintendent.]

The spawning season of the lake trout in Lake Superior fields, on which the Duluth hatchery depends for its stock of eggs, began about four days later than usual at nearly all points, the bulk of the eggs being taken between October 17 and November 1, though in the vicinity of Isle Royale, Mich., small lots were secured at intervals from the last week in September to about the middle of November. The run of fish was irregular and the egg collections light, the total aggregating only 12,726,500, or little more than half the take of an average season. On account of unseasonable weather and water conditions, poor transportation facilities, and a lack of ice at some of the more isolated fisheries, the quality of the eggs obtained was so impaired as to cut down the output of lake trout from this station to a total of 6,379,500, of which 175,000 were eyed eggs, shipped on assignment to other hatcheries, 6,057,000 fry, and 147,500 fingerling fish.

In the course of the lake-trout spawning season 940,000 whitefish eggs were collected in the Isle Royale field, and on January 6 this number was augmented by the receipt of 10,000,000 eyed eggs of very good quality from the Put in Bay (Ohio) hatchery. The combined stock yielded an output of 9,600,000 fry, all of which were planted in good condition, in various parts of Lake Superior. The station also distributed the product of 150,000 brook-trout eggs received from a commercial hatchery in New England and two consignments of rainbow-trout eggs, aggregating in the neighborhood of 100,000, the latter being transferred to the station from western hatcheries of the bureau.

In cooperation with the Minnesota fisheries authorities the force of the Duluth station established and operated two field stations for the collection of pike-perch eggs during the spring—one on the Rat Root River and the other on Boy River, a tributary of Leech Lake. The bureau's share in the proceeds of these operations amounted to 13,680,000 eggs. At Boy River the work was not altogether successful, as more than 98 per cent of the fish taken had deposited their eggs previous to capture. This may have been due to the unusually low water stages that obtained in the early part of the season, the fish not being attracted to the streams and spawning in the shallow waters of Leech Lake.

NORTHVILLE (MICH.) STATION AND SUBSTATIONS.

[W. W. THAYER, Superintendent.]

There was a further decrease in the number of whitefish and lake-trout eggs secured from Lakes Michigan and Huron, two causes for which are assigned—the State laws and inexperienced and unreliable spawn-takers. Under the present laws fishermen are permitted to use an unlimited number of nets during the fishing season and are not required to make any provision for the salvage of ripe eggs taken.

The effect of this is that so many nets are operated by the fishermen that they are not able to lift them at proper intervals, and the fish taken are either dead or the quality of their eggs impaired. During the spawning season in the fiscal year 1921 there was a good catch of fish and weather conditions were generally favorable, but for the reasons stated the egg collections were unsatisfactory, both as to quantity and quality. This applies to both the lake trout and the whitefish. The egg collections amounted to 30,876,000 of the lake trout and 12,080,000 of the whitefish, and all of them were incubated at the Charlevoix hatchery. The loss on the former amounted to 59 per cent and on the latter to 51 per cent. The output of the station was augmented by the transfer of 59,120,000 whitefish eggs from the Put in Bay station and 25,000 steelhead eggs from the Birdsview (Wash.) field, the fry from both lots entering into the general distribution.

The pike-perch work on Saginaw Bay was fairly successful, but it does not represent by any means the potential value of this region as an egg-collecting field. The spawning season extended from March 26 to April 16, during which period 284,290,000 eggs were taken. Of this number 54,050,000 were deposited on the spawning grounds after being fertilized and 223,200,000 were sent to the Detroit hatchery of the Michigan Fish Commission for incubation. The importance of the work in this field has been mentioned on several occasions and funds should be forthcoming to place hatchery facilities in this field for the full development of the work.

From the Northville station there were distributed 475,000 brook-trout fry and fingerlings, resulting from eggs purchased of commercial fish-culturists, and 90,500 rainbow trout were produced from eggs transferred from the West Virginia and Missouri stations of the bureau. Approximately 31,200 smallmouth black bass reared from the Northville station brood stock were also distributed, and at the close of the year there remained in the station ponds about 75,000 bass and 2,000 rainbow-trout fry.

PUT IN BAY (OHIO) STATION.

[S. W. Downing, Superintendent.]

Owing to quite generally favorable weather conditions in Lake Erie and to the close cooperation of the commercial fishermen, the whitefish work of the Put in Bay station resulted very satisfactorily, though the spawning season was unusually late. Between November 20 and December 12 eggs to the number of 376,500,000 were collected from fishermen operating in the various fields and placed in the Put in Bay hatchery. Of these, 141,060,000 were secured in the vicinity of Port Clinton, Ohio; 93,840,000 at Isle St. George; and smaller numbers from the fisheries around Toledo, Middle Bass Island, and Catawba Island. In the former prolific whitefish field near Monroe Piers, Mich., no eggs whatever were obtained, as fishing operations were brought to a close very early in the spawning season by a heavy and protracted wind and rain storm which came on just as preparations had been completed for the penning of the partially ripe fish. Shipments of green and eyed eggs aggregating 139,870,000 were forwarded to various State and Federal hatcheries and 7,000,000 fertilized eggs were deposited on the reefs where taken. The remaining stock produced 167,500,000 fry, which were liberated on the spawning grounds in the lake, care being taken to scatter them over as wide an area as possible. The incubation period was shortened by the unusually mild winter, averaging only 119 days, in a mean temperature of 38¾° F.

The high-water temperatures prevailing during most of the winter brought on a run of pike perch in March, and some of the commercial fishermen reaped very good returns during the latter part of that month. No spawning fish were in evidence in March, however, and the run throughout the entire season was characterized by the very small number of spawners included in it. Egg-collecting operations extended from April 5 to April 24, but the number of eggs taken was proportionately small. Despite the fact that the fishermen were willing and anxious to act on any suggestion with a view to obtaining good eggs, the quality of the eggs was uniformly poor, being about the poorest, in fact, ever noted in eggs handled at the station. The total of 111,600,000 laid down in the hatchery yielded only 12,600,000 fry. These were strong and active, however, and the entire output was liberated in good condition on the spawning grounds in the lake.

Soon after the middle of May the carp propagation work, inaugurated two seasons ago in connection with the Port Clinton fisheries, was taken up, a small hatching battery for the purpose being set up in one of the fish houses at that point. During the egg-collecting period, extending from May 23 to June 11, spawn takers made daily visits to the fishing grounds to take eggs from the ripe fish landed in the seines, liberating at the same time the fry hatched from earlier lots. The catch of carp was below that of a normal season, but the egg collections were considerably larger than in either of the two previous seasons, the total amounting to 74,325,000. From this stock 63,325,000 fry were hatched and planted on the spawning grounds in the Portage River, between Port Clinton and Oak Harbor.

During the fall, arrangements were made with local fishermen on Lake Erie to save all smallmouth black bass taken in their seines and hold them in live boxes until a sufficient number could be secured to warrant a shipment. By this means 805 adult fish of that species were collected during October and forwarded to various pond fish-cultural stations of the bureau to serve as a brood stock.

CAPE VINCENT (N. Y.) STATION.

[J. P. SNYDER, Superintendent.]

During the first half of November lake-trout eggs to the number of 549,000 were taken at points on Stony Island, N. Y., and Pigeon Island, on the Canadian side of Lake Ontario. As is usual at that time of the year, stormy weather was encountered and all of the eggs were obtained during but four days of weather suitable for fishing. Thirty-nine thousand eggs were shipped to applicants, and of the 450,000 fry hatched from the remainder 80,000 were furnished for stocking interior waters in the State of New York and 370,000 were returned to Lake Ontario waters. Collections of whitefish eggs from Lake Ontario amounted to 150,200,000.

The collecting operations for both lake trout and whitefish were conducted in American and Canadian waters under the same cooperative agreement that was effective last season. In Canadian waters the work was handicapped by lack of a suitable boat, making it necessary to plant on the spawning grounds immediately after fertilization 29,650,000 of the eggs taken at Deseronto and Big Island. Canadian hatcheries received 30,000,000 of the eggs obtained, in accordance with the terms of the agreement; 29,300,000 were turned over to hatcheries of the New York Conservation Commission and 1,000,000 were diverted to the Washington exhibit. The remainder were incubated at the Cape Vincent station and the resulting fry planted in Lake Ontario waters. Egg collections of cisco (lake herring) from Ontario waters totaled 317,200,000, of which 73,200,000 were obtained in Canadian waters at Deseronto and Bygotts Point. The fisheries authorities of Pennsylvania and New York received 104,410,000 and 65,000,000, respectively; 17,100,000 fertilized eggs were planted on the spawning grounds, and the fry hatched from the remainder were returned to Lake Ontario waters.

During the spring a small number of brood yellow perch were obtained from trap nets set in the St. Lawrence River, and from the 15,000,000 eggs thus secured 11,000,000 fry were hatched and returned to the St. Lawrence River. A consignment of 8,000,000 eyed pike-perch eggs received from the Lake Champlain hatchery yielded for distribution 7,970,000 fry of excellent quality, an usually high percentage. In addition to the commercial species enumerated 150,000 rainbow-trout eggs from the bureau's Virginia station and approximately 450,000 brook-trout eggs from commercial dealers were incubated and the fry distributed to applicants in New York State.

A boat suited to the needs of the station was obtained by transfer from the Navy, but because of the time consumed in making needed repairs to motors was not available for service during the past season. When fully equipped, this boat will add much to the productivity of the station, being particularly valuable in connection with the whitefish and cisco work in Canadian waters.

SWANTON (VT.) SUBSTATION.

[A. H. DINSMORE, Superintendent.]

The work at this point is conducted cooperatively with the State of Vermont. During the operating season of 1921, extending from March 2 to May 10, pike-perch eggs to the number of 112,312,500, also 43,950,000 yellow-perch eggs, were secured for incubation. The winter being unusually mild, the Missisquoi River was open at an early date. Nets were set during the first part of March and hauled at frequent intervals at the various points to anticipate the presence of fish. The first pike perch were taken at Sandy Point March 25 and at Campbell's on April 4. Three trap nets were in operation at the mouth of the river, but the results from their use would not appear to warrant their continuance. All fish taken were immediately transferred to the inclosure for ripening, but because of low water stages, resulting in an improper circulation of water through the inclosure, the mortality was high, and all brood fish on hand were released on

April 20. A cold spell in April, following the warm weather of March, caused a protracted incubation period for the pike-perch eggs. In this connection it is interesting to note that while the egg collections were made during the period from April 6 to 20 there was very little difference in the dates on which any lot of eggs reached the eyed stage or completed incubation. The eggs were of extremely poor quality, the loss during incubation being in excess of 77 per cent.

Collections of yellow-perch eggs were in progress from April 21 to April 23. Of the 43,950,000 taken 12,000,000 were delivered to the State hatchery at Burlington, Vt. The remainder were incubated with but slight loss. Upward of 33,000,000 of the pike-perch eggs were shipped to applicants, 14,700,000 going to hatcheries in the State of Vermont.

PROPAGATION OF YELLOW PERCH, BRYANS POINT (MD.) STATION.

[L. G. HARRON, Superintendent.]

Fish-cultural operations were undertaken at this point on March 1, the work being addressed to the propagation of the yellow perch. Between the 3d and the 10th of March 18,226 brood fish were taken. Spawning occurred between the 10th and the 23d of March, resulting in a total collection of 172,630,000 eggs of excellent quality. Of these 2,600,000 were shipped to Washington, where they served as an exhibit during incubation, the fry being used to supply applicants in Virginia. The remaining eggs were incubated in the hatchery, producing 158,819,450 fry, which were planted on the spawning grounds.

MARINE FISH CULTURE.

The season's work in this field may be considered satisfactory, the output of eggs and fry comparing favorably with that of the year previous. While there was a falling off of nearly 50 per cent in the output of cod as compared with last year, this is compensated for by satisfactory increases in the production of other species, notably the haddock. The work during the past season was extended to include the pole flounder (*Glyptocephalus cynoglossus*), a species not previously propagated. This fish, locally known as the "gray sole," has only recently been introduced in the markets of New England. Its existence in these waters has long been known, but previous to the use of the otter trawl in the shore fisheries it was not generally known to fishermen. Because of its small, weak mouth it was not taken on the trawl lines. It has since proved to be a popular fish, commands a high price in the markets, and a fishery of importance is being built up in connection with it.

Inadequate funds have prevented the development of possibilities for valuable work in the conservation of the large number of eggs of the marine fishes that are annually lost in connection with commercial fishing. Such work has now been undertaken on a limited scale by placing spawn takers on the fishing vessels operating in the offshore fisheries, to strip the mature eggs from the fish taken, fertilize, and return them immediately to the water. The work is considered of special value, since it deals with the conservation of vast quantities of eggs of the cod and haddock which have heretofore been annually destroyed.

BOOTHBAY HARBOR (ME.) STATION.

[E. E. HAHN, Superintendent.]

Fish-cultural work at this station during the year was addressed to the winter flounder and the pollock and resulted in an output of 841,235,000 and 11,906,000 of the respective species. The pollock fry were produced from eggs collected in the Gloucester fields and represent the first really successful attempt to make long-distance shipments of pollock eggs. Collection of flatfish eggs was commenced February 23 and continued to April 22. A total of 6,298 female brood fish were handled during the season and yielded 906,696,000 eggs. Though weather conditions favored the work, the spawning season ended earlier than usual, and because of this circumstance the take of brood fish was smaller than had been anticipated. On the other hand, the female fish taken were above the average in size and yielded a correspondingly large number of eggs. Some experiments in the rearing of the fry were conducted but without marked results.

A careful watch of the local fishing grounds where a limited number of boats engage in a spring fishery for cod and haddock was maintained with the view of obtaining eggs. The results were negative, however, as has been the case for several seasons, no fish in spawning condition being taken. Similar results followed a continuation of an effort to locate spawning areas of the alewife in the Damariscotta River and other points in the vicinity of Boothbay Harbor.

The steamer *Gannet* has been connected with the work of this station and has rendered valuable assistance in fish-cultural operations, particularly in the flatfish work, also in transporting men and supplies in connection with the repairs that have been made to the lobster pound at Pemaquid, Me.

GLOUCESTER (MASS.) STATION.

[C. G. CORLISS, Superintendent.]

In this field the output of pollock fry has for a number of years been larger than that of any other species propagated. With the general adoption of the gill net for taking pollock in the shore fishery and the prevailing high prices, this fish, which was formerly of minor importance, has come into high favor. During the calendar year 1920 more than 4,000,000 pounds of pollock, valued at $118,502, were landed fresh at Gloucester, Mass., approximately 3,745,000 pounds of this amount having been taken in the shore fishery. In 1921, the pollock spawning season extended from November 15 to January 21, and the egg collections aggregated 650,850,000 as compared to 954,800,000 the preceding year. In the course of the fishing season there was a rather sharp decline in the market price of pollock, which resulted in the withdrawal of many boats from this line of work. The weather throughout the spawning period was exceptionally good, and to this fact the higher quality of the eggs obtained is attributed. Twenty-four million of the eggs were transferred to the Boothbay Harbor (Me.) station, and the remainder produced 143,160,000 fry, which were distributed on the pollock spawning grounds.

A rather unusual occurrence connected with the pollock work is the fact that the fish apparently sought new spawning grounds during the season. Heretofore practically all of the spawning fish have been taken in Massachusetts Bay, and all fish taken from spawning grounds to the eastward of Cape Ann have been barren of eggs. This year, however, large numbers of eggs were obtained from fish caught on the grounds lying from 20 to 30 miles eastward of Cape Ann.

The season's collection of cod eggs fell considerably below last year's established record collection of 570,704,000. Two reasons are ascribed for the falling off, (1) the comparatively small run of fish on the shore spawning grounds, and (2) the low market price for cod. Eggs were taken between January 15 and April 29, the total amounting to 210,040,000. Of these 151,530,000 were planted on the spawning grounds immediately after being fertilized, this method being resorted to at times during the spring months, when the low density of the sea water does not permit of making transfers to the hatchery. In addition to the local collections cod eggs to the number of 8,700,000 were transferred to Gloucester from the Woods Hole hatchery. The fry distribution from the station amounted to 50,900,000.

Propagation of the haddock at the Gloucester station was eminently successful and is represented by a record collection of eggs of that species. The causes contributing to this result were favorable weather, an abundance of fish on the spawning grounds throughout the season, and the comparatively high market price for haddock. The price was an important factor in attracting to this fishery a large number of fishermen who ordinarily follow the cod or other lines of fishing. The spawning period extended from January 22 to April 25, and 629,120,000 eggs were taken. Of these, 182,120,000 were deposited on the spawning grounds for the reason stated above.

Since the mild winter suggested the probability of an early spawning season for flatfish, nets were set as early as February 2 for the capture of a brood stock, but no fish were secured until March 14. During the first week of the season the take of adult fish was unusually large, giving promise of a fine egg collection. With the beginning of active commercial fishing, however, the collection of fish for propagation work fell off rapidly, and the season's operations resulted in obtaining only 154,740,000 eggs. From this stock 132,070,000 fry were hatched and distributed.

Because of the prominence the pole flounder has attained in the New England markets in recent years and the constantly increasing number of fishermen engaged in its capture, an investigation of the spawning habits of the fish was made with the view of undertaking its artificial propagation in the event that course seemed advisable. At the present time commercial fishing for the pole flounder begins in midwinter some 15 miles off Cape Ann. The fish appear to work slowly inshore, and by July fishing for them is in progress in the shoal waters of Ipswich Bay. The average daily catch per boat is from 8,000 to 12,000 pounds.

Large numbers of the fish were examined in April, but no ripe spawn was found until May 22. From that date until June 30, when the work was brought to a close, 19,410,000 eggs were taken, fertilized, and planted on the spawning grounds. The eggs of the pole flounder are about one-twentieth of an inch in diameter, a liquid quart containing approximately 426,000. They are semi-buoyant and nonadhesive. It is probable that spawning continues throughout the summer months. It would appear that the species is worth the attention of fish culture, and that considerable numbers of eggs for artificial propagation are obtainable in the commercial fishery at comparatively small expense.

WOODS HOLE (MASS.) STATION.

[W. H. THOMAS, Superintendent.]

At the approach of the cod spawning season at this station negotiations were entered into with fishermen operating vessels equipped for carrying live fish to supply brood cod for the propagation work, but as only one suitable vessel was available the number of fish secured was smaller than was desirable. The first consignment of 485 fish was delivered on November 15. Five further consignments delivered between that date and December 6 brought the total brood stock up to 2,441 fish, all of which were placed in the spawning cistern. Stormy weather prevented any further deliveries. The fish were an exceptionally fine lot, a large percentage being females. For several seasons heretofore cod propagation at the Woods Hole station has been reduced to almost negligible proportions because of the very large percentage of barren fish among the brood stock. It is impossible to assign an entirely satisfactory reason for this condition, but it may have been due partly to the undersize of the fish and also to the fact that they were taken in places not usually frequented by spawning fish. The fish secured this season were of good size and were taken on fishing grounds located some distance offshore. The egg returns from them were very satisfactory, the total amounting to 214,702,000. Of this stock, 8,700,000 green eggs were transferred to the Gloucester station and 124,441,000 fry were hatched.

On account of more favorable weather conditions the results of the season's flatfish work were larger than those of the previous year, though the egg collections were not equal to that of the record year of 1918. Operations in local fields began on January 12 and resulted in a collection of 803,567,000 eggs. A very satisfactory increase in the number of fish obtained at Quisset Harbor is to be recorded. The collecting station at Wickford was opened March 18 and was in operation until March 28, when high-water temperatures made it impracticable to continue the work. The egg collections at this point amounted to 112,228,000, or less than half of last year's. From the total of 915,855,000 eggs obtained from all points fry to the number of 795,355,000 were hatched and deposited in local waters.

During March, 1920, the three-story frame building connected with the Woods Hole station, the first floor of which was occupied as a machine shop while the two upper stories furnished storage space for fish-cultural and scientific equipment, was destroyed by fire. A special appropriation of $65,000 for rebuilding and replacing equipment was provided by Congress, becoming available June 5, 1920.

Advantage was taken of this opportunity in reconstruction to make certain changes in building and equipment that will add much to the convenience and efficiency of the operations and also effect an economy. The new building, of fireproof construction, provides for a machine shop, boiler and pump room, garage, and ample storage space. The old boiler and pump room, of frame construction, constituting a further fire menace, has been removed. The new boiler space is adjacent to and connected with the coal shed by a covered passage, thus eliminating a long and expensive haul of coal from the storage to the boiler.

Another important change was the construction of a sand filter, with a capacity of 300 gallons of water per minute. The arrangements are such that the water from the cod-spawning cistern enters the filter by gravity. From the filter it is returned to the storage tanks by the pumps. "Make-up" water will be added each day in sufficient quantities to keep the supply in good condition. This will add to the efficiency of the fish-cultural work by eliminating from the hatchery the sediment that is carried in the water taken direct from the harbor and which has been particularly detrimental to the eggs under incubation during periods when the harbor water is agitated by high winds. The arrangement will be further effective in a saving of fuel, since it is found expedient to raise the temperature of the hatchery water supply from 8 to 10 degrees during the winter months. The new system will permit of the water that has been warmed being kept in circulation throughout the entire system. Modern heating apparatus, with automatic thermo controls and an electrically operated pump, for use during the summer when but comparatively small quantities of water are used, will effect a further saving in fuel consumption.

PROPAGATION OF BUFFALOFISH, ATCHAFALAYA (LA.) SUBSTATION.

[C. F. Culler, in Charge.]

The propagation of buffalofish in the Atchafalaya River district of Louisiana is meeting with success, dependent to a large extent on the regulations recently established by the Louisiana Conservation Commission. Under existing arrangements no fisherman is allowed to operate nets during the spawning season without first securing from the State authorities a permit, which is revocable in the event that the eggs of all ripe fish taken are not delivered without charge to collecting agents of the bureau. It is considered that permission to fish during the closed season, with the right to retain the fish captured after stripping, is sufficient compensation for the eggs turned over to the bureau.

This work was inaugurated in the spring of 1918 to meet the large and increasing market demands for buffalofish, and while the water stages in the river during the spawning season are not uniformly favorable the experience gained has demonstrated that, with the local cooperative assistance at present afforded, there is no reason why hatching operations should not be continued on an extensive and profitable basis. Thus far the fishermen have willingly complied with the terms of the regulations, and the cooperation rendered by them has contributed largely to the success of the work.

In the season of 1921 the substation was opened on January 23 and, in order to free the hatchery water supply of the large amount of sediment contained in it, a filter was installed in the water-supply line. No sand being available for the purpose, cinders were substituted, and to the presence of this material is attributed the loss of approximately 46,000,000 of the first eggs received. The removal of the cinders and the refilling of the filter with sand and gravel corrected the situation, though the output of the substation was considerably reduced.

The first eggs were taken on February 27, and during the spawning season, which ended on March 25, a total of 96,440,000 eggs were taken. Of these, 1,440,000 were planted on the spawning grounds after being fertilized and 38,600,000 fry were developed at the hatchery. The conditions were unusual, inasmuch as the Atachafalaya River was at a low stage until late in January, whereas a rise occurs in the late fall in more normal years, its effects continuing into the spring months. To this condition may be attributed the short season and the small numbers of fish on the customary spawning grounds. The water temperatures during the egg-collecting period ranged from 60 to 76° F. The incubation period was 10 days in a mean water temperature of 60°. The eye spots in the egg are visible to the unaided eye in from four to five days, and the fry have absorbed the umbilical sac in from four to five days after hatching.

Further counts and measurements to ascertain the correct number of eggs to a liquid quart were made and a standard of 120,000 was established as a result. Observations were made at several points to determine the percentage of fertilization that is attained in eggs deposited under natural conditions. The results varied from zero in certain places to as high as 40 per cent at others, with an average of 10 per cent at all points considered. Efforts were also made to secure information relative to the spawning of the paddlefish, but nothing of a reliable nature was gained.

Buffalofish propagation conducted on an experimental scale at Clarendon, Ark., has been permanently discontinued, it having been found that very few of the local fishermen are inclined to lend their cooperation.

PROPAGATION OF ANADROMOUS FISHES OF ATLANTIC COASTAL STREAMS.

Included under this head are the shad, glut herring, alewife, striped bass or rockfish, and the Atlantic salmon.

PROPAGATION OF SHAD, BRYANS POINT (MD.) AND EDENTON (N. C.) STATIONS.

The work addressed to the shad is conducted at only two hatcheries, Bryans Point, on the Potomac River in Maryland, and Edenton, on Albemarle Sound in North Carolina. It is interesting to note that the run of shad is being maintained in these regions, notwithstanding the failure to put into effect the greatly needed regulatory measures for which the bureau has worked. During the 12-year period from 1910 to 1921, both fiscal years inclusive, the Maryland hatchery distributed a total of 448,799,000 shad fry, an average annual output of 37,399,000. The total output of shad from the North Carolina hatchery during the same period amounted to

409,683,000, or an average annual ouput of 34,140,250. Practically all of these fry in each instance were distributed on local spawning grounds. In view of the conditions that exist in other shad streams where artificial propagation is not conducted, it seems but just to assume that the hatcheries have been a factor in maintaining the shad fisheries in their vicinity.

The bureau is frequently importuned by State officials and others to render assistance in restocking depleted shad streams by planting therein a portion of the output of its two hatcheries. In their efforts to obtain this assistance the illogical argument has been advanced that the shad hatcheries, being the property of the Federal Government and supported by public funds, should apportion their output in accordance with public demands and without regard to the source of supply. Were the bureau to be influenced by such reasoning it would result in dividing the comparatively small output of its two hatcheries among various States along the Atlantic seaboard. The numbers allotted in any instance would be negligible, and such a course would inevitably result disastrously to the fisheries in the waters in which hatchery operations are now conducted.

For many years the bureau followed the policy of making systematic plants of shad fry in the principal shad rivers and tributary streams along the Atlantic seaboard, but the results did not justify a continuance of such efforts, because the States concerned did little or nothing for the protection of the species, and with the rapid and constant increase in fishing operations and fishing devices the run constantly lessened. Finally, in order to maintain the dwindling supply in home waters the bureau found it necessary to discontinue shipments to outside points and return to the local spawning grounds the entire product of its shad hatcheries.

The status of the shad fisheries at the present time is precarious in the extreme, fully warranting the adoption of drastic measures if they are to be saved from total and early extinction. In spite of the discouraging situation, however, the States most nearly concerned have thus far appeared loath to take any decidedly aggressive action toward safeguarding or increasing the run.

While the falling off of the shad run in many Atlantic coastal rivers and their total disappearance in others are due to several causes, the chief factor involved would seem to be a total lack of protection during the spawning season. As a result of the extensive fishing operations near the mouths of such streams and in the salt and brackish waters below very few shad are able to reach their spawning grounds. The considerable amount of trade waste entering the streams has also had a deleterious effect.

The collection of shad eggs in the Potomac, at the Bryans Point (Md.) station, fell considerably below that of a normal season, amounting to only 15,620,000. During February and March the weather was unusually mild, with high water temperatures, the maximum in March being 64° F., with a mean temperature of 52° F. As a result, spawning shad were taken unusually early, and 316,000 eggs were secured during that month. Weather conditions in April were a reversal of those in March, with equally unfavorable results to the work, and the season was brought to an early close on May 9. Approximately 1,110,000 of the eggs secured were sent to central station for an exhibit, and the resulting fry were returned to the Potomac River. The eggs retained for incubation at the hatchery produced 13,639,175 fry, all of which were deposited on local spawning grounds.

The conditions during the season were especially favorable to pound-net operations. The high water temperatures in March appeared to cause the shad in their upstream migration to leave the deep-water channels, which are unobstructed by nets, and seek the shallower water of the flats, thus coming in contact with the pound nets set to intercept them. In 1915 similar conditions prevailed, and that season and the one under discussion represent the only marked variations in the collections of shad eggs at this station in a long period of years.

Another factor bearing on the shad work in the Potomac River is the apparent increasing indifference of certain fishermen to the necessity for cooperating with the bureau by saving for propagation the eggs from the spawning fish taken by them. Most of the fishermen render this service willingly, realizing its value to them and to their industry, but the high prices paid for shad in recent years have evidently created among a certain class of fishermen a feeling that the only important consideration is to get the largest number of shad to market in the shortest possible time. This attitude has undoubtedly resulted in the loss of a very considerable number of eggs, and if it continues it may become advisable to invoke the aid of the Maryland and Virginia authorities. Since the shad fishermen are licensed by the State in which they operate, it would seem that a regulation might be put into effect that would require all fishermen taking shad on the spawning grounds within certain areas and in working distance of the hatchery to assist employees of the bureau in conserving the ripe eggs under penalty of a revoked license for failure to comply.

The first shad eggs for the Edenton (N. C.) hatchery were secured on March 28, and on May 5 the season ended with a total collection of 21,710,000 eggs. As at Bryans Point, climatic conditions were unfavorable for the best results, the fluctuating water temperatures being particularly annoying. A considerable reduction in the expense of collecting eggs was effected during the season by closer cooperative relations with the fishermen, a situation that the bureau has constantly endeavored to foster. One of the difficulties in obtaining shad eggs in this region is the large number of pound nets used. As such nets are lifted at infrequent intervals, the eggs of fish taken in them are seldom fit for incubation. Eggs of the shad appear to be at their best when taken from fish caught between sundown and midnight. For this reason gill nets, which are set on the ebb tide and lifted at half-hour intervals, constitute the most dependable source of egg supply for the Edenton hatchery.

The Edenton station also propagates pond fishes, mention of which is made on page 63.

PROPAGATION OF GLUT HERRING, EDENTON (N. C.) STATION.

The propagation of glut herring was taken up last season for the first time at Edenton, and the results obtained may warrant a continuance of the work. Some opposition was made by local fishermen on the ground that the stripping of the fish reduced their market value, an objection which is not altogether well founded. While it is true that the appearance of the female may be affected by the stripping process, the roe at spawning time has no market value. The spawning season of this species coincides with that of the shad, and for that reason the egg collections were limited, the hatching capacity permitting of a total collection of 56,130,000.

PROPAGATION OF ALEWIFE, BOOTHBAY HARBOR (ME.) STATION.

For the past two seasons attempts have been made to secure eggs of the alewife for artificial propagation at the Boothbay Harbor (Me.) station. The Damariscotta River supports a run of the species, and there is a fishery of some importance at Damariscotta Mills. An examination of the fish taken at this fishery in tidewater very soon disclosed that no fish with mature spawn were obtainable from this source. The efforts made to hold the fish in an inclosure, awaiting the maturity of the eggs, were not successful, and attempts to secure eggs from the fish after their entrance into fresh-water ponds above the falls were equally unsuccessful. Seines, pound nets, and fyke nets were employed at Damariscotta Mills and at West Boothbay Harbor in ponds where the alewife is known to spawn, but the results were negative in every instance in so far as they pertained to eggs for propagation, though considerable numbers of fish with immature eggs and also of spent fish were taken. No satisfactory explanation of this unusual situation is at hand, since alewives in spawning condition are taken in various forms of nets at other points.

PROPAGATION OF STRIPED BASS, WELDON (N. C.) SUBSTATION.

The bureau propagates the striped bass or rockfish at a single substation, located on the Roanoke River at Weldon, N. C., where a yearly average of about 12,500,000 fry is hatched and returned to the spawning grounds in the river. The work is greatly handicapped by the floods usually encountered and also by the difficulty experienced in securing ripe fish of the two sexes at the same time. During the height of the run this latter condition is less pronounced than it is earlier or later in the season. Contrasted with the output of some of the commercial species, the work at this hatchery is not large, but it is showing a steady and gratifying increase, as is evidenced by a comparison of the results of the past 10 years. The production of striped bass fry at Weldon rose from 5,256,000 in 1912 to 20,184,000 in 1921, an increase of nearly 400 per cent.

PROPAGATION OF ATLANTIC SALMON, CRAIG BROOK (ME.) STATION.

[J. D. De Rocher, Superintendent.]

For many years it has been the practice of the bureau to purchase in May and June practically all the salmon captured by the Penobscot River fishermen, estimating the average weight at 12½ pounds, and paying the prevailing market prices for them, together with a bonus of 60 cents per fish for careful handling. The fish have been held in a large lake or inclosure until their eggs were mature, and after having been stripped they have been released in the river. Operations along these lines have resulted in the purchase of almost the entire catch and paying for the fish at a seemingly exorbitant price, this amounting in effect to the maintenance of the run for the sole purpose of furnishing employment to a few river fishermen.

After thoroughly canvassing the situation the bureau recently decided to curtail its expenditures in this direction, with the view of ascertaining if equally good results could not be brought about by less expensive methods. Taking all related facts into consideration, it would seem that the State of Maine should interest itself in providing efficient fishways over the dams which at present obstruct the passage of the salmon to their natural spawning grounds.

At the beginning of the fiscal year there were on hand 316 brood salmon, obtained by purchase from local fishermen in June. At the spawning season in October these fish yielded 911,720 eggs, from which 821,240 fry were hatched. On March 12, 1921, 600,000 eggs of this species were received from the New Brunswick hatcheries of the Canadian Government in exchange for eggs of the brook, rainbow, and blackspotted trouts. These were successfully incubated, producing 565,760 fry, all of which entered into the general distributions in Maine waters.

Propagation of Fishes of Interior Waters.

The serious inroads that have been made in the public waters of the interior as a result of the extensive and rapidly increasing use of the touring automobile are making it exceedingly difficult to maintain the fish supply in such waters. Recognizing the necessity for heavier stocking of their waters, many of the States have called upon the bureau for assistance, which, in view of its greatly overtaxed resources, it has not always been possible to extend. One of the greatest demands is for brook trout. The bureau does not produce its brook-trout eggs, but of necessity relies upon commercial fish-culturists for a large portion of its supply. In many instances such eggs can not be considered as more than a by-product of the commercial plants. They are, as a rule, taken from 2-year-old and 3-year-old fish and for that reason do not have the stamina that might be expected from the progeny of older fish. In view of this situation, Congress has been asked for sufficient funds to establish a plant for the production of the brook-trout eggs needed to fill the bureau's hatcheries. After placing it on an operative basis such a plant could be made to produce eggs of superior quality in numbers sufficient to meet the bureau's requirements and at a smaller cost than is now involved in the purchase of a poor grade of eggs.

The demand for smallmouth black bass can not be met by the hatcheries, the principal handicaps in the work with this species being unfavorable weather and insufficient pond space. Means for increasing the production of bass and other so-called warm-water fishes are again mentioned as being one of the most important requirements of the service. During a long period of time the output of such fishes has not kept pace with the demand, and to meet the deficiency the bureau has found it necessary to utilize for general distribution a small percentage of the fishes rescued from the Mississippi River overflows. In recent years the demand for bass has increased, but funds have not been provided for increasing the production of the species at the fish-cultural stations. This has resulted in a tendency to draw more heavily on the rescue work to meet the demands, until the number of bass so diverted in the fiscal year 1921 amounted to approximately 43 per cent of the total number rescued. Any increased diversion of bass from this source is not advisable, and unless other means are found for an increased production of the fish-cultural stations a large number of applications must of necessity remain unhonored.

Of interest in connection with the fish-cultural work is the development in recent years of fish and game protective associations in practically all parts of the country. Composed as they are of the leading citizens of the communities in which they reside, their influence for the protection and conservation of the natural resources is of great benefit. Such organizations endeavor to obtain the services of men experienced in stocking local streams with fish life, and in many instances they maintain ponds at their own expense for the purpose of rearing young fish obtained from State or Federal hatcheries to a larger size than would be otherwise possible before planting them in public waters. The intelligent cooperation resulting from this movement is marked and is worthy of encouragement. Another favorable influence exerted by organizations of this character is an increased respect on the part of the general public for the State fish and game laws. It is the policy of nearly all such organizations to favor better protective laws, to demand of their members a strict observance thereof, and to urge the same line of conduct on all others with whom they come in contact.

Among the more important species propagated for the stocking of interior waters are the catfish; rainbow, blackspotted, and brook trout; crappies; largemouth and smallmouth black bass; rock bass; and sunfish. The results accomplished with these species by the various stations during the fiscal year 1921 are reviewed in the following discussion. Data concerning the spawning seasons are given on pages 73 and 74, and a tabulation of the amount and cost of fish food used occurs on page 76.

NEW ENGLAND SALMON AND TROUT STATIONS.

BERKSHIRE (MASS.) STATION.

[WILLIAM A. CASLER, Superintendent.]

Fish-cultural work at this station, which is located near the town of Hartsville, Mass., was confined to operations with the brook and rainbow trout. Between October 20 and November 10 brook-trout eggs to the number of 133,500 were collected from brood fish in the station ponds, and two lots of eggs, aggregating 322,500, were acquired by purchase from commercial hatcheries. As the station fish were old and somewhat imperfect through interbreeding, the quality of their eggs was poor and heavy losses resulted, both during the incubation period and at the time the fry were ready to take food. A heavy loss was also sustained on one lot of the commercial eggs from the disease known as "bluesac." In each case, however, after culling out the defective stock no further trouble was experienced, and the distributions of young fish from the three lots of eggs comprised 296,825 healthy No. 1 and 2 fingerlings, with 34,000 fingerlings on hand at the close of the year.

From two lots of rainbow-trout eggs—one of 50,000 transferred from the White Sulphur Springs hatchery and another of 6,920 taken from the station fish—43,900 thrifty fingerlings were produced, of which 2,000 remained on hand at the end of the year. The spawning season of the rainbow trout at this station extended from December 22 to January 20.

CRAIG BROOK (ME.) STATION.

[J. D. De Rocher, Superintendent.]

In addition to the propagation of the Atlantic salmon, for which purpose this station was primarily established, it has an annual output of brook trout from eggs purchased of commercial fish-culturists. The distribution of this species for the fiscal year 1921 amounted to 1,085,000 fry and 23,625 fingerling fish. The year's distributions also included landlocked salmon fry and fingerlings to the number of 43,545, these fish being the product of eggs transferred from Grand Lake Stream. A detailed account of the work with the Atlantic salmon is contained in the section devoted to the anadromous fishes, page 45.

Having an abundant water supply of excellent quality, this station possesses opportunities for development as a trout-rearing center. At comparatively small cost its capacity may be increased to the point where it will alone adequately meet the requirements of that section of the country.

GREEN LAKE (ME.) STATION AND SUBSTATION.

[John A. Story, Superintendent.]

Perhaps the most important part of the work of this station is the propagation of the landlocked salmon. Operations addressed to this species are conducted at the main station, a substation at Grand Lake Stream, and an egg-collecting station on Fish River Lakes, the work at the latter point being done on a cooperative basis with the Maine Commission of Inland Fisheries and Game. At Fish River Lakes egg collections were made from Cross, Eagle, and Square Lakes Thoroughfares, aggregating 525,000. These were all delivered at the State hatchery for eyeing. Under the agreement 250,000 of them were reserved for planting in parent waters, while the remainder were divided equally between the bureau and the State hatcheries after being eyed. The lakes were at high level prior to the spawning season, with but little rain during that period. Under these conditions there was but little and a constantly decreasing current over the usual spawning areas. This is thought to have been a factor in the reduced egg collections, though whether or not it was the most important one it is hardly possible to say. A total of 336 male and 260 female fish were handled during the season, the first being taken on October 24 and the last on November 9.

The number of landlocked salmon eggs taken from Green Lake represents an average season. Pound nets were set at the mouth of Great Brook as usual, and 87 female and 49 male fish were taken, the first fish entering the trap on October 14 and the last on November 19. Eggs to the number of 220,300 were secured, of which 70,000 were shipped to applicants. From the remainder 122,120 fry were hatched and distributed.

Of the 317,200 eggs obtained at Grand Lake Stream 115,000 were shipped to other points and 184,400 were retained for parent waters. To the unseasonably warm weather, which continued through the late fall, and the consequent high-water temperatures the delayed and prolonged run of spawning salmon is attributed. Spawning fish were still being taken in small numbers daily, when a sudden temperature change, with danger from ice, made it necessary to discontinue operations. The adult fish taken this season were of a larger average size than is usual at this point. Several specimens weighing 6 and 7 pounds were taken, yielding an average of 1,600 eggs per fish. During July and August 79,000 fingerling salmon carried over from the previous year were liberated in Grand and Dobsis Lakes.

The work addressed to the propagation of smelt met with a fair degree of success. From the 8,000,000 eggs obtained 7,000,000 fry were hatched and liberated in local waters and 600,000 eyed eggs were shipped to applicants. Practically all of the eggs were obtained this season from natural spawning, the adult fish being confined in troughs until this function was performed, after which they were liberated and the eggs transferred to hatching jars. Comparative tests of this method of obtaining eggs as against artificial stripping seems to prove the superiority of the former method. Of 150,000 eggs taken by artificial stripping only about 15 per cent produced fry, while the percentage of hatch obtained from natural spawning was 95. It was noted, however, that the best results were obtained from fish that were about ready to spawn when taken. When held in confinement for more than 36 hours prior to spawning, eggs of a poor quality resulted. In one instance a trough in which approximately 500,000 eggs had been deposited was left undisturbed for observation after the removal of the adult fish. On the fourth day the eggs showed the effects of smothering, this condition, which is well known to fish-culturists, being brought about by improper aeration of the water. The dam at the outlet end of the trough was raised, thus subjecting the eggs to a more rapid flow of water and relieving the dangerous symptoms. These eggs completed incubation in 14 days, with a mean water temperature of 55.5° F., as against 20 to 27 days for the eggs incubated in Downing jars, with a mean water temperature of 46°.

In addition to the species already mentioned, brook-trout eggs to the number of 788,860 acquired by purchase from commercial dealers and 50,000 rainbow-trout eggs transferred from the bureau's Virginia station were received during the year. Fifty thousand of the brook-trout eggs were reshipped to the Grand Lake Stream substation. From the eggs of that species retained at Green Lake 608,050 fry were distributed. The rainbow-trout eggs underwent a rather heavy loss during incubation and produced only 26,000 fry.

The distributions from the Grand Lake substation consisted of 47,880 brook-trout fry, 115,000 eyed eggs of the landlocked salmon, 55,000 landlocked-salmon fry, and 79,100 landlocked-salmon fingerlings, with approximately 74,000 fingerlings of that species on hand at the end of the year.

NASHUA (N. H.) STATION.

[WALDO F. HUBBARD, Superintendent.]

The work at this station was concerned with the brook and rainbow trouts, pike perch, and smallmouth black bass. A few brook-trout eggs were obtained from brood fish at the station, but most of the eggs of this species were acquired by purchase. The rainbow eggs, with the exception of 16,638 taken from fish in the hatchery ponds, were transferred from the Wytheville (Va.) station, and the pike-perch operations consisted in the incubation of 2,000,000 eyed eggs shipped from Swanton, Vt. During the spawning season of the smallmouth black bass in Lake Sunapee, extending from June 2 to June 17, collections of fry of that species to the number of 31,700 were made and shipped to applicants. The work with the various species was conducted without unusual incident, and the output of fish for distribution is shown in the table on page 12.

ST. JOHNSBURY (VT.) STATION.

[A. H. DINSMORE, Superintendent.]

From this station as a center the usual field stations for the collection of brook-trout eggs were operated at Lake Mitchell and Darling Pond. Largely because of climatic conditions, the results of the work at both points were rather unsatisfactory. The egg collections amounted to 214,148 and 411,777, respectively, all of which were of the usual high quality.

During the summer of 1920 an investigation was made of the fish-cultural possibilities existing at points on the Big Margalloway and Little Margalloway Rivers and Parmacheenee Lake, in northern Maine. As the field gave promise of satisfactory returns, a tentative plan was formulated for undertaking work in cooperation with the Northern Oxford Guides Association. The first eggs were taken October 13, and the collections, which extended to October 27, aggregated 300,000. As the main objects of the work were to build up the supply of trout in the local waters and to encourage the local organization in their fish-cultural activities, the bureau claimed only 50,000 of the eggs secured. The others were successfully incubated in the log hatchery put up by the association, and the resulting fry were planted, with but slight loss, in local waters. While the work was not particularly successful from a fish-cultural standpoint, the information gained will be useful in connection with any future work that may be attempted in that field.

At Lake Dunmore, Vt., a new field station was established for the collection of lake-trout eggs and was operated jointly by Federal and State employees. Eggs to the number of 130,000 were collected and sent to the Holden hatchery, another subsidiary of the St. Johnsbury station, to be eyed. After reaching the eyed stage half of them were turned over to the State fisheries authorities.

In accordance with past custom a considerable number of brook-trout eggs was purchased, and as usual they were greatly inferior to the eggs obtained from wild stock. Such purchases amounted to 877,800, and 56,000 eggs in addition were turned over to St. Johnsbury station by a Massachusetts dealer, with the understanding that half the resulting fry were to be placed at his disposal for sale to persons desiring fish for stocking private waters, the other half to be the property of the bureau. Two shipments of steelhead-salmon eggs, aggregating 58,000, were received from one of the Puget Sound (Wash.) stations, and a consignment of 25,000 landlocked-salmon eggs was forwarded from the Grand Lake Stream (Me.) hatchery.

Following the custom of past years, collections of smallmouth black bass fry were undertaken at Lake Tarleton, and though started some 10 days earlier than ever before they did not precede the unusually early spawning of the bass. High winds interfered with the work, making difficult the placing of screens and the dipping of the fish, and in some instances the screens were destroyed. Approximately 54,000 fry were obtained from this source and placed in ponds at the St. Johnsbury station for later distribution. This work at Lake Tarleton enables the bureau to secure limited numbers of bass for distribution in the Vermont field and at the same time assists in keeping down their numbers in the lake, where they are considered objectionable.

At the Holden substation approximately 350,000 brook-trout eggs were received, some from the field stations and some from commercial hatcheries, and the distributions of fry and fingerling fish from this lot amounted to 173,700, with 47,380 fingerlings on hand at the end of the year. The rather serious losses made evident by these figures are attributed mainly to an accident occurring on April 15, when the spring water supply to the hatchery was cut off. A more extensive system of aeration had been installed to overcome the losses occurring in recent years through defective aeration of the water. The new system promises good results, but because of this accident the evidence in its favor can not yet be considered conclusive. This substation also handled and distributed the product of approximately 145,000 lake-trout eggs collected at Lake Dunmore, Vt., 25,000 of the same species transferred from the Charlevoix (Mich.) field, and 50,000 rainbow-trout eggs received from the West Virginia hatchery of the bureau.

Work looking to the development of the York Pond (N. H.) site as a station for the production of brook-trout eggs was carried forward as expeditiously as the limited funds available for the purpose would allow. During the summer the small bottom west of the pond and the extensive flat below it were cleared and a small log cabin to house the employees was constructed. Officers of the Forest Service have rendered valuable aid in the work of developing this station. Through their efforts the camp has been provided with telephone connections, and they are planning for the construction of a wagon road to the site. They have also rendered assistance in running levels, with the view of turning the flow of one or more of the adjacent brooks into the pond system.

ROCKY MOUNTAIN TROUT STATIONS.

BOZEMAN (MONT.) STATION AND SUBSTATIONS.

[W. T. THOMPSON, Superintendent.]

Although the cold, stormy weather of winter was unduly protracted, interfering with fish-cultural work into the late spring months, a satisfactory season is to be recorded in this field. With Bozeman station as headquarters an auxiliary station is operated at Meadow Creek, in the Madison Valley, and substations in the Glacier National Park and the Yellowstone Park.

BOZEMAN (MONT.) STATION.

Fish-cultural work at the Bozeman station was confined to the incubation of eggs transferred from other points, these transfers amounting to 1,357,200 rainbow-trout eggs from Meadow Creek, 1,236,400 blackspotted-trout eggs from Yellowstone Park, and brook-trout eggs from the Springville and Leadville stations in the numbers of 350,000 and 782,000, respectively. Part of the rainbow-trout eggs were shipped to applicants and other stations; the remainder were hatched and distributed as fry and fingerlings to fill the demands for them in Montana, Wyoming, Idaho, Washington, and Oregon. Approximately 800,000 fry of the rainbow trout and blackspotted trout remained on hand at the close of the fiscal year.

MEADOW CREEK (MONT.) AUXILIARY STATION.

The Meadow Creek egg-collecting or auxiliary station was opened on April 9. The weather throughout the spring was cold and stormy, and there was no clearly defined run of fish, as is the case under more favorable conditions. The first rainbow trout appeared at the rack early in April, and the run continued at intervals up to June 10, during which period 2,273,000 eggs were taken. Of this number 1,357,200 were sent to the Bozeman station. The eggs taken during the latter half of the spawning season were of poorer quality than usual, probably because of the turbid water, which was materially affected by the storm conditions. The results of hatching were therefore disappointing, and of those retained for stocking home waters only 300,000 fry were realized. Near the close of the fiscal year 500,000 blackspotted-trout eggs were received at the Meadow Creek hatchery from the State hatchery at Anaconda, and these, with 30,000 rainbow-trout fry, were on hand June 30.

Mixed in with the rainbow-trout run were a limited number of grayling, though not sufficient to warrant spawn taking. The fish appeared to have been driven into the lake by the soft ice in the stream shortly after their appearance at the racks, the grayling evidently being very susceptible to influences of this kind. In recent years grayling have deserted the Meadow Creek spawning grounds, to which they formerly ascended in considerable numbers every spring. Whether or not the successful establishment of the rainbow trout therein is responsible for the abandonment of the stream by the grayling is conjectural, but the present spawning grounds of the fish in the region are unknown, though several attempts have been made to locate them.

YELLOWSTONE PARK (WYO.) SUBSTATION.

The spawning season of the blackspotted trout in the Yellowstone Park involves portions of two fiscal years. At the beginning of the fiscal year 1921 there were on hand in the hatchery 850,000 eggs which had been collected in June, and this number, added to the total obtained in July, gave an aggregate collection of 6,430,400 for the season. During the spring of 1921 the season was late, as at the Meadow Creek auxiliary station, and ice was still in Yellowstone Lake at the arrival of the spawning crews on June 10. The first eggs were taken at Fish Lake, near Soda Butte, on June 19, and at the close of the fiscal year the total egg collection numbered 1,747,500, of which 829,600 were obtained from Fish Lake and the remainder at different points on Yellowstone Lake. All eggs taken during the year were of excellent quality. The usual limited numbers were assigned to various State fish and game commissions, and smaller numbers were diverted for stocking the waters of the Glacier National Park. The remaining eggs were incubated at the lake hatchery, and fry to the number of 2,012,400 were distributed in Yellowstone Park waters, the park superintendent cooperating in the distribution.

GLACIER PARK (MONT.) SUBSTATION.

From the Glacier Park hatchery, which was in operation for a period extending from June 13 to September 17, 1921, there were distributed in park waters 2,035,000 fry and fingerling grayling, brook, rainbow, and blackspotted trout, with approximately 445,000 grayling and rainbow-trout fry on hand at the close of the fiscal year. The rainbow trout were derived from the Madison Valley egg collections and the blackspotted trout from the Yellowstone Park. For the grayling and the brook trout the bureau is indebted to the Montana Fish and Game Commission, and grateful acknowledgment of this cooperative assistance is hereby made. As in the Yellowstone Park distributions, officers of the national park service rendered valuable assistance in transporting the fish to suitable points for planting.

LEADVILLE (COLO.) STATION.

[CHARLES B. GRATER, Superintendent.]

The output of fry and fingerling fish from this station was smaller than usual because of certain conditions affecting the egg collections at two important sources. Low water at Turquoise Lake exposed the customary spawning beds of the trout, and attempts to take the fish by seines and fyke nets at other probable spawning points were not altogether successful. Similar conditions existed at Engelbrecht Lake, where further difficulties were experienced also in the matter of transportation. The aggregate total of brook-trout eggs obtained from the collecting fields occupied was 4,305,400. This station also handled 1,209,000 blackspotted-trout eggs transferred from the Yellowstone Park field, 130,000 rainbow-trout eggs from the stations in Wyoming and Utah, and 25,000 lake-trout eggs shipped from Michigan.

The Leadville station has for a number of years been able to successfully operate field stations at a number of privately owned lakes and reservoirs, obtaining from them considerable numbers of brook-trout eggs for distribution in the form of fry and fingerling fish to applicants throughout Colorado and New Mexico and at the same time maintain unimpaired the original sources of supply. In recent years this work has suffered from the frequent labor changes occasioned by the low rate of compensation offered, and in certain instances the lake owners have refused to permit the continuance of fish-cultural work under the direction of the inexperienced men whom the bureau has been forced to place in charge. The time is at hand when a more definite policy with reference to this field of operations will have to be adopted if the work is not to seriously deteriorate.

SARATOGA (WYO.) STATION.

[O. N. BALDWIN, Superintendent.]

As has been mentioned in several previous reports, this field remains practically undeveloped because of lack of funds. Every year the station employees, at the expenditure of much time and labor, secure limited numbers of eggs at field stations where, with proper equipment and means for eying eggs intended for transfer and for the complete incubation of those needed for the maintenance of the local run of fish, the egg collections might be very greatly increased, the loss of eggs incident to their transfer in the green state obviated, operating expenses reduced, and the general efficiency of the work greatly improved. During the spring of 1921, with the primitive means available, the Sage Creek collecting field yielded 1,185,295 rainbow-trout eggs, Lost Creek, 982,185, and Canyon Creek—occupied for the first time—351,850, a total of 2,519,330. The station brood stock also produced 140,000 eyed eggs of this species.

Brook-trout eggs to the number of 1,132,400 were handled during the year. Of these 134,000 were taken from the station brood stock, 448,000 were received from Springville (Utah) station, and the remainder were taken at a new and promising field station located at Big Creek Lake, in North Park, Colo. This field is about 100 miles from the Saratoga station, well up on the Continental Divide. Incubation of the brook-trout eggs was completed a full month earlier than usual, with the result that most of the fry were taking food early in the winter.

Incidental to the other fish-cultural work, there are taken each season small numbers of Loch Leven-trout eggs, this species appearing to thrive in the streams of the region. With the more complete development of fields contiguous to the station it is probable that very successful work can be accomplished with the Loch Leven. Besides the species already mentioned, 200,000 blackspotted-trout eggs were received from Yellowstone Park collections and were incubated with a loss of only 6,000. The resulting fry and fingerlings entered into the general distribution. With improved roads and better transportation facilities there is reason to believe that the black-spotted trout will also eventually bear a conspicuous part in the operations of the Saratoga station. There remained on hand at the close of the year upward of 1,000,000 eggs, fry, and fingerling fish.

SPEARFISH (S. DAK.) STATION.

[D. C. BOOTH, Superintendent.]

There was a decrease in the output of this station during the fiscal year 1921 as compared with previous years, this condition resulting from the very limited water supply available. For a number of years the spring that has furnished the station with water has been decreasing in volume, until during the season of 1920 its flow did not exceed 25 gallons per minute. Quite opportunely, the city of Spearfish found it necessary to augment the city supply by constructing a new reservoir, and the bureau was able to effect an arrangement whereby it obtains the surplus water for its fish-cultural work. The expense involved in installing the new system made it necessary to greatly curtail all other expenditures during the year.

From the brood fish on hand 222,500 brook-trout eggs, 37,600 Loch Leven-trout eggs, and 79,000 rainbow-trout eggs were obtained These collections were supplemented by the transfer of 150,000 rainbow-trout eggs from the Bozeman and Springville stations and 200,000 of that species from a commercial fish-culturist in Pennsylvania in exchange for an equal number of brook-trout eggs furnished from the bureau's Leadville station. Some 46,000 green brook-trout eggs were purchased from a local source, and 25,000 lake-trout eggs were received from the Duluth station. The fry and fingerlings resulting from all of this stock entered into the general distributions.

SPRINGVILLE (UTAH) STATION AND SUBSTATION.

[CLAUDIUS WALLICH, Superintendent.]

Fish-cultural work in this field during the year resulted in the distribution to applicants or in local waters from which egg collections were made of 463,600 No. 2 to No. 5 fingerling brook, blackspotted, and rainbow trouts, 250,000 eyed rainbow-trout eggs, 2,000 fingerling catfish, and 600,000 fry of the Bonneville whitefish from the Paris (Idaho) substation. In addition to the above approximately 700,000 fry and fingerlings of the various species of trout handled remained on hand at the close of the year and a total of 1,202,000 eyed brook-trout eggs were shipped, being consigned to the Bozeman, Saratoga, Spearfish, and Clackamas stations. These eggs do not enter into the records as an output of the Springville station.

Eggs to the number of 51,400 were obtained from the brood stock of brook trout at their first spawning. Because of inadequate facilities for handling the spawning fish there was a loss of eggs from natural spawning. The eggs taken were of a quality equal to that from wild fish. Spawning continued throughout the month of December. The brood stock of blackspotted trout yielded 107,800 eggs, the spawning season extending from March 20 to May 20. An overflow of muddy water through the pond system during the spawning season interfered with the most efficient conduct of the spawn-taking work, hence the quality of the eggs was somewhat impaired. Spawning of the rainbow trout continued from December 30 to March 19, during which period 179,000 eggs were taken. In contrast to the brook trout the rainbows have continued in a healthy and growing condition and successful results from the brood stock of that species are anticipated.

From the collecting stations located on Fish Lake, which are operating jointly by the bureau and the State of Utah, 1,901,400 brook-trout eggs and 1,734,800 rainbow-trout eggs were obtained as the bureau's share of the work. Employees of the bureau occupied the station at Twin Creeks from October 30 to November 14, after which the field was left to employees of the State. It is encouraging to note that the run of brook trout at this point has increased since the bureau's operations were undertaken, and it has been reported from reliable sources that a noticeable increase in the average size of the fish has occurred during the past two seasans, though this has not been verified by actual measurements or weight. The abundance of immature fish in the creek and along the shores of the lake appears to be a further indication of the success of the liberal planting of large-sized fingerlings.

During the course of the brook-trout egg collections it was noted that the adult rainbow trout were dying in considerable numbers, a condition that had existed for several months from information brought out on inquiry. The cause of the mortality could not be ascertained. The rainbow-trout spawning season at Twin Creeks occurred between May 1 and June 4, and at this time there was no indication of the mortality noticed in the previous fall.

There are several promising opportunities for extending the trout work of this station, among which may be mentioned the Kayune Reservoir, which is the property of the U. S. Fuel Co. This reservoir has been offered to the bureau exclusively for fish-cultural work, and the reports received from the plants of brook trout and rainbow trout made in it are most encouraging. There are very good prospects for early railroad communication with the Strawberry Reservoir, of the Reclamation Service, which is at present inaccessible during the spawning season of the rainbow trout. A recent investigation of Jorgensen Creek, a tributary of Fish Lake, about 4 miles from the present camp on Twin Creeks, indicates that a field station might profitably be established at that point. At the time the place was visited 46 large fish which had been beheaded by coyotes were noted.

The substation established for the propagation of the Bear Lake whitefish at Paris, Idaho, was opened on November 22 and operated until April 10. The usual difficulties encountered during the egg-collecting season—severe cold, violent winds, and snowstorms—prevailed without abatement. Eggs to the number of 1,056,000 were taken, from which 600,000 fry were hatched and planted, 500,000 being deposited on the spawning grounds in Bear Lake and 100,000 in Utah Lake.

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

The stations possessing the greatest attractions for the general public are, perhaps, those located in sections of the country where the natural conditions make it possible to propagate both the Salmonidæ and the pond fishes. At such stations a brood stock of the various species handled is maintained at all times and work of a strictly fish-cultural nature is under way throughout the year, whereas the fish-cultural work at certain of the hatcheries, especially those handling the commercial species, is seasonal in its character. The "combination" stations operated by the bureau are located at Erwin, Tenn.; Manchester, Iowa; Neosho, Mo.; White Sulphur Springs, W. Va.; and Wytheville, Va. Following is the aggregate output, by species, of this group of stations for 1921:

Brook trout	1,664,950
Crappie	14,332
Largemouth black bass	121,978
Pike perch	500,000
Rainbow trout	2,583,244
Rock bass	95,385
Smallmouth black bass	112,591
Sunfish	62,355
Yellow perch	58
Total	5,154,893

ERWIN (TENN.) STATION.

[A. G. KEESECKER, Superintendent.]

The aggregate output of this station shows an increase of about 30 per cent over that of the previous year. The spawning season of the rainbow trout began on November 8 and continued to January 27, the total egg collection amounting to 936,000, of which 822,000 were eyed. With the exception of 55,000 eyed eggs supplied to the State hatchery at Elkmont, Tenn., the entire lot was incubated in the Erwin hatchery. The losses were merely nominal, and the output of this species for the year amounted to 755,100, this number including 59,926 fingerlings derived from eggs transferred from the Neosho (Mo.) station. As an addition to the brood stock 10,000 steelhead eggs transferred from the Birdsview (Wash.) station were incubated, producing 9,300 fry. The year's work with the rainbow trout indicates a very satisfactory improvement, both with regard to the productivity of the brood fish and the quality of the eggs secured. No brood stock of brook trout is maintained at this station, all eggs of that species handled being acquired by purchase from commercial dealers. During the year the 439,300 eggs thus acquired resulted in an output of 300,435 fingerlings.

The spawning season of the smallmouth black bass began on April 13 and continued to May 28. Twelve nests were occupied, and 10 of them were productive, though the percentage of fry hatched in each nest was small. The distribution of this species amounted to 5,165 fingerlings, and it was estimated that upward of 3,000 were on hand at the close of the year. The outcome of the operations with the largemouth black bass was better, 65,980 of these being available for distribution, with approximately 10,000 on hand at the end of June. During the spawning period, extending from April 13 to June 1, the warm weather during the spring was followed by colder weather, and this was an important factor in reducing the output of both species of black bass. The year's distribution also included 17,200 rock bass, 400 strawberry bass, and 20,350 sunfish, all fingerlings.

MANCHESTER (IOWA) STATION.

[FRANK E. HARE, Superintendent.]

The output of this station consists of 125,500 eyed eggs of the rainbow trout and 678,585 fry and fingerling fish of the different species propagated. The rainbow-trout brood stock did not yield an altogether satisfactory return, there being only 378,600 eggs taken. With the maturity of plans now being formulated a very decided improvement in this direction is confidently expected. During the spring 25,000 eggs taken from wild rainbow trout were transferred to Manchester from the bureau's Montana station with the view of infusing new blood in the brood stock, and the product of an equal number of steelhead eggs shipped from the Birdsview (Wash.) station will also be reared with that end in view. The adult brook trout, consisting of 625 2-year-old fish and 35 fish 3 years old and over, yielded 58,000 eggs. These fish were again affected by a gill disease just prior to the spawning season and suffered a heavy mortality. Brook-trout eggs to the number of 550,000 were obtained from commercial dealers in Massachusetts and incubated with satisfactory results. The cold weather of the late spring reduced the output of largemouth black bass to 2,500 fingerlings, but better success attended the culture of the rock bass, the distribution of that species amounting to 53,910 No. 1½ fingerlings.

NEOSHO (MO.) STATION.

[FRED J. FOSTER, Superintendent.]

There was a very satisfactory increase in the output of rainbow trout from this station for the fiscal year 1921. The records indicate that the egg shipments were increased over those of the preceding year by 48 per cent, while the increase in the number of fingerling fish distributed was as high as 117 per cent. The improvement was not confined solely to the increased number of fish and eggs produced but has been extended to the quality of the product and a betterment of the condition of the brood stock.

For a number of years the station has been supplied with water from two sources—the Hearell Spring and the McMahon Reservoir. Observations made by the superintendent led to the belief that the eggs of fish held in ponds supplied from the spring were not equal, either in numbers or quality, to those taken from fish in ponds supplied from the reservoir. For the purpose of testing the soundness of this theory the following experiment was conducted: A number of 3-year-old rainbow trout from the same hatch, which up to the time of the experiment had been held in the same pond, were divided into two equal lots. One lot was placed in pond No. 18, supplied entirely with water from the McMahon Reservoir, and the other was placed in Pond F, supplied largely from Hearell Spring. The eggs obtained from fish held in the McMahon water proved 82 per cent fertile, while the rate of fertility of the other lot was only 67. This and further experiments along the same lines gave these results:

Pond.	McMahon water.	Hearell water.	Fertile eggs.	Pond.	McMahon water.	Hearell water.	Fertile eggs.
	Per cent.	*Per cent.*	*Per cent.*		*Per cent.*	*Per cent.*	*Per cent.*
No. 18	100	0	82	No. 5	50	50	77
No. 15	70	30	80	No. F	30	70	67

It is unfortunate that more complete data on these experiments are not available, and perhaps the data at hand can not be accepted as conclusive. Nevertheless, the evidence seemed sufficiently strong to warrant the construction of two new ponds supplied entirely with the McMahon water and the alteration of present lines to admit of a further elimination of the Hearell water from the stock ponds. During the coming year the brood stock of rainbow trout will be held exclusively in ponds supplied with the McMahon water. The nature of the apparent ill effects of the water from Hearell Spring on the adult fish has never been ascertained, but an ovarian affection appears to prevail among the fish that have been retained in that water for any considerable period.

Another item of possible interest in trout culture at the Neosho station was the occurrence of a disease among the fingerling trout, both at the main station and at the Roaring River substation, resulting in some loss. The trouble first appeared as a discoloration of the gills from cream to brown in color, sometimes one and sometimes both gills being affected. This was followed by an apparent disintegration of the tissues and finally by a peculiar sloughing off of the gill. The trouble manifested itself only in the newly constructed ponds or in ponds supplied with water from recently constructed reservoirs. On being removed to surroundings entirely remote from new concrete work the fish recovered rapidly, even in advanced cases where the gill seemed to have been destroyed. After being treated with a 1 to 1,000 solution of copper sulphate these affected ponds were allowed to remain idle for several months, and no trouble in connection with their use has since developed.

The output of pond fishes also shows an improvement over the recent past, the aggregate having been exceeded only in two previous seasons. Further improvement in this line of effort involves some interesting problems. The ovarian trouble of the rainbow trout may be present among the pond fishes held in water from Hearell Spring, and investigations looking toward the solution of this phase of the subject are already under way. The station ponds devoted to the production of the warm-water species are well supplied with natural food for their young, and were fingerling fish produced to the extent of the natural food available the station's output would be materially increased. The warm-water species propagated are largemouth and smallmouth black basses, rock bass, sunfish, crappie, and yellow perch. Artificial nests were tried in connection with the spawning of the largemouth black bass, with results that led the superintendent to recommend their general use. The output of the station by species is indicated in the tabular statement showing the production of fish by stations on page 12.

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[DELL BROWN, Superintendent.]

Work at this station during the year was conducted along the usual lines. The results from trout propagation, both the brook and the rainbow, were of a satisfactory nature, but, on the other hand, the spawning of the two species of the pond fishes turned out to be an almost total failure.

The brood stock of approximately 2,700 female rainbow trout 2 years old and older produced 1,058,900 eggs, or more than a half million in excess of the previous season's collection. Only 68 per cent of them hatched, however, and the cause of this heavy mortality can not be explained. On reaching the eyed stage 447,000 were supplied to applicants and transferred to other stations of the bureau. The remainder were incubated at the station, together with a consignment of 100,000 received from the Wytheville (Va.) hatchery. The brood stock of brook trout, consisting of about 150 3-year-old fish and 350 2-year-old fish, yielded 80,000 eggs, which number was supplemented by the purchase of a million eggs from commercial dealers in New England. The so-called "white-spot" disease caused some mortality among the fry of this species just prior to the feeding stage, and a gill affection was prevalent later among the fingerlings. Eggs to the number of 22,000 were taken from 150 3-year-old albino brook trout. The males of this lot appeared to be lacking in virility, and some difficulty was experienced in obtaining the necessary fertilizing medium. Nine thousand fingerlings resulted from these albino aggs, 1,000 of which were furnished to applicants, leaving 8,000 on hand at the close of the year.

A consignment of adult smallmouth black bass obtained from Lake Erie waters for a brood stock survived the winter without undue loss, numbering 115 at spawning time. During the spring 46 nests of this species were noted in the ponds, and the output of fry amounted to 100,500. The 23 largemouth black bass on hand produced 25,800 fry and 600 fingerling fish. The results from the rock bass and sunfish were negligible. This condition was attributed in part to lack of proper nourishment, it having never been the custom to feed the brood-pond fishes at this station. Steps have now been taken to feed them on beef heart, and the results will be carefully noted.

WYTHEVILLE (VA.) STATION.

[GEORGE A. SEAGLE, Superintendent.]

During the spawning season of the rainbow trout the 2,960 adult females on hand yielded 870,352 eggs, of which shipments totaling 480,000 were transferred in the eyed state to applicants and to other hatcheries of the bureau. The spawning season was unusually protracted, extending from October 10, 1920, to March 15, 1921, the wild fish recently introduced into the brood stock probably being the later spawners.

At the beginning of the spawning season 695 2-year-old fish were turned over to a representative of the scientific division for experiment. From these fish 30,500 eyed eggs and 19,000 fry were returned to the hatchery stock at the end of the season's investigations, and they are included in the station's output. The experimental work connected with the spawning of the rainbow trout will be continued over a series of years, the operations next year to be conducted at Erwin, Tenn. With this end in view 416 of the adult fish involved in last season's work have been transferred to Erwin.

The output of brook trout from the station was reduced to negligible proportions by an apparently infectious disease which attacked the fry shortly after incubation was completed. Eggs from commercial hatcheries to the number of 274,000 were received, but because of this trouble only 30,900 fry were available for distribution. The output of this species also included 1,900 No. 4 fingerlings carried over from last year's hatch.

The largemouth black bass, usually prolific at this station, produced very few young. The brood stock consisted of 194 fish, and during April 60 nests were counted in one pond. A sudden drop in temperature had the effect of destroying all the eggs deposited, and the few fry produced were the result of a later spawning. The distribution of rock bass consisted of 14,060 fingerling fish Nos. 2 and 3 produced from 230 brood fish, while 10,325 sunfish comprised the output from a stock of 200 breeders of that species. Adult crappie to the number of 47 were carried through the year, but so far as could be ascertained the fish did not spawn, nor have they been known to take food. Of the 20 catfish transferred from the Cold Springs (Ga.) station last year only 5 remained at the end of June, 1921. Because of the rather dense growth of vegetation in the pond in which they were carried nothing could be learned as to any possible spawning activities. A consignment of 500,000 pike-perch eggs received from the Swanton (Vt.) hatchery was successfully incubated, and the resulting fry were planted in New River, Va.

With the view of increasing the efficiency of the work at the Wytheville station, particularly in connection with trout propagation, further repairs and improvements were made in addition to the new water-supply system installed last year. The more important features of this improvement were the demolition of the old wooden building used as a nursery and the construction of a new two-story building 56 by 36 feet. The building is of concrete to the window sills of the second story and of frame construction above that. It will contain 60 standard troughs—20 on the first floor supplied with brook water and 40 on the second level—which may use either brook or spring water, or a mixture of both as may be desirable. An enlarged settling tank and filter are also in process of construction for the correction of the turbid condition to which the spring water is subject for long intervals after heavy rains.

WORK OF POND FISH-CULTURAL STATIONS.

Climatic conditions play an important part in all branches of fish culture, but the success or failure of a season's work at a pond-cultural station is peculiarly susceptible to temperature changes in the spring. If the weather in the early spring is warm, the spawning activities of the fish, particularly the basses, are hastened. Should this condition be followed by a period of falling temperatures, it inevitably results in the desertion of the nests by the adult fish and the loss of practically all the eggs produced.

Future work looking to an increase in the output of the pond fishes must lie along the line of more intensive cultural methods. The proper steps to be taken in this direction are as yet more or less of an unsolved problem, but such studies as have been made would indicate that the problems are subject to satisfactory and practical solution. To the practical fish-culturist the deductions formed by observation of the results obtained from a certain pond giving most excellent results are sometimes seemingly contradicted by the results from another pond where conditions, from the generally accepted theories, are more favorable. Further investigations and studies of these interesting and important problems are urged as being absolutely essential.

Another point in connection with the operation of the pond stations is to determine the most suitable and effective way to distribute the output. The very young fry can not be successfully handled. Even the transfer of such fry to rearing ponds usually meets with a very heavy mortality. On the other hand, if they are retained in the spawning ponds with the adults the first fry appearing are sure to prey to a large extent on the progeny of the later spawners and will themselves fall a prey to the adults. The loss of young fish from cannibalism is large in an artificial pond under the best of conditions. Perhaps the most suitable time to effect the transfer to rearing ponds or to distribute the fish in them is in the advanced fry or No. 1 fingerling stage. At this time they are hardy enough to withstand careful handling, and, being still under the guardianship of the male parent, may easily be taken in a net as they school along the shores of the pond.

SUMMARY OF OUTPUT.

The output of the stations devoted to the culture of the so-called warm-water or pond fishes during the fiscal year 1921 aggregated 2,473,711, as opposed to a production of 1,837,598 the preceding year. The seven stations included in the pond fish-cultural group are given in the table below, with the figures of the aggregate output of each for the fiscal years 1920 and 1921. The Edenton (N. C.) station, though listed with the pond fish-cultural stations, also does important work with the shad and glut herring, mention of which is made on pages 42 and 44 in this report.

Output of Pond Fish-Cultural Stations, Fiscal Years 1920 and 1921.

Station.	Output.		Station.	Output.	
	1920	1921		1920	1921
Cold Springs, Ga	226,833	279,675	San Marcos, Tex	376,500	408,811
Edenton, N. C	42,560	32,990	Tupelo, Miss	472,420	479,875
Louisville, Ky	404,475	1,020,450			
Mammoth Spring, Ark	39,895	32,325	Total	1,837,598	2,473,711
Orangeburg, S. C	274,915	219,675			

COLD SPRINGS (GA.) STATION.

[CHARLES W. BULLOCK, Superintendent.]

Five spawning and two rearing ponds were completed during the year at this station, and it was hoped the additional facilities provided would permit of a material increase in output. As at other points in the Southern States, the weather during the bass spawning season was not propitious. There was a heavy spawning during an unusually warm period in March, permitting of the shipment of more than 100,000 advanced fry in April, whereas the distribution does not usually begin before May 1. A sudden cold spell in April caused a drop of 20 degrees in the water temperature. This resulted in destroying what had appeared to be bright prospects for a remarkably successful season. During the cold weather many of the schools disappeared, and the fish hatched later were small and their rate of growth slow. The few stragglers surviving from the schools destroyed preyed freely on the weaker fish. Perhaps not of the least importance in contributing to the disappointing results was the almost total disappearance from the ponds of the cladocerans, copepods, and chironomids that had been observed in abundance during the early spring. While the numbers of bass produced for distribution represent a very fair average for the station, in view of the promising outlook in the early spring the results are disappointing.

At the Harris Ponds substation catfish and bluegills are reared in the same ponds. In certain respects the bluegills can be more satisfactorily handled than the bass, as they take readily to artificial feeding. It is never possible to anticipate results in the propagation of catfish. In certain seasons the output will be ample for all needs, while the next season, under apparently identical conditions, only small numbers of young are produced. During the past season only 5,000 fingerlings were obtained from 60 adults. In the course of the spring one of the ponds were stocked with 50 adult catfish in addition to the bluegills. Later in the season a heavy mortality occurred as a result of a parasitic affection.

Attempts to propagate crappie at this station have not been particularly successful. Two ponds devoted to the species produced 1,750 fingerlings. Two hundred of these were reserved for brood fish, but as they are very shy and nervous, refusing to take artificial food, it is doubted if they will be of much value in that connection.

The station water supply is lacking in lime or other mineral substance, excepting for a trace of silica. The presence of lime in solution has always been considered desirable in pond fish culture. By way of experiment the water supply to one of the ponds was arranged to pass over a cask of lime, and the results are being noted.

The output of the station for the fiscal year consisted of 212,555 largemouth black bass, 4,120 catfish, 1,550 crappie, 61,350 sunfish, and 100 warmouth bass. Approximately 145,000 of the bass were fry, while the others were all of the fingerling size.

EDENTON (N. C.) STATION.

[EDW. M. HAYNES, Superintendent.]

Five ponds at this station are devoted to the production of the pond fishes, and their output for the year consisted of 23,085 largemouth black bass and 9,904 sunfish, all of the fingerling 2½ size. Thirty adult crappie, obtained during the season for use as brood fish, failed to reproduce, the fluctuating air and water temperatures during the spawning season having a decidedly unfavorable influence on these fish, as it also did on the bass. No recent changes have occurred in the method of conducting the work at this point.

LOUISVILLE (KY.) STATION.

[CHARLES W. BURNHAM, Superintendent.]

The fiscal year 1921 marks the most successful season in the history of the station in the production of fish. The output aggregated 1,020,450 fry and fingerlings, divided, by species, as follows: Largemouth black bass, 33,100; rock bass, 4,500; smallmouth black bass, 156,700; sunfish, 76,150; and yellow perch, 750,000. These fish were distributed to applicants in Kentucky, Indiana, and Ohio, and liberal plants of sunfish were made in local waters.

The brood stock of smallmouth black bass was increased during the year by the purchase of 277 adults from Lake Erie fishermen. Of this number 52 died shortly after being received. The remainder were placed in a spawning pond, but failed entirely to spawn. It is difficult to assign a reason for this, as the fish appeared to be in a healthy condition throughout. A number of those that died from the effects of transportation were examined and found to be carrying eggs, and the 125 older fish at the station produced very excellent results under similar conditions.

It is perhaps worthy of mention here that of the 200 adult smallmouth black bass sent to the Mammoth Spring (Ark.) station from Lake Erie none survived the winter. In connection with the propagation of the basses, it is interesting to note that the young smallmouth black bass grow much more rapidly than the young of the largemouth black species.

Yellow-perch propagation at Louisville was successful this season, the 750,000 fry distributed being the progeny of 300 brood fish. It may be possible to considerably extend this branch of the work by increasing the number of breeders carried in the ponds.

MAMMOTH SPRING (ARK.) STATION.

[WILLIAM S. VINCENT, Superintendent.]

A considerable amount of work looking to the improvement of the pond system was accomplished at this station during the year. Such work in the main has consisted in the installation of concrete "kettles" and outlets in many of the ponds, comprising what is believed to be an innovation in pond construction. (See Fig. 3, opp. p. 68.) Improvements were also made in the drainage system. Four small rearing ponds were converted into one large one, and work was done for the improvement and increased fertility of the bottoms of the ponds.

In an effort to build up the brood stock a number of adult fish of the various species propagated were obtained from local waters during the late summer and early fall. In October 200 adult smallmouth black bass were transferred from Lake Erie. Most of these were unable to survive the winter, and all had perished prior to the spawning season. Hence, the total number of brood fish of this species on hand at that period did not exceed 200. The smallmouth black bass were first observed to be spawning on March 28, when 12 nests were noted, and 38 nests had been occupied by April 8. By the end of the third day fungus had entirely destroyed the eggs on the first 12 nests, and only a negligible number of fry was produced from the remainder of the first spawning. Spawning was resumed on May 6 and 7, when 12 more nests were occupied. From this spawning the total output of smallmouth black bass, amounting to 26,500 fry and fingerling fish, was obtained. No satisfactory explanation for the failure of the early spawning is at hand. The long interval between the spawning periods observed this season is unusual. In previous years it has rarely exceeded one week. In addition to the smallmouth black bass, smaller numbers of the largemouth black bass and rock bass were distributed.

ORANGEBURG (S. C.) STATION.

[GEORGE W. N. BROWN, Superintendent.]

At this station a new pond, approximately 1 acre in area and supplied with water from springs at the head of the small cove in which it is built, was completed and stocked with bass. The output consisted of 204,675 largemouth black bass, 300 crappie, 500 rock bass, and 14,200 sunfish (bluegills), all of fingerling size. A small number of sunfish carried over from the previous year were distributed in connection with the current season's hatch. The station has also a small stock of the spotted catfish (*Ictalurus punctatus*), and it was estimated that approximately 1,000 young of the species were on hand at the close of the year.

SAN MARCOS (TEX.) STATION.

[MARK RILEY, Superintendent.]

The distributions from this station for the year 1921 included the following species: Largemouth black bass, 257,715; catfish, 70,000; crappie, 5,904; rock bass, 320; sunfish, 74,872. The San Marcos station has for a number of years been successful in producing goodly numbers of fish for distribution at a cost that compares favorably with that at any other station. Local conditions seem particularly suited to the purpose, and, unlike the conditions at all other stations, it is not necessary to supply artificial food for either the young or the adult fish. The output for the year 1921 was curtailed by fluctuating water temperatures during the spring and, further, by the ponds overflowing on two occasions, an occurrence that is caused by the unsatisfactory method of street drainage. To augment the production of fish beyond the capacity of the station ponds it has been customary to stock privately owned ponds or "tanks" with fish, with the understanding that the bureau shall have the privilege of taking a reasonable number of the progeny for distribution. Very satisfactory results have been obtained by this method, particularly with the crappie.

TUPELO (MISS.) STATION.

[DAVID DAVIES, Superintendent.]

The output of this station for the year consisted of 405,500 largemouth black bass, 73,005 sunfish, and 1,280 crappie, and the distribution was extended to approximately 310 applicants, located in Mississippi, Alabama, Tennessee, Arkansas, Louisiana, and Kentucky. The station output was also supplemented by a carload shipment of miscellaneous fishes from the rescue field on the upper Mississippi River, consisting of crappie, catfish, rock bass, buffalofish, carp, and yellow perch, all of which entered into the general distributions.

Of possible interest in connection with pond fish culture was the unusually late spawning of the largemouth black bass this year. On August 19, 1921, a lot of 3,000 advanced largemouth black-bass fry were taken from one of the station ponds, and again, on September 28, another lot of the same species and size was obtained.

PRACTICAL DEVICES FOR USE IN POND FISH CULTURE.

A PRACTICAL SYSTEM OF CLEANING FISHPONDS.

The necessity for the frequent cleaning of ponds in which fish are retained under artificial conditions is well known. If the ponds are of cement or lumber construction, the usual method of cleaning is to lower the water level and scrub the sides and bottom of the pond with a suitable brush. During the cleaning process the water in the pond becomes turbid and polluted from stirring up the accumulated sediment and filth from the bottom of the pond. The fish are forced to endure this unnatural condition until the pond is scrubbed, the accumulation of sediment flushed out through the outlet, and the pond again filled with clear water. In addition to this unfavorable condition to which the fish are exposed they are subject to further possible injury by bruises from contact with the brushes used in the scrubbing process. These conditions are entirely unavoidable under the system of cleaning in general use.

At the Manchester (Iowa) station a system of cleaning ponds that successfully overcomes both these difficulties has been adopted. (See Fig. 2.) At this station there are eight stock ponds of cement construction. They are approximately 80 by 13 feet and are 3 feet deep at the outlet, the bottom sloping upward toward the inlet, where the depth is 2½ feet.

For the proper cleaning of the ponds a cement wall or dam, extending into the pond 4½ feet from each side, is installed, leaving a 4-foot opening in the middle. This dam is placed 20 feet from the inlet end of the pond and is 1 foot high. The open ends are grooved to accommodate a dam board 2 inches in thickness. In cleaning the pond the water level is lowered until that portion of the pond bottom between the inlet and the division wall is just covered. The pond being deeper at the outlet end, there is still sufficient water to hold the fish safely while the other section of the pond is being cleaned and flushed. After cleaning the first section the water is permitted to rise until the division wall is about submerged. The fish are then driven through the 4-foot opening in the wall into the clean section of the pond by the use of a "push screen." A board

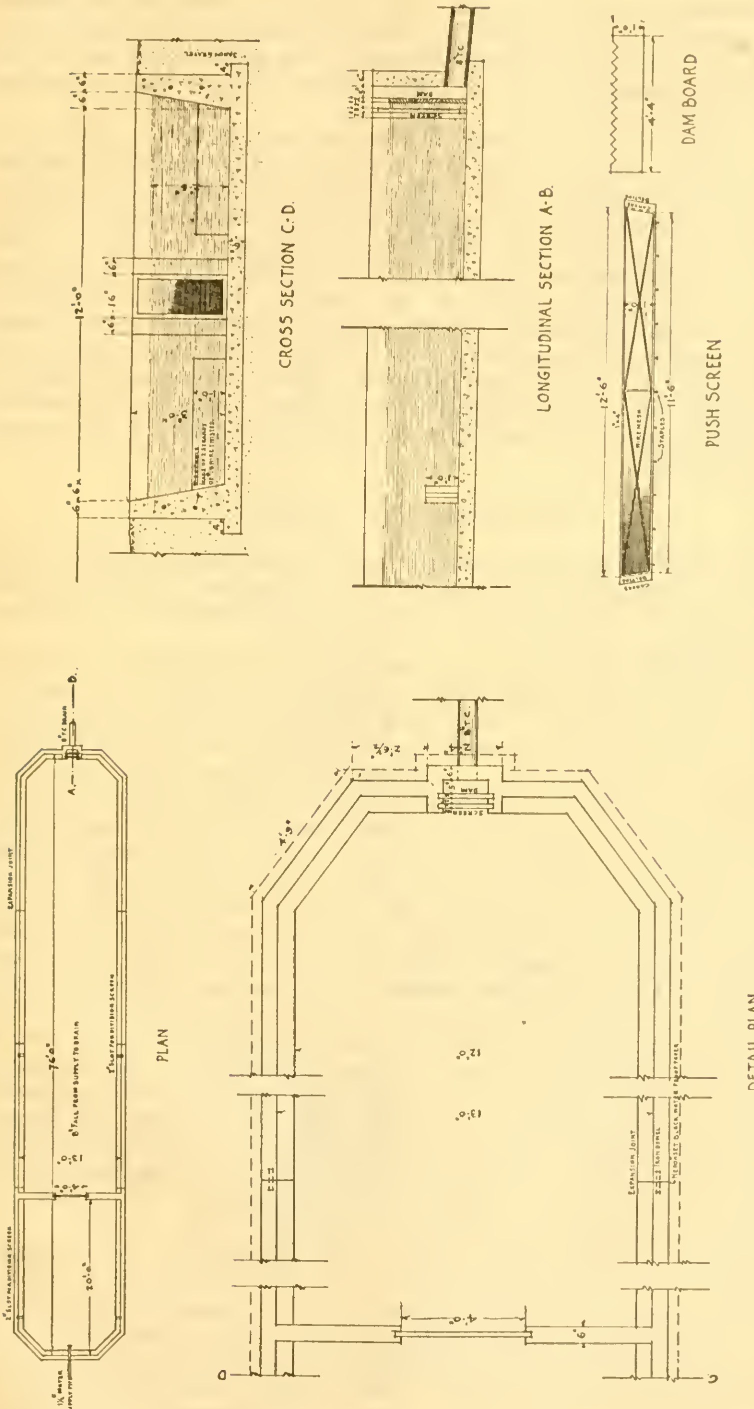


FIG. 2.—Plan of dam and "push screen" for convenient cleaning of stock fishponds. (Designed by F. E. Hare.)

2 inches thick, 1 foot wide, and 4 feet long is inserted in the grooves in the ends of the division wall to retain the fish, while the remaining portion of the pond is being cleaned. The dam board has a saw tooth edge permitting the overflow water to pass but preventing the escape of the fish.

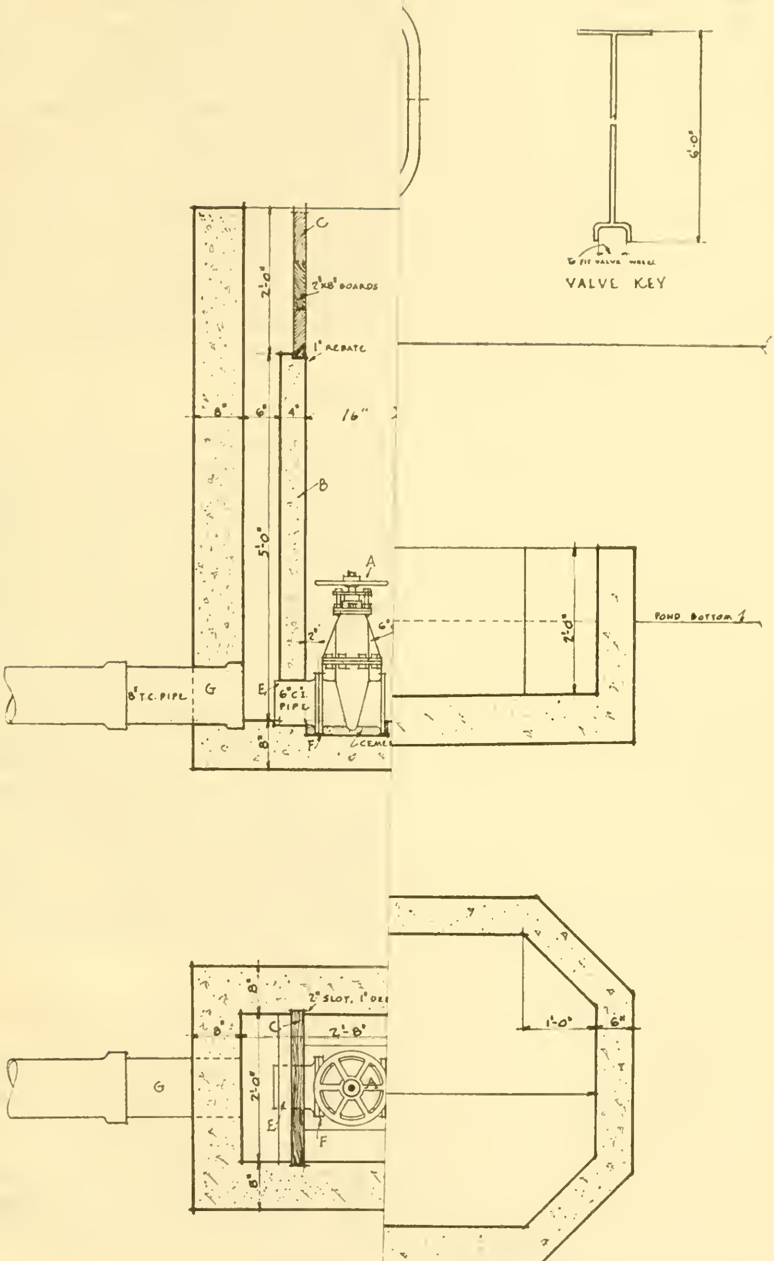
The "push screen" consists of a frame made of 1 by 4 inch lumber, to which is attached poultry netting of 1-inch mesh or smaller if the size of the fish requires. The smaller dimension of the lumber forms the face of the screen, to offer but slight resistance when being pushed through the water. Its shape conforms to the shape of the ponds. At Manchester the sides flare outward. In size it is somewhat shorter than the width of the pond for convenient handling, and to prevent the escape of fish around the ends strips of heavy duck or canvas belting are attached to each end of the screen. Iron staples driven into the bottom board at suitable intervals and slightly protruding will serve to keep the board from dragging on the bottom of the pond and facilitate the easy movement of the screen through the pond.

POND OUTLET AND "KETTLE."

As being of possible interest and value to persons interested in the subject a drawing of the pond outlet and "kettle" previously mentioned (p. 64), with descriptive text and specifications for construction, are given (Fig. 3).

In referring to the cut of the pond outlet and "kettle" it will be noted that it contains features not embodied in other constructions of a similar character. The drain box is made in about the same manner as those now in use at many stations, but in place of the wooden dam boards it has a cement dam *B*, the height of which is determined by the water level when the pond is filled. If it is desired to raise the water level of the pond, the wooden dam boards can be dropped in the slot *C*. The screen *D* is the same as those now in use. To draw down the water in the pond, a gate valve *A* is so placed at the bottom that all of it can be drawn through the kettle. To make this removable, a flanged valve of the standard low-pressure type is used. A short nipple with a flange on one end is placed in the forms when making the drain box. Later a rubber gasket is cut to size and the gate valve is bolted into place. It is not necessary to bolt the valve around the bottom, since it may be desirable at some time to remove it, and it would be a difficult matter to get at bolts so located. A 6-inch gate valve as described above measures approximately $10\frac{1}{2}$ inches from face to face of flanges. Therefore, a standard valve should be used in place of the medium or heavy service valves. It will be necessary to place the flange of the nipple as close to the cement dam *B* as possible. Therefore, the bolts should be put in place before cementing.

Another feature of the plan is the construction of a cement "kettle" in front of the drain box. It will be noted that the side walls of this kettle extend approximately 12 inches above the earth floor of the pond, so that in drawing down the water in the pond when it drops below this point it must then enter at the sluice gates *I*. The small fish will be drawn down through these gates and will immediately seek the more quiet water at the upper end of the kettle.


6'-0"
VALVE KEY
C
2'-0"
2"x8" BOARDS
1" REBATE
8"
6"
4"
16"
B
5'-0"
A
2'-0"
POND BOTTOM
2"
6"
8" T.C. PIPE
G
E
6" C.I. PIPE
8"
F
CEME
8"
2" SLOT, 1" DE
8"
C
2'-8"
1'-0"
6"
G
2'-0"
A
E
F
8"

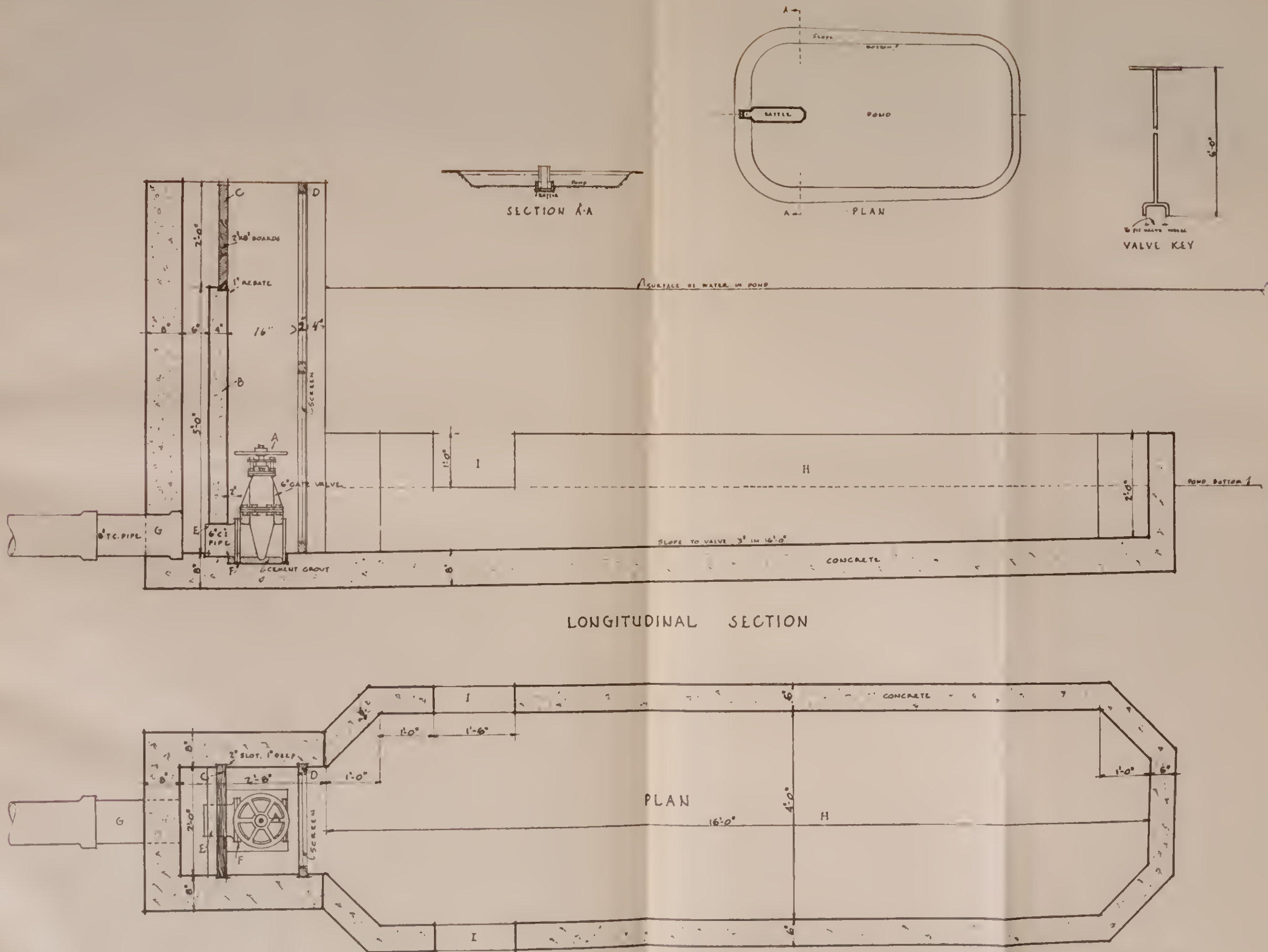


Fig. 3.—Plan of pond outlet and kettle for fishponds. (Designed by G. C. Leach.)

100267°—22. (Face p. 68.)

The water in this portion of the kettle is more or less clear. If only a few fish are desired, they can sometimes be dipped out with the ordinary hand dip net. In some instances it has been found advisable to put a cement walk around the outside of the kettle. This enables the fish-culturist to dip the fish out with greater ease and without agitating the mud on the earth bottom of the pond.

When it is desired to draw the water entirely off the pond, it is first lowered to about one-half its depth and the mud on the bottom of the kettle is stirred with a long-handled spade or broom until it is well agitated, when the gate valve *A* is opened wide and it is flushed out. After this the pond may be drawn down slowly and the fish drawn into the kettle. When the earth bottom of the pond is bare, there will be 1 foot of water in the kettle.

A 6-inch gate valve is sufficiently large for a pond one-half acre or less in area, an 8-inch valve for a three-fourths acre pond, and a 10-inch valve for a 1-acre pond.

SPECIFICATIONS.

Gate valve *A* is flanged and bolted to companion flanges *F* on nipple *E*, which passes through the center of cement dam *B*. The height of dam *B* is to correspond with the desired water level in the pond. Should it be necessary to raise the water level, wooden dam boards may be dropped in the slot *C*. *D* is the screen made in one or two sections, with a mesh in accordance with the size of fish to be carried. The gate valve should be set low enough for the water to drain out of the kettle *H*. Kettle *H* is constructed with end and side walls 12 inches higher than the earth bottom of the pond.

Preparatory to drawing down the pond for the removal of the fish the water is lowered by opening the gate valve with extension rod *J* to a point where it is possible to clean the bottom of the kettle with a long-handled brush. The mud and roily water is flushed out by opening the gate valve wide.

In drawing down the pond after the water level drops below the top wall of the kettle all water from the pond must enter at the side sluices *I*. This leaves the water comparatively quiet in the upper end of the kettle. The small fish seek that portion of the kettle and may easily be removed with a hand dip net.

Material in drain box.

Sides 8 inches, bottom 6 inches; total amount concrete, 50 cubic feet.

Cement	bags	12	1–2–4 mixture. Sand and broken stone or screened gravel.
Sand	cubic feet	22.5	
Stone and gravel	do	45	

Sides 6 inches, bottom 6 inches; total amount concrete, 38 cubic feet.

Cement	bags	9	1–2–4 mixture.
Sand	cubic feet	17	
Stone or gravel	do	34	

Fittings for drain box.

6-inch standard flanged gate valve.
6-inch companion flange.
6-inch nipple 6 inches long,

Reinforcement for dam.

Galvanized stock fence wire, 24-inch width preferred.

Material for kettle.

Walls 6 inches, bottom 6 inches; total amount concrete, 80 cubic feet.

Cement	bags	20	1–2–4 mixture.
Sand	cubic feet	38	
Stone or gravel	do	75	

MODIFIED FORM OF POND OUTLET.

Figure 4 on page 71 shows a modified form of the outlet just described, Figure 3.

In this outlet terra-cotta pipe has been substituted for iron, and the bell end of the terra-cotta ell, closed by the wooden disk, replaces the gate valve, while the cement dam, screen, removable wooden dam boards, and other features remain the same. When the pond is full, the ell opening is closed by the wooden disk, made tight by the use of clay. The wooden dam boards need not be used unless it is desired to raise the water level above the height of the permanent cement dam. To drain the pond, the wooden dam boards are fitted into their proper place and the wooden disk closing the ell opening in the terra-cotta dam pipe is removed by means of the iron rod to which it is attached. The depth of water at any stage of the operation may be controlled by proper manipulation of the wooden dam boards.

Each of the outlets described here, as well as the one described in a previous publication of the bureau,[3] has distinctive points of advantage and have been developed in meeting the varied conditions encountered in fishpond construction. It remains for the prospective pond builder to select the type best suited to his needs. The types described here are considered particularly desirable in ponds of comparatively large area or where the amount of water to be carried requires the use of correspondingly large pipe. The convenience of the valve in controlling the flow of water in drawing the pond, Figure 3, is easily recognized, but practically the same results are obtainable with the simpler installation shown in Figure 4, and the cost of fittings for this type will be somewhat less.

Work of Central Station, Washington, D. C.

[L. G. HARRON, Superintendent.]

Beginning with rainbow-trout eggs in December, 1920, and closing with pike-perch eggs in May, 1921, there were incubated in the hatchery apparatus maintained in the fisheries building at Washington for public display 7,717,000 fish eggs, representing eight species of fish—chinook salmon, rainbow and brook trouts. whitefish, cisco yellow perch, pike perch, and shad—from which 6,400,327 fry and fingerlings were distributed to applicants in Maryland, Virginia, West Virginia, Delaware, Pennsylvania, and New York.

[3] Coker, R. E.: Progress in Biological Inquiries, 1921. Report of the Division of Scientific Inquiry for the Fiscal Year 1921. Appendix VIII, Report, U. S. Commissioner of Fisheries for 1921, 38 pp., 2 figs. (A new Form of Pond Outlet, pp. 21–24, Figs. 1 and 2.) Washington, 1922.

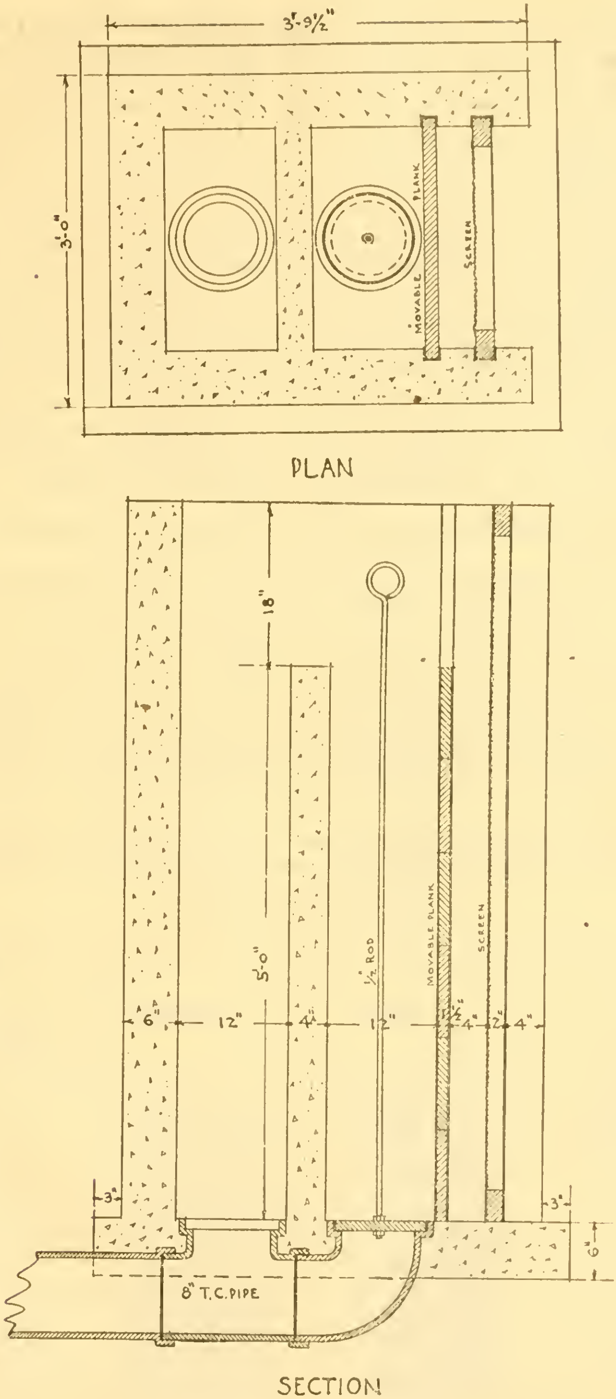


FIG. 4.—Plan of a simple and inexpensive outlet for fishponds. (Designed by G. C. Leach.)

In addition to the hatchery exhibit a display of adult fresh-water fishes was maintained in the aquaria throughout the year. The total number of fish exhibited was 2,614, representing 45 species. Collections for restocking were made from time to time from the Potomac River at Bryans Point, Md. Other sources of supply were the bureau's stations at White Sulphur Springs, W. Va.; Bellevue, Iowa; Bozeman, Mont.; the New York Aquarium, and the New York Conservation Commission hatchery at Caledonia, N. Y.

The health of the aquaria fishes throughout the year was generally good, with the exception of a short period during May and June, when a number of the fish were attacked by the parasite Ichthyophthirius, causing a considerable loss, particularly among the warm-water fishes. It has recently been found that this parasite may be destroyed by treating the fishes infected with a saturated solution of bicarbonate of soda. The solution is conveniently applied directly to the fish when held in shallow water with a small paintbrush. The treatment removes the mucous coating from the fish and destroys the parasite with no injury to the fish.

Spawning Seasons of Fishes Handled at Stations.

Records of the spawning seasons of the various species of fishes handled at the bureau's stations during the fiscal year 1921, together with the water temperatures at the beginning and end of such periods, are given in the following table, in which the stations are grouped and arranged as in the preceding discussion of the propagations of the commercial species and the species for stocking the interior waters; that is, Pacific salmon, Great Lakes, Marine, New England salmon and trout, Rocky Mountain trout, combination trout and pond fish-cultural, and pond fish-cultural stations.

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, WITH WATER TEMPERATURES AT BEGINNING AND END OF PERIODS, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

Station.	Species.	Spawning season.	Water temperatures, °F.	
			Beginning of season.	End of season.
Afognak, Alaska	Sockeye salmon	July 31 to Sept. 24	52	40
Baker Lake, Wash	Silver salmon	Nov. 17 to Dec. 15	40.5	35.5
	Sockeye salmon	Oct. 10 to Nov. 30	46	39
Birdsview	Chinook salmon	Sept. 20 to Oct. 25	43	41
	Silver salmon	Nov. 20 to Feb. 11	43	41
	Steelhead salmon	Mar. 26 to May 21	44	47
Brinnon	Chum salmon	Nov. 15 to Jan. 6	50	48
	Steelhead salmon	Apr. 15 to May 11	42	52
Duckabush	Chum salmon	Aug. 28 to Sept. 12	49	49
	Silver salmon	Nov. 27 to Mar. 1	46	44
	Steelhead salmon	Apr. 11 to May 27	46	48
Quilcene	Chum salmon, early	Aug. 23 to Oct. 6	51	50
	Chum salmon, late	Nov. 4 to Jan. 3	45	45
	Silver salmon	Oct. 20 to Jan. 20	47	43
	Steelhead salmon	Mar. 22 to June 1	45	49
Quinault	Chinook salmon	Oct. 1 to Nov. 15	47	40
	Silver salmon	Nov. 3 to Dec. 15	42	40
	Sockeye salmon	do	42	40
Sultan	Chinook salmon	Sept. 13 to Oct. 15	51	47
	Silver salmon	Oct. 8 to Feb. 2	49	42
	Steelhead salmon	Mar. 10 to May 28	42	45

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

PACIFIC SALMON STATIONS—Continued.

Station.	Species.	Spawning season.	Water temperatures, °F. Beginning of season.	End of season.
Clackamas, Oreg	Chinook salmon	Sept. 19 to Nov. 15	56	48
Upper Clackamas	Chinook salmon, spring run.	Aug. 25 to Sept. 24	59	60
Little White Salmon	Chinook salmon	Sept. 19 to Oct. 14	47	46
	Chum salmon	Oct. 28 to Dec. 2	42	39
	Silver salmon	Nov. 26 to Dec. 2	41	39
Big White Salmon	Chinook salmon	Sept. 19 to Oct. 15	47	47
Rogue River	Blackspotted trout	Mar. 29 to May 12	40	46
	Chinook salmon, spring run.	Aug. 11 to Oct. 15	56	40
	Silver salmon	Oct. 10 to Nov. 25	45	40
	Steelhead salmon	Feb. 26 to May 10	40	46
Applegate Creek	Chinook salmon	Nov. 1 to Dec. 1	42	40
	Silver salmon	Nov. 18 to Mar. 1	40	40
	Steelhead salmon	Jan. 5 to May 19	37	50
Washougal River	do	May 10 to June 2	48	62
Salmon, Idaho	Chinook salmon, spring run.	Aug. 14 to Sept. 15	63	60
Baird, Calif.:				
Battle Creek	Chinook salmon	Oct. 19 to Nov. 11	48	49
Mill Creek	do	Oct. 26 to Nov. 18	54	52
GREAT LAKES STATIONS.				
Duluth, Minn: Marquette, Mich.	Lake trout	Oct. 10 to Nov. 10		
Northville, Mich.: Charlevoix.	do	Nov. 12 to 26	48	45
Put in Bay, Ohio:				
Catawba Island	Whitefish	Nov. 13 to 29	40	41
North Bass Island	do	Nov. 10 to 29	43	41
Port Clinton	Carp	May 23 to June 13	68	75
	Pike perch	Apr. 5 to 24	48	49
	Whitefish	Nov. 13 to 29	40	41
Toledo	Pike perch	Apr. 8 to 24	48	49
Cape Vincent, N. Y.:				
Bygotts Point	Cisco	Nov. 22 to Dec. 1	35	32
	Whitefish	Nov. 10 to 23	43	34
Pigeon Island	Lake trout	Nov. 1 to 15	50	48
St. Lawrence River	Yellow perch	May 15 to June 15	46	50
BRYANS POINT (MD.) STATION.				
Bryans Point, Md	Yellow perch	Mar. 10 to 23	53	57
	Shad	Apr. 22 to May 9	56.5	57
MARINE STATIONS.				
Boothbay Harbor, Me	Flatfish	Mar. 10 to Apr. 22	36	45
Gloucester, Mass	Cod	Jan. 15 to Apr. 29	38	48
	Haddock	Jan. 22 to Apr. 25	36	46
	Pole flounder	May 22 to end of summer, probably.	56	
	Pollock	Nov. 15 to Jan. 21	46	36
	Winter flounder	Mar. 18 to Apr. 22	40	46
Woods Hole, Mass	Cod	Nov. 26 to Feb. 4	45	34
	Winter flounder	Jan. 16 to Mar. 30	38	43
NEW ENGLAND SALMON AND TROUT STATIONS.				
Berkshire, Mass	Brook trout	Oct. 21 to Nov. 10	44	44
	Rainbow trout	Dec. 22 to Jan. 20	44	40
Craig Brook, Me	Atlantic salmon	Oct. 20 to Nov. 12	55	46
Green Lake, Me	Landlocked salmon	Nov. 10 to Dec. 1	45	37
	Smelt	Apr. 20 to 22	51	51
Grand Lake Stream	Landlocked salmon	Oct. 31 to Nov. 28	54	36
Nashua, N. H	Brook trout	Nov. 3 to Dec. 20	48	47
	Rainbow trout	Nov. 3 to Dec. 23	48	46
St. Johnsbury, Vt	Brook trout	Oct. 15 to Nov. 1	54	43
	Lake trout	do	54	43

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

ROCKY MOUNTAIN TROUT STATIONS.

Station.	Species.	Spawning season.	Water temperatures, °F.	
			Beginning of season.	End of season.
Bozeman, Mont.:				
Meadow Creek, Mont.	Rainbow trout	Apr. 15 to June 10	43	54
Yellowstone Park, Wyo.	Blackspotted trout	June 13 to July 22	40	55
Leadville, Colo	Brook trout	Oct. 10 to Dec. 7	40	32
Saratoga, Wyo	do	October and November	51	41
	Rainbow trout	April and May	48	54
	Loch Leven trout	October and November	51	41
Spearfish, S. Dak	Brook trout, brood stock	Oct. 25 to Jan. 14	46	44
	Loch Leven trout, wild fish.	Oct. 16 to Dec. 12	46	45
	Rainbow trout, brood stock.	Jan. 18 to Mar. 20	44	39
Springville, Utah:				
Fish Lake	Brook trout	Nov. 1 to 14	42	42
	Rainbow trout	May 1 to June 4	42	42

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS.

Station.	Species.	Spawning season.	Beginning of season.	End of season.
Erwin, Tenn	Brook trout	Oct. 1 to Jan. 1	54	53
	Carp	May 1 to July 1	54	54
	Catfish	June 1 to Oct. 20	54	54
	Largemouth black bass	Apr. 15 to June 1	54	55
	Rainbow trout	Nov. 1 to Jan. 15	53	53
	Rock bass	May 1 to Sept. 1	54	54
	Smallmouth black bass	Apr. 15 to June 1	54	55
	Sunfish	May 1 to Sept. 1	54	54
	Yellow perch	Mar. 1 to Apr. 30	54	54
Manchester, Iowa	Brook trout	Nov. 4 to Dec. 17	50	50
	Largemouth black bass	May 15 to June 1	50	50
	Rainbow trout	Dec. 22 to Apr. 19	50	50
	Rock bass	May 15 to June 1	50	50
Neosho, Mo	Crappie	April and May	57	57
	Largemouth black bass	Apr. 8 to June 20	57	58
	Rainbow trout	November to February	57	57
	Rock bass	Apr. 21 to July 18	57	58
	Smallmouth black bass	Apr. 22 to June 10	57	58
	Sunfish	May 10 to Sept. 1	57	58
	Yellow perch	Apr. 8 to 20	57	57
White Sulphur Springs, W. Va.	Brook trout	Nov. 15 to Dec. 13	53	50
	Largemouth black bass	May 1 to 25	64	73
	Rainbow trout	Nov. 11 to Jan. 31	53	49
	Rock bass	May 1 to June 15	67	75
	Smallmouth black bass	May 1 to 25	64	73
	Sunfish	May 1 to June 15	67	75
Wytheville, Va	Largemouth black bass	Apr. 15 to June 20	60	60
	Rainbow trout	Oct. 10 to Mar. 15	54	54
	Rock bass	May to July	60	60
	Smallmouth black bass	Apr. 15 to June 20	60	60
	Sunfish	May to July	60	60

POND FISH-CULTURAL STATIONS.

Station.	Species.	Spawning season.	Beginning of season.	End of season.
Cold Springs, Ga	Catfish	May 1 to June 30	64	80
	Crappie	Apr. 1 to June 30	61	80
	Largemouth black bsss	Mar. 15 to July 15	64	72
	Sunfish	Apr. 1 to July 31	61	72
Edenton, N. C	Largemouth black bass	Mar. 20 to June 15	64	80
	Sunfish	June 1 to July 15	74	80
Louisville, Ky	Largemouth black bass	Apr. 7 to 24	60	64
	Rock bass	Apr. 24 to June 15	64	76
	Smallmouth black bass	Apr. 14 to May 2	60	61
	Sunfish	Apr. 25 to June 30	68	85
	Yellow perch	Mar. 26 to Apr. 7	58	58
Mammoth Spring, Ark	Rock bass	May 1 to June 1	59	60
	Smallmouth black bass	Mar. 28 to May 7	67	64

SPAWNING SEASONS OF FISHES HANDLED AT STATIONS, ETC.—Continued.

POND FISH-CULTURAL STATIONS—Continued.

Stations.	Species.	Spawning season.	Water temperatures, °F. Beginning of season.	End of season.
Orangeburg, S. C.	Catfish	Apr. 25 to June 30	74	78
	Crappie	Apr. 10 to June 30	70	78
	Smallmouth black bass	Mar. 15 to June 1	63	76
	Sunfish	Apr. 5 to June 30	68	78
San Marcos, Tex.	Crappie	March through June, mainly.		
	Largemouth black bass	Whole year, but mainly March through May.		
	Sunfish	Whole year		
Tupelo, Miss.	Crappie	Apr. 5 to May 20	68	77
	Largemouth black bass	Mar. 15 to June 1	69	82
	Sunfish	Apr. 11 to June 20	63	83

Fish Food Used at Fish-Cultural Stations.

AMOUNT AND COST OF FISH FOOD USED.

The ideal condition sought by all fish-culturists is a water area so arranged that a natural food supply is available when needed, but from our present knowledge the ideal is impossible of attainment in most cases and artificial feeding must be resorted to. In the rearing of fish under artificial environment, therefore, the problem of a satisfactory food supply at a reasonably low cost is ever present.

The following table gives for the fiscal year 1921 the number of pounds and the cost per pound of artificial fish food used at the various fish-cultural stations during the fiscal year 1921:

POUNDS AND COST PER POUND OF FISH FOOD USED, FISCAL YEAR 1921.

PACIFIC SALMON STATIONS.

Station.	Salted salmon.		Canned salmon.		Frozen salmon eggs.		Beef liver.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Afognak, Alaska	860	$0.015						
Yes Bay, Alaska	600	.03						
Baker Lake and substations, Wash.	1,215	.03					114	$0.15
Quinault, Wash.	3,000	.015						
Clackamas, Oreg., and substations	43,200	.03	9,000	$0.001	9,440	$0.04		
Baird, Calif., and substations	8,000	.01					880	.11
Total	56,875		9,000		9,440		994	

Station.	Beef spleen.		Pork liver.		Milk.		Wheat middling.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Gals.*	*Cost.*	*Lbs.*	*Cost.*
Afognak, Alaska								
Yes Bay, Alaska								
Baker Lake and substations, Wash.	2,886	$0.05			176	$0.25		
Quinault, Wash.			2,230	$0.07				
Clackamas, Oreg., and substations	10,395	.045						
Baird, Calif., and substations							760	$0.03
Total	13,281		2,230		176		760	

Pounds and Cost per Pound of Fish Food Used, Fiscal Year 1921—Continued.

NEW ENGLAND SALMON AND TROUT STATIONS.

Station.	Beef liver.		Beef hearts.		Beef spleen.		Sheep liver.		Pork liver.		Fishotine.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Berkshire trout hatchery, Mass.	1,336¾	$0.13	......	......	4,100	$0.05	372	$0.05	347	$0.07	......	......
Craig Brook, Me.	192	.12	......	......	......	......	......	......	......	......	......	......
Green Lake, Me.	352	.10	......	......	......	......	80	.07	170	.05¼	......	......
Nashua, N. H.	1,263	.08	215	$0.05	......	......	1,337	.04¾	512	.06	......	......
St. Johnsbury, Vt.	758½	[1].08	......	......	......	......	......	......	......	......	57	$0.09
Total	3,892¼	......	215	......	4,100	......	1,789	......	1,029	......	57	......

ROCKY MOUNTAIN TROUT STATIONS.

Station.	Beef liver.		Beef hearts.		Beef spleen.		Sheep liver.		Wheat chop.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Bozeman, Mont.	9,649	$0.09	......	......	......	......	......	......	......	......
Leadville, Colo.	32	.12½	2,711	$0.08¼	......	......	......	......	......	......
Spearfish, S. Dak.	922	.12	1,280	.12	......	......	2,680	$0.07½	......	......
Springville, Utah	4,234	.07	1,018	.07	1,770	$0.05	8,064	.06	4,000	$0.03½
Saratoga, Wyo.	3,997	[1].08	......	......	......	......	835	.04	......	......
Total	18,834	......	5,009	......	1,770	......	11,579	......	4,000	......

COMBINED TROUT AND POND FISH-CULTURAL STATIONS.

Station.	Beef liver.		Beef hearts.		Sheep liver.		Sheep hearts.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Erwin, Tenn.	......	......	2,896	$0.08½	6,431	$0.06¼	......	......
Manchester, Iowa	......	......	2,637	.06¼	13,697	.03½	......	......
Neosho, Mo.	......	......	385	.06¼	10,919	.04	......	......
White Sulphur Springs, W. Va.	74	$0.09	2,903	.06½	21,387½	.04	8,275	$0.04½
Wytheville, Va.	......	......	2,705	.08¾	6,882	.06	......	......
Total	74	......	11,526	......	59,316½	......	8,275	......

Station.	Canned herring milt.		Meatein.		Azotine.		Shorts.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Erwin, Tenn.	96	$0.14	200	$0.08	......	......	5,300	$0.04½
Manchester, Iowa	......	......	......	......	......	......	200	.03¾
Neosho, Mo.	......	......	......	......	......	......	4,000	.03
White Sulphur Springs, W. Va.	96	.14	......	......	......	......	......	......
Wytheville, Va.	......	......	......	......	250	$0.07¾	5,825	.03½
Total	192	......	200	......	250	......	15,325	......

POND FISH-CULTURAL STATIONS.[2]

Station.	Beef liver.		Beef hearts.		Fresh fish.		Fishotine.		Shorts.	
	Lbs.	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*	*Lbs.*	*Cost.*
Cold Springs, Ga.	......	......	285⅔	$0.08¾	5,154	$0.16½	400	$0.09½	400	$0.04
Edenton, N. C.	56¾	$0.20	......	......	269¼	.15½	......	......	......	......
Louisville, Ky.	......	......	289	.15	......	......	......	......	......	......
Mammoth Spring, Ark.	......	......	446½	.12	......	......	......	......	......	......
Orangeburg, S. C.	......	......	971	.12½	......	......	......	......	......	......
Tupelo, Miss.	......	......	1,908	.11	......	......	......	......	......	......
Total	56¾	......	3,900⅛	......	5,423¼	......	400	......	400	......

[1] Beef liver and hearts combined.
[2] No artificial foods used at the San Marcos (Tex.) station.

FOOD FOR BASS.

One of the principal problems encountered at most of the pond fish-cultural stations pertains to a suitable food supply for both young and adult bass. At the Cold Springs (Ga.) station fresh mullet was for a number of years the staple food for the bass, but this material has not given entire satisfaction, and recently the price has been prohibitive. Beef hearts and groupers have been tried, but the fish show some reluctance in accepting either of these materials. More recently pork hearts have been tried with very satisfactory results.

TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

During the past year the bureau has purchased several cases of canned herring milt for the purpose of testing its value as a food for young rainbow trout. It has been tried at several hatcheries, and while the results of the tests made in comparison with other foods in more general use are not necessarily conclusive they seem to indicate that canned herring milt when used alone is not a satisfactory article of diet for young trout, though when used in combination with a meat product it may perhaps be considered a desirable article for the fish-culturists to keep on hand as an emergency food. It has the advantage of being easily prepared, does not "smoke" or discolor the water, and will keep for a long period.

A noticeable feature in connection with this experiment is that for a short period—ranging from 10 to 17 days—the fish receiving herring milt exclusively appeared to thrive equally as well as those receiving a meat diet and the mortality was not greater, but beyond that time the death rate increased so rapidly that in most cases the experiments were discontinued, as it appeared that none of the fish would survive under the treatment. A change to the usual foods appears to have restored normal conditions among the fish.

The tabulated statement of the results of these tests in feeding may be of interest. Rainbow trout were involved exclusively, and in each instance the fish had not previously received artificial food.

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT.

ERWIN (TENN.) STATION.

[Test continued for 16 days—2,500 fish per trough.]

Trough number.	Food used.	Weight per 1,000 fish— At beginning of test.	Weight per 1,000 fish— At end of test.	Weight per 1,000 fish— Gained during test.	Loss per 1,000 fish during test.
		Ounces.	Ounces.	Ounces.	Per cent.
1	Beef heart	6	8	2	7½
2	Canned herring milt	6	7	1	21½

RESULTS OF TESTS WITH HERRING MILT AS FOOD FOR RAINBOW TROUT—Contd.

NEOSHO (MO.) STATION.

[Test continued for 30 days—2,000 fish per trough.]

Trough number.	Food used.	Weight per 1,000 fish.			Loss per 1,000 fish during test.
		At beginning of test.	At end of test.	Gained during test.	
		Ounces.	*Ounces.*	*Ounces.*	*Per cent.*
1	Canned herring milt 3 days, beef hearts 3 days, alternately	6	$12\frac{1}{2}$	$6\frac{1}{2}$	$1\frac{9}{10}$
2	Canned herring milt 3 days, sheep liver 3 days, alternately	6	$11\frac{1}{2}$	$5\frac{1}{2}$	$5\frac{3}{5}$
3	Beef heart	6	$19\frac{3}{4}$	$13\frac{3}{4}$	$1\frac{4}{5}$
4	Sheep liver	6	12	6	$4\frac{1}{10}$

WHITE SULPHUR SPRINGS (W. VA.) STATION.

[Test continued for 20 days—10,000 fish per trough.]

1	Canned herring milt	$4\frac{1}{2}$	$8\frac{1}{4}$	4	$12\frac{4}{5}$
2	Sheep liver	$4\frac{1}{2}$	$9\frac{1}{2}$	5	$1\frac{1}{10}$
3	Canned herring milt 10 days, sheep liver 10 days, alternately	$4\frac{1}{2}$	9	5	$1\frac{3}{10}$

WYTHEVILLE (VA.) STATION.

[Test continued for 10 days—13,000 fish per trough.]

1	Canned herring milt	$4\frac{3}{4}$	5	$\frac{1}{4}$	$7\frac{19}{65}$
2	Beef heart	$4\frac{3}{4}$	$6\frac{1}{4}$	$1\frac{1}{2}$	$3\frac{11}{20}$

Rescue Operations.

[C. F. CULLER, in Charge.]

OUTLINE OF POSSIBLE EXTENSION.

So much has already been said regarding the importance of the rescue operations conducted in the Mississippi Basin, their value, simplicity, practical returns, and comparatively low cost that these phases of the work should be familiar to all interested persons. A brief outline of the possibilities of extending the work, with suggestions as to its requirements, may not be out of place, in view of the bill now pending before Congress to provide funds for enlarging its scope. Almost unlimited possibilities exist for the further extension of the work. In the bureau's greatest effort during the fiscal year 1920, when approximately 160,000,000 of fishes were saved, not more than 40 per cent of the available territory was covered. There are many miles of unbroken stretches of river lowlands where floods annually result in the destruction of millions of fish, while the major tributaries of the Mississippi afford a field of unknown possibilities. For the economical and efficient conduct of the work it would be desirable to establish headquarters near the central point of the more important operations, with a personnel available for its prosecution at all times. Under present arrangements the personnel for the rescue work is drawn from four of the regularly established fish-cultural stations. This diversion is apt to result in a comparative lack of interest in the work of the home stations, and not infrequently it curtails their operations. Moreover, men drawn from other lines of activities can not be expected to be as familiar or as efficient in the prosecution of the rescue work as will men who can devote all their time to it. The work has grown to such proportions that men drawn from the fish-cultural stations can no longer handle it to the fullest advantage under such conditions.

The rescue field would afford profitable employment for such a force throughout the year, the line of operations to be something as follows: Rescue of fishes along the upper reaches of the river would occupy the attention of the men from July to December, during which time a crew of five men could save from 8,000,000 to 10,000,000 fish, at a total approximate cost of $2,000. That number of fish purchased from commercial fish-culturists would cost the bureau from $25,000 to $30,000 and to citizens of the Mississippi Valley would represent a food value of $1,000,000 to $1,500,000 when placed on the market three years after being rescued. These figures are very conservative when compared with the results attained at the bureau's regularly established fish-cultural stations. At the close of the rescue season important work in the salvage of eggs in connection with the commercial fisheries in Louisiana would consume practically all the time of the men from February to April. From Louisiana the crew would work northward to the confluence of the Ohio and the Mississippi Rivers, where important fields are open in the three adjoining States. The Illinois River overflows its dikes during the spring freshets, and in May or early June large pumps are operated to remove the water from the land. Many millions of young fish are thus left in the fields to perish or are passed through the pumps and destroyed. During the comparatively short periods when active rescue work is not under way the time could be profitably employed in repair and maintenance of the equipment used.

In addition to a personnel provided especially for the rescue work there should be two or three additional holding stations, these being essential for the "hardening" of the fish required for distribution. A part of the rescued fish are held in tanks of clear water and "hardened" for several days to enable them to withstand transportation. They are then shipped in the bureau's specially equipped distribution cars and planted in suitable tributary waters. Experience has shown that greater results can be attained in this way than by returning all fish rescued to the main river. The wider distribution also gives to people living in various parts of the Mississippi Valley a better opportunity to obtain fresh fish.

In addition to the requirements outlined above, houseboats with living quarters for a crew of five or six men should be provided. These boats would be placed in certain sections of the river, and when the pools at one point had been cleaned up they would be moved downstream to other fields. Launches will be needed to transport the crews to and from the fields of operation, to carry supplies, and to distribute fish. It has been found more economical to own launches than to rent them. Boats for hire are seldom in good running condition, and much valuable time is lost in repairs before the men can be placed in the field. There will be necessity for a boathouse and storeroom at a central point for the proper housing of boats and equipment; also for two dwelling houses to serve as quarters for the men in immediate charge of the work.

Since the Mississippi River is largely a boundary water, most of the States regard the rescue operations as a work belonging to the Federal Government rather than to the States. Most of the States have rendered excellent cooperation; but in many cases their appropriations for rescue and fish-cultural work have been more or less sporadic, hence the work could not be well organized nor efficiently handled. Moreover, most of the States have a problem in maintaining the fish in their interior waters.

Citizens throughout the Mississippi Valley have urged the bureau to extend this valuable work, arguing that they are entitled to fresh fish as a food, and that it should not be necessary for them to depend upon the Pacific coast, the Atlantic coast, or the Great Lakes for their supply. They can not understand why an earnest effort should not be made to save the millions of fish that are dying in pools along the river.

METHODS EMPLOYED IN RESCUING FISH.

A rescue crew usually consists of five men and a foreman. A launch is employed in going to and from the field of operations, and the equipment for each field comprises two seines of one-fourth-inch mesh, from 50 to 75 feet long and 5 feet deep; six galvanized-iron tubs of 1½-bushel capacity; small dip nets; two tin dippers; and a small flat-bottomed boat, the latter being used in ponds too deep for wading.

After making a haul the fish are assorted into tubs by species and size. The number per tub is ascertained by noting the water displacement, one or more rings having been made on the inside of each tub, and the number established by actual count. The count is verified several times during the season, as the fish in some instances are subject to rapid growth.

When first taken from the warm water the fish will not safely stand a long railway journey. Therefore those intended for distribution are taken to the nearest holding station and hardened by being held for several days in cool running water. While the number of fish diverted for supplying applicants at a distance may seem large in the aggregate, it represents less than 1 per cent of the total collections. Such diversions during the fiscal year 1921 amounted to 660,110 fish of miscellaneous species.

REVIEW OF THE WORK.

The aggregate number of fish rescued during the fiscal year 1921 amounted to 120,656,420, a decrease of almost 36,000,000 as compared with the record of the previous year. Two causes contributed to this result. Labor conditions were unsatisfactory, making it difficult to obtain efficient crews at all points at the rate of compensation offered. The river remained at a high stage for a longer period than usual, thus permitting large numbers of fish bred in the overflow waters to return to the river unaided. This appears to have been particularly true with reference to such species as the carp, buffalofish, and catfish.

The work began at Prescott, Wis., on August 12 and was brought to a close at Bellevue, Iowa, on November 10, these dates indicating an unusually short season on account of the natural conditions mentioned. The work was conducted in the following fields:

One crew, with house boat, from Prescott, Wis., to Red Wing, Minn.; thence to Genoa, Wis.

Two crews on house boats from Wabash to Winona, Minn.; thence to Dakota and Dressback, Minn.

Two crews from Homer, Minn.

One crew from La Crosse, Wis.

One crew from Genoa, Wis.

One crew from Ferryville, Wis.

Two crews from Lynxville, Wis.

One crew from Marquette, Iowa.

One crew with house boat from Dubuque to Bellevue, Iowa.

One crew from Bellevue, Iowa.

In addition to the regular rescue work collections of eggs from carp and buffalofish taken by commercial fishermen were made at Bellevue and Lynxville. The eggs were taken, fertilized, and planted on the natural spawning grounds. Such work was done from May 9 to 25 and resulted in the fertilization of 68,287,000 buffalofish and 42,718,000 carp eggs. Had these eggs not been thus handled they would have been sent to the markets in the fish and lost. While the planting of fertilized eggs is not considered as efficient as incubating them in a well-equipped hatchery, it is believed that under certain conditions it is expedient and results in much good if properly done.

In addition to the operations on the upper Mississippi rescue work was conducted from the Fairport (Iowa) biological station; also on the Illinois River at Meredosia and Cairo, Ill., and at San Marcos, Tex. The operations from Fairport and substations were in conjunction with the propagation of the fresh-water mussel, large numbers of the rescued fish being inoculated with the mussel glochidia before being liberated. Owing to unfavorable water stages the active season at Cairo was very short, extending only from October 1 to 19. In this field one seining crew working under the direction of the superintendent of the Louisville (Ky.) station salvaged a total of 1,057,215 fish of miscellaneous species at a total cost of $582.07, or at the rate of 55 cents per thousand fish handled. In the vicinity of the San Marcos (Tex.) station 202,886 black bass, catfish, and sunfish were removed from the bed of a stream, which almost entirely evaporated during a protracted hot spell, and were deposited in living waters. Reference to the table on page 7 will show the points from which rescue work was prosecuted during the season, the number of fishes salvaged at each and restored to the original waters, and the number delivered to applicants.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS.

Extent and Character of the Work.

[E. C. FEARNOW, Superintendent of Fish Distribution.]

BRIEF REVIEW OF THE WORK.

The 4,962,489,405 fish and fish eggs (see table, p. 5) representing the net product of the hatcheries and rescue stations of the bureau for the fiscal year 1921 were widely disseminated, the distribution reaching practically every State in the Union and the Territories of Alaska and Hawaii. Consignments of fish eggs were also shipped to the Governments of Canada, France, and Switzerland, and an allotment of fish was forwarded to an applicant in Mexico.

Fully 93 per cent of the output is represented by important commercial species—the salmons, shad, whitefish, pike perch, yellow perch, lake trout, cod, pollock, haddock, flounder, buffalofish, and carp. All of such fishes are planted on or adjacent to the spawning areas where the eggs originate, or the eggs are consigned to State commissions for incubation and distribution in nonproductive waters where conditions appear to favor the development of new fisheries. (See p. 87.) Included under the head of the commercial fishes are the large numbers of food fish annually salvaged from the overflowed territory along the Mississippi River and at other points (see pp. 7 and 78), a branch of the work that has become one of the most popular, practical, and beneficial of the bureau's activities.

Among the more important species propagated for the stocking of interior waters are the brook, rainbow, and blackspotted trouts, the largemouth and smallmouth black basses, rock bass, sunfish, crappies, and catfish. While the numbers of such fishes are by comparison small, representing only 7 per cent of the aggregate output, the importance of this work is not to be underestimated. It is this branch of its work which brings the bureau in close contact with the general public, as is evidenced by the large number of applications received each year, and the interest thus aroused in the fisheries can not be other than beneficial. The economic value of the work is large. In most instances the reports received from applicants regarding the results obtained from planting fish furnished by the bureau are of a highly satisfactory nature. (See p. 88.)

SUMMARY OF DISTRIBUTION TO ALL APPLICANTS.

The following table shows in summarized form how many and what species of fish and fish eggs out of the net product of the hatcheries and rescue stations for the fiscal year 1921 were delivered to all applicants, both in the United States and Territories and in foreign countries. Only a small percentage of the immense numbers of fish rescued from overflowed lands was delivered to applicants, the great bulk having been returned to the original waters, as is shown in the table on page 7.

Summary, by Species, of Distribution of Fish and Eggs to All Applicants, Fiscal Year 1921.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES.

State and species.	Number.
Alabama:	
Carp	45
Catfish	2,240
Crappie	1,900
Largemouth black bass	†153,550
	46,565
Rock bass	4,000
Sunfish	45,300
Alaska: Sockeye salmon	*350,000
	†30,761,000
	26,977,500
Arizona:	
Brook trout	73,000
Catfish	1,200
Crappie	2,775
Rainbow trout	37,000
Rock bass	200
Sunfish	1,000
Yellow perch	300
Arkansas:	
Catfish	5,620
Crappie	6,520
Largemouth black bass	†39,000
	24,461
Rainbow trout	49,061
Rock bass	10,140
Smallmouth black bass	†25,500
	2,639
Sunfish	20,120
Yellow perch	1,000
California:	
Chinook salmon	*3,000,000
	4,593,400
Rainbow trout	*25,000
Steelhead salmon	*20,000
Colorado:	
Blackspotted trout	†868,500
Brook trout	†27,000
	2,004,050
Lake trout	24,000
Largemouth black bass	9,725
Loch Leven trout	34,000
Rainbow trout	*200,000
	62,500
Sunfish	600
Connecticut:	
Brook trout	135,600
Catfish	2,400
Largemouth black bass	2,380
Pike perch	†150,000
Rainbow trout	13,000
Delaware: Pike perch	†500,000
District of Columbia:	
Rainbow trout	13,500
Shad	†800,000
Florida:	
Largemouth black bass	2,450
Sunfish	400
Georgia:	
Brook trout	38,000
Catfish	3,060
Crappie	300
Largemouth black bass	†82,500
	45,405
Rainbow trout	70,000
Rock bass	100
Sunfish	37,250
Warmouth bass	100
Hawaii: Rainbow trout	*25,000
Idaho:	
Blackspotted trout	*50,000
	23,000
Brook trout	29,275
Landlocked salmon	*15,000
Rainbow trout	*128,000
	27,000
Whitefish	*500,000
	†500,000
Illinois:	
Brook trout	500
Buffalofish	141,653
Carp	125,211
Catfish	1,546,730
Crappie	148,204
Drum	175
Lake trout	*10,000
Largemouth black bass	8,741
Pike and pickerel	410
Pike perch	250
Rainbow trout	*1,000
Rock bass	900
Sunfish	208,350
White bass	2,510
Whitefish	*2,000,000
Yellow perch	100
Miscellaneous fishes	16,390
Indiana:	
Brook trout	†24,000
	22,500
Carp	25
Catfish	1,980
Crappie	1,040
Largemouth black bass	†12,000
	8,775
Rainbow trout	18,500
Rock bass	600
Smallmouth black bass	12,900
Sunfish	2,760
Yellow perch	2,275
Iowa:	
Brook trout	11,775
Buffalofish	†68,267,000
	557,590
Carp	†42,718,000
	528,902
Catfish	3,272,437
Crappie	6,405,468
Drum	2,120
Lake trout	*50,000
Largemouth black bass	44,797
Pike perch	37,560
Rainbow trout	*64,500
	5,500
Rock bass	47,000
Smallmouth black bass	1,500
Sunfish	5,230,707
White bass	9,410
Yellow perch	223,175
Miscellaneous fishes	3,487,105
Kansas:	
Catfish	250
Largemouth black bass	240
Rainbow trout	1,625
Sunfish	200
Yellow perch	800
Kentucky:	
Buffalofish	107,350
Carp	41,715
Catfish	673,400
Crappie	172,400
Largemouth black bass	†20,000
	6,675
Pike perch	4,900
Rainbow trout	500
Rock bass	4,775
Smallmouth black bass	†146,000
	2,500
Sunfish	131,750
White bass	800
Yellow perch	†450,000
	1,200
Louisiana:	
Buffalofish	†40,040,000
	150
Catfish	600
Crappie	530
Largemouth black bass	150

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs: dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.
Maine:	
Atlantic salmon	†1,387,000 280
Brook trout	*256,890 †1,730,930
Flounder (winter)	†841,235,000
Lake trout	*50,000
Landlocked salmon	*375,000 †208,115 108,400
Pollock	†11,906,000
Rainbow trout	†26,000
Smelt	†7,000,000
Sockeye salmon	†17,500
Maryland:	
Brook trout	18,700
Catfish	1,500
Chinook salmon	2,500
Cisco	*300,000
Crappie	2,180
Lake trout	*4,000
Largemouth black bass	4,350
Pike perch	*1,000,000
Rainbow trout	*150,000 37,750
Rock bass	360
Shad	†7,436,250
Sunfish	4,260
Whitefish	*100,000
Yellow perch	†85,205,850 300
Massachusetts:	
Brook trout	257,525
Carp	100
Catfish	7,400
Cod	*208,800,000 †175,341,000
Flounder (pole)	*19,410,000
Flounder (winter)	†848,993,000
Haddock	*188,940,000 †271,880,000
Largemouth black bass	550
Pike perch	†725,000
Pollock	†443,160,000
Rainbow trout	*50,000 29,600
Smallmouth black bass	†12,000
Sunfish	180
Michigan:	
Blackspotted trout	*10,000
Brook trout	†264,000 500,375
Carp	200
Catfish	6,950
Crappie	640
Lake trout	*1,000,000 †14,875,000
Landlocked salmon	*10,000
Largemouth black bass	16,400
Pike perch	*277,250,000 †8,040,000
Rainbow trout	†34,000 64,975
Rock bass	600
Smallmouth black bass	19,351
Smelt	*400,000
Steelhead salmon	†23,810
Sunfish	1,675
Whitefish	*20,000,000 †29,500,000
Yellow perch	1,200
Minnesota:	
Brook trout	78,820
Buffalofish	30,175
Carp	1,190,320
Catfish	10,746,580
Minnesota—Continued.	
Crappie	15,929,225
Drum	19,405
Lake trout	†670,000 20,000
Largemouth black bass	153,765
Pike and pickerel	175,040
Pike perch	†2,500,000
Rainbow trout	56,400
Smallmouth black bass	1,000
Steelhead salmon	*70,000
Sunfish	11,727,380
White bass	6,990
Whitefish	†100,000
Yellow perch	4,912,812
Miscellaneous fishes	527,080
Mississippi:	
Carp	84
Catfish	2,460
Crappie	1,344
Largemouth black bass	†165,500 37,640
Rainbow trout	5,000
Rock bass	300
Sunfish	49,030
Yellow perch	100
Missouri:	
Buffalofish	8,395
Carp	19,684
Catfish	269,638
Crappie	130,570
Drum	420
Largemouth black bass	21,361
Pike perch	470
Rainbow trout	59,329
Rock bass	4,125
Smallmouth black bass	2,260
Sunfish	51,680
White bass	840
Yellow perch	768
Miscellaneous fishes	480
Montana:	
Blackspotted trout	*350,000 †854,000
Brook trout	522,500 *200,000 436,175
Catfish	1,600
Grayling	†1,400,000
Largemouth black bass	1,350
Rainbow trout	*225,000 †250,000 758,000
Steelhead salmon	*75,000
Nebraska:	
Brook trout	†32,900 39,000
Largemouth black bass	1,000
Rainbow trout	43,000
Nevada: Rainbow trout	*50,000 23,000
New Hampshire:	
Brook trout	†381,000 519,500
Catfish	4,600
Lake trout	*25,000 †12,000 1,400
Landlocked salmon	*20,000 5,850
Pike perch	*2,000,000 †500,000
Rainbow trout	33,000
Smallmouth black bass	†14,200
Steelhead salmon	545
Whitefish	*250,000

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings].

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.
New Jersey:	
Brook trout	7,400
Catfish	600
Crappie	400
Largemouth black bass	4,040
Pike perch	*1,000,000 †1,050,000
Rainbow trout	4,000
Sunfish	4,800
Yellow perch	100
New Mexico:	
Blackspotted trout	†73,500
Brook trout	492,000
Catfish	3,600
Crappie	3,755
Largemouth black bass	900
Rock bass	1,400
Sunfish	1,400
Yellow perch	100
New York:	
Blackspotted trout	*10,000
Brook trout	†446,000 42,000
Carp	100
Catfish	7,200
Cisco	*121,210,000 †89,800,000
Crappie	750
Lake trout	*1,510,000 †156,000 5,550
Landlocked salmon	*125,000 4,000
Largemouth black bass	12,490
Pike perch	*525,000 †10,495,800
Rainbow trout	*10,000 †65,100 1,900
Steelhead salmon	*199,000 2,500
Whitefish	*59,300,000 †41,100,000
Yellow perch	†13,700,000 3,700
North Carolina:	
Brook trout	253,500
Crappie	950
Glut herring	†43,815,000
Largemouth black bass	†5,500 102,580
Rainbow trout	453,100
Rock bass	11,200
Shad	†15,756,000
Smallmouth black bass	1,635
Striped bass	†20,181,000
Sunfish	27,520
North Dakota:	
Carp	5
Catfish	800
Crappie	500
Largemouth black bass	6,380
Rock bass	400
Ohio:	
Brook trout	†33,000
Buffalofish	1,000
Carp	†63,325,000
Catfish	6,375
Crappie	1,800
Largemouth black bass	14,380
Pike perch	†12,600,000
Rainbow trout	†10,000
Rock bass	600
Smallmouth black bass	6,300
Sunfish	10,570
Whitefish	*30,640,000 †167,500,000
Ohio—Continued.	
Yellow perch	†300,000 300
Oklahoma:	
Catfish	2,250
Crappie	4,350
Largemouth black bass	2,720
Rainbow trout	*100,000 56,400
Rock bass	1,350
Sunfish	2,000
Yellow perch	2,200
Oregon:	
Black-spotted trout	101,500
Brook trout	4,000
Chinook salmon	*3,650,000 10,682,900
Rainbow trout	*601,940 189,500
Shad	†2,347,100
Silver salmon	417,050
Steelhead salmon	1,316,000
Pennsylvania:	
Brook trout	†3,000 613,475
Carp	85
Catfish	11,600
Chinook salmon	10,000
Cisco	*65,000,000
Crappie	3,050
Lake trout	*50,000
Landlocked salmon	*10,000
Largemouth black bass	21,870
Pike perch	†2,174,200
Rainbow trout	396,701
Rock bass	200
Smallmouth black bass	125
Steelhead salmon	*55,000
Sunfish	11,800
Whitefish	*10,000,000
Yellow perch	1,175
Rhode Island:	
Brook trout	23,000
Flounder (winter)	†78,432,000
Largemouth black bass	150
Smallmouth black bass	†5,500
South Carolina:	
Crappie	300
Largemouth black bass	117,875
Rainbow trout	16,000
Sunfish	5,000
South Dakota:	
Brook trout	379,100
Catfish	400
Crappie	375
Loch Leven trout	2,000
Lake trout	5,000
Largemouth black bass	3,850
Rainbow trout	84,110
Sunfish	500
Tennessee:	
Brook trout	13,935
Catfish	5,100
Crappie	4,050
Largemouth black bass	†86,000 23,955
Rainbow trout	*55,000 171,000
Rock bass	8,900
Smallmouth black bass	3,530
Sunfish	15,200
Yellow perch	900
Texas:	
Catfish	70,350
Crappie	5,904
Largemouth black bass	257,370
Rock bass	320
Sunfish	74,872

SUMMARY, BY SPECIES, OF DISTRIBUTION OF FISH AND EGGS, ETC.—Continued.

[Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings or yearlings.]

UNITED STATES AND TERRITORIES—Continued.

State and species.	Number.
Utah:	
Blackspotted trout	91,300
Brook trout	188,300
Catfish	2,250
Lake trout	*50,000
Rainbow trout	161,000
Whitefish	†100,000
Vermont:	
Brook trout	†591,400 89,200
Lake trout	*25,000 †38,300 4,900
Landlocked salmon	*20,000 6,000
Pike perch	*14,700,000 †13,150,000
Rainbow trout	7,200
Steelhead salmon	*25,000 6,320
Yellow perch	*12,000,000 †2,600,000
Virginia:	
Brook trout	118,350
Catfish	1,300
Crappie	160
Largemouth black bass	†15,000 24,063
Pike perch	†500,000
Rainbow trout	279,600
Rock bass	10,660
Shad	†6,452,925
Smallmouth black bass	†88,500 100
Sunfish	8,225
Yellow perch	†74,113,600 300
Washington:	
Blackspotted trout	*100,000 †9,000 79,700
Brook trout	*300,000
Chinook salmon	*130,000 17,491,965
Chum salmon	†7,000,000 19,436,400
Rainbow trout	*75,000 3,000
Silver salmon	†600,000 6,069,100
Washington—Continued.	
Sockeye salmon	†8,000,000 3,457,000
Steelhead salmon	*49,000 †15,000 1,603,550
West Virginia:	
Brook trout	212,815
Catfish	8,100
Crappie	2,700
Largemouth black bass	†6,000 8,212
Rainbow trout	181,100
Rock bass	175
Smallmouth black bass	†12,000 750
Sunfish	3,400
Yellow perch	800
Wisconsin:	
Brook trout	†103,000 655,355
Buffalofish	799,520
Carp	2,009,104
Catfish	18,580,500
Crappie	14,470,840
Drum	11,960
Lake trout	†512,000 15,000
Largemouth black bass	171,990
Pike and pickerel	322,130
Pike perch	†5,000,000
Rainbow trout	†29,000 150,190
Sunfish	12,687,546
White bass	6,620
Whitefish	*28,760,000
Yellow perch	1,012,230
Miscellaneous fishes	904,110
Wyoming:	
Blackspotted trout	*100,000 †2,044,900 182,300
Brook trout	*100,000 302,400
Catfish	5,900
Lake trout	20,150
Largemouth black bass	8,660
Loch Leven trout	28,000
Rainbow trout	*309,800 327,000
Smelt	*200,000

FOREIGN COUNTRIES.

Country and species.	Number.
Canada:[1]	
Blackspotted trout	*200,000
Rainbow trout	*280,000
Whitefish	*30,000,000
France: Rainbow trout	*150,000
Mexico:	
Largemouth black bass	600
Yellow perch	500
Switzerland:	
Lake trout	*50,000
Rainbow trout	*50,000

[1] In exchange for trout eggs 600,000 Atlantic salmon eggs were received from Canada.

ASSIGNMENTS TO STATE FISH COMMISSIONS.

The following table shows the States in which the State fish commissions, as applicants, received part of the distribution shown in the preceding table and gives the species and numbers of fish and fish eggs assigned to each such commission:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, FISCAL YEAR 1921.

[NOTE.—Asterisk (*) denotes eggs; dagger (†), fry; all others are fingerlings.]

State and species.	Number.
California: Chinook salmon	* 3,000,000
Colorado: Rainbow trout	* 50,000
Connecticut: Brook trout	52,000
Idaho:	
Blackspotted trout	* 50,000
Landlocked salmon	* 15,000
Rainbow trout	* 50,000 7,000
Whitefish	* 500,000
Illinois:	
Catfish	25,300
Crappie	5,800
Drum	175
Largemouth black bass	200
Pickerel	410
Pike perch	250
Rock bass	500
Sunfish	26,325
White bass	175
Whitefish	* 500,000
Iowa:	
Lake trout	* 50,000
Rainbow trout	* 62,000
Maine:	
Lake trout	* 50,000
Landlocked salmon	* 475,000
Maryland:	
Cisco	* 300,000
Lake trout	* 4,000
Pike perch	* 1,000,000
Rainbow trout	* 150,000
Whitefish	* 100,000
Massachusetts: Rainbow trout	* 50,000
Michigan:	
Lake trout	* 1,000,000
Landlocked salmon	* 10,000
Pike perch	* 223,200,000
Smelt	* 200,000
Whitefish	* 20,000,000
Minnesota:	
Catfish	6,800
Crappie	5,200
Largemouth black bass	9,340
Steelhead salmon	* 70,000
Sunfish	5,200
Yellow perch	2,250
Missouri:	
Rainbow trout	100
Sunfish	100
Montana:	
Blackspotted trout	* 350,000
Rainbow trout	* 150,000
Steelhead salmon	* 75,000
Nebraska:	
Brook trout	32,900
Rainbow trout	30,000
Nevada: Rainbow trout	* 50,000
New Hampshire:	
Lake trout	* 25,000
Landlocked salmon	* 20,000
Pike perch	* 2,000,000
Whitefish	* 250,000
New Jersey: Pike perch	* 1,000,000
New York:	
Cisco	* 104,410,000
Lake trout	* 1,500,000
Landlocked salmon	* 100,000
Steelhead salmon	* 199,000
Whitefish	* 29,200,000
Ohio: Whitefish	* 23,640,000
Oklahoma:	
Rainbow trout	* 100,000 † 41,000 8,000
Rock bass	100
Oregon:	
Chinook salmon	* 3,650,000
Rainbow trout	* 604,940
Pennsylvania:	
Chinook salmon	10,000
Cisco	* 65,000,000
Lake trout	* 50,000
Steelhead salmon	* 30,000
Whitefish	* 10,000,000
South Dakota:	
Brook trout	2,100
Rainbow trout	3,000
Tennessee: Rainbow trout	* 55,000
Utah: Lake trout	* 50,000
Vermont:	
Lake trout	* 25,000
Landlocked salmon	* 20,000
Pike perch	* 14,700,000
Steelhead salmon	* 25,000
Yellow perch	* 12,000,000
Washington:	
Blackspotted trout	* 75,000
Rainbow trout	* 75,000
Steelhead salmon	* 49,000
Wyoming:	
Blackspotted trout	* 100,000
Brook trout	* 100,000
Catfish	1,200
Largemouth black bass	2,150
Rainbow trout	* 309,800
Total	* 483,914,740 † 41,000 236,575

CONSIDERATIONS IN DISTRIBUTION OF COMMERCIAL FISHES.

The output of the bureau's hatcheries handling the commercial species is planted in local waters on the natural spawning grounds in so far as this may be desirable or practicable. This course is obviously necessary for the maintenance of the fishery involved, particularly where commercial fishing is aggressively prosecuted or where, as in the case of the anadromous fishes, commercial activities are coincident with the spawning season of the fish. It has been ably argued that the bureau's hatcheries belong to the people and that the output should be distributed more widely in neighboring States. If such a course were to be generally followed, the results would most certainly be disastrous. If a hatchery addressed to the propagation of a commercial species is successful in maintaining the fishery against the inroads of market fishing in the region covered by its activities, it may be fairly classed as efficient. If its annual output is only just sufficient to accomplish this purpose, it would be suicidal to divert any portion of it to other waters. Most of the States object, and with justice, through their fisheries authorities to the shipment outside their boundaries of eggs taken in their waters or the fry produced from such eggs.

The attitude of the fishermen is also a consideration. In most cases the bureau is to a large extent dependent on them for its egg collections. Speaking generally, the fishermen are deeply interested and render hearty cooperation. They watch the work with jealous interest, and any large or unwarranted diversion of eggs or fry would meet with strong opposition from them, and if persisted in would certainly result in refusal of the fishermen to deliver their eggs to the hatcheries. While the bureau's hatcheries are operated for the general good and the public is benefited by the increased food supply, the local fishermen are perhaps most intimately interested, and they should render every possible assistance to the hatcheries. Certain States now have laws whereby fishermen are given permits to fish during the closed season, with the restriction that all mature eggs shall be delivered to an agent of the bureau or the State for propagation. As the fishes are the property of the State, such a requirement is held to be just.

On the other hand, if a hatchery of the bureau succeeds in obtaining large numbers of eggs, more than are required for local waters, an intelligent distribution of the output to other waters is then permissible and even desirable. Under the most favorable conditions the results of natural spawning can not be expected to equal from 75 to 80 per cent of the numbers of young fishes put out by an efficient hatchery. Nature undoubtedly provides for a rather wide distribution of young fishes from natural reproduction. It is therefore not always advisable to limit the distribution of the output of a hatchery beyond reasonable restrictions, because if more young fishes are placed in a limited area than the waters can support they can not be expected to produce proportionate returns in marketable fish.

The following are among the points to be considered in connection with the distribution of the commercial species in new waters: (1) Do the waters under consideration support a commercial fishery? (2) Are the laws adequate for the protection of the fishes? (3) What are the conditions regarding dams or other barriers and pollution from trade or other forms of waste? (4) What is the attitude of local fishermen, and will they be willing to cooperate in the collection of eggs for the work of artificial propagation?

RESULTS OF PLANTING FISHES IN INTERIOR WATERS.

By E. C. Fearnow,
Superintendent of Fish Distribution.

The question has frequently been asked whether the bureau's work in stocking streams and ponds in the interior States is producing satisfactory results. While the numerous letters received from applicants from time to time are favorable in character, no effort has heretofore been made to condense such information into a tabular form to indicate the general effects of the work.

The system of card-indexing applications, inaugurated in 1917, will in course of time give such information. However, it is believed that a table classifying the results accomplished during several years would be very useful in giving the bureau and the general public a concrete idea as to the value of the work that is being done in the interior States. A table of this character would also be invaluable when making assignments of fishes, as it would show what species are most productive in a given region.

The following is an explanation of the grades used in classifying the results: "Excellent" means that the fish increased in size and multiplied. "Good" is used where the applicant was satisfied, the fish attaining a large size, the number of fish apparently on the increase. "Fair" means that the results are only ordinary, many of the applicants merely use this word to express the results of the plants. "Overflow" is used where the dam of the pond broke and the fish escaped. This does not mean a loss of the fish, as in many instances the statement is made that certain streams were stocked by the breaking of dams. "Uncertain" is used where the applicant is undecided as to results. Most of the reports classified under this heading cover plants of fish made in large streams and lakes, where it was found difficult to determine whether the fish furnished by the bureau had actually produced results, owing to the waters being previously stocked with the same species. "Poor" covers reports which indicate that the plants were a failure. Failures are attributed to a number of causes as follows: Not adapted to the waters; fish received in poor condition; destroyed by snakes and other noxious animals. Many failures are attributed to the severe winter of 1916 and 1917, when ponds froze to an unprecedented depth. In some instances the fish were stolen.

The following table shows the general results of planting fishes during the fiscal year 1917:

General Results, by Species, of Fish Plantings, Fiscal Year 1917.

Species.	Number of reports.	Increase and growth.					
		Excellent.	Good.	Fair.	Overflow.	Uncertain.	Poor.
Catfish	127	34	47	25	2	8	11
Buffalofish	2	1	1				
Shad	1					1	
Whitefish	4	2	2				
Steelhead salmon	20	3	6	2		8	1
Landlocked salmon	28	8	15	3		1	1
Rainbow trout	589	157	224	98	7	50	53
Blackspotted trout	288	101	151	26		6	4
Loch Leven trout	6	2	3			1	
Brown trout	1	1					
Lake trout	21	4	9	2		3	3
Brook trout	1,514	532	717	124	6	45	90
Grayling	9	5	2	1		1	
Smelt	3		3				
Crappie	235	59	77	49	9	20	21
Largemouth black bass	927	270	415	108	32	52	50
Smallmouth black bass	326	101	131	41	5	29	19
Rock bass	76	14	21	19	4	9	9
Sunfish	280	57	88	59	25	18	33
Pike perch	97	43	19	11	1	14	9
Yellow perch	32	10	8	4		4	6
White perch	11		2	1		7	1
Total	4,597	1,402	1,943	574	92	277	309

Of the 4,597 reports received 30.5 per cent showed excellent results, 42.2 per cent good, 12.4 per cent fair, a little over 2 per cent overflow, over 6 per cent uncertain, and 6.5 per cent poor.

Black bass and sunfish appear to produce highly satisfactory results in most of the States, though many applicants have been dissatisfied with the sunfish on account of its small size, the growth attained not being as large as with some species. The stock of sunfish at most of the bureau's hatcheries has been improved in recent years, and it is believed that from now on this fish will give perfect satisfaction.

The rainbow trout appears to be especially well adapted to the waters of California, Colorado, New Mexico, Montana, North Carolina, and Wisconsin, while on the other hand a large percentage of failures or of only fairly good returns have been reported with that species in Arizona, Massachusetts, Ohio, New York, and Pennsylvania. This tends to accentuate the frequently expressed opinion that the rainbow trout is not as a rule adapted to eastern waters. It is true that the rainbow trout appears to have been very successfully established in West Virginia and in certain sections of Tennessee and North Carolina, but the data at hand would indicate that for eastern waters in general the conditions are better adapted to the brook trout. Numerous reports have been received to the effect that no rainbow trout were ever seen in waters where they had been planted. Mention of this failure of the rainbow trout to establish itself in certain sections of the country is very prominent in the reports.

DISTRIBUTION COSTS AND EQUIPMENT.

COST OF DISTRIBUTION.

As in all other lines of activity, the cost of distributing the output of the bureau's hatcheries has increased very considerably in recent years. The net increase in distribution costs since 1916 has amounted to approximately 150 per cent. The distribution of an output not appreciably decreased during this period, with no increase in funds provided for the conduct of the work, has been accomplished only by exercising the most rigid economy at every point. Unless additional funds for the propagation and distribution of food fishes is forthcoming, it may be necessary to inaugurate decided changes in the distribution methods to meet the increasing demands for fish.

During the fiscal year 1921 the cars of the bureau traveled 85,060 miles, while detached messengers in charge of live fishes traveled 385,988 miles, honoring approximately 10,000 applications for fish. The total cost of making this distribution, including maintenance and repairs to five distribution cars, amounted to $69,600.

DISTRIBUTION CARS.

The two steel cars added to the distribution service during the spring of 1920 have fully demonstrated their superiority over the cars of wood construction. Their increased carrying capacity, together with lower cost for maintenance and repair, make them in every respect a high-class investment. It is recommended that the two wooden cars still in use be replaced with cars of steel at an early date. In addition to the advantages already cited, it is frequently necessary to accept second-class service in the movement of the wooden cars, as many railroads refuse to move them in their first-class trains.

POCKET THERMOMETER FOR USE IN CARRYING LIVE FISH.

An improved device of interest in connection with the distribution of live fish is a pocket thermometer designed especially for the convenience of messengers in making shipments of fish or fish eggs. The column of mercury is protected by a hard rubber jacket, provided with a pocket clip and a ring, to which a cord may be attached. The advantages claimed for it over the type of thermometer previously used are its lighter weight and its greater convenience when in actual use. It is also less subject to breakage than the metal-jacketed thermometer.

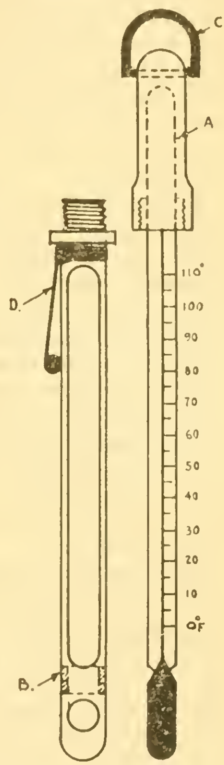


Fig. 5.—Pocket thermometer designed particularly for use in connection with the distribution of living fishes. (Designed by E. C. Fearnow.)

Procedure in Assignments of Fishes to Applicants.

APPLICATION BLANKS.

On receipt of a request for fish the bureau supplies a blank calling for a complete description of the waters to be stocked. When the blank is properly executed and returned with the indorsement of a Member of Congress, the bureau endeavors to assign a suitable species of fish thereon, and the delivery is made at the earliest practicable date, at the applicant's railroad station, without cost to him. As the information requested on the application blank is used as a basis for determining the species to be assigned and to some extent the number of fish that will be furnished, the applicant should endeavor to have it as complete and accurate as possible.

SELECTION OF SPECIES.

One of the most perplexing problems confronting the division of fish culture is how to distribute the product of its hatcheries in a manner which will bring about the best results and at the same time be just and equitable to the large number of persons who every year apply to the bureau for fishes for stocking waters, both public and private.

Many persons who are familiar with some particular species of fish insist on its introduction into waters in which they may be interested. In one case an applicant who has recently moved to a new section of the country wants his favorite fish in the local waters, while in another case an applicant applies for a certain species on the recommendation of a friend or because the species has afforded him pleasure in another region. The importance of making a careful survey of the waters to be stocked, with the view of determining the species best adapted thereto, is often not recognized. It has been proved beyond a doubt that in nearly every case it is advisable to plant a species which is native to the locality, and in specifying his choice of fish the applicant should bear this in mind. Nonindigenous species should not be introduced unless it can be clearly shown that the native species, because of changed conditions, have failed to maintain themselves. There are many notable examples of the successful transplanting of fishes where the results have been highly beneficial. However, there is always an element of uncertainty in the planting of nonindigenous fishes in any region, and it should be undertaken only after a careful consideration of all phases of the situation, because if promiscuous plantings were to be permitted the work of fish culture might easily become a curse instead of a blessing to mankind.

The carp is an appropriate example of the results of the indiscriminate introduction of a foreign species. This fish was popular in the early history of fish culture in America, largely, perhaps, because it was a favorite with European fish-culturists and because of its rapid growth and ready adaptability to new surroundings. Through carelessness and indifference the carp became widely distributed in the waters of the country, with the result that in many sections a stigma will always apply to this sturdy fish. Nevertheless, there is a place in the piscatorial world for the carp, and for certain waters it fills a demand that can not be adequately met by any other species. It frequently happens that carp can be successfully and profitably propagated in waters that are quite unsuited to the finer species; and, under proper restrictions, this idea should be encouraged.

Aside from possible injury to indigenous species that may follow the introduction of foreign fishes, there are other important points to consider: Will the new inhabitants find a suitable temperature range and other conditions congenial to their reproduction? Will the food supply be of a suitable character and ample for their needs? Unless these essentials are present an introduced species can not establish itself in a new environment on a self-maintaining basis. Not infrequently species of fishes that are possessed of the highest food and game qualities in their natural habitat will, when transplanted in less favorable surroundings, degenerate to a point where they have no attractions either from a food or a game standpoint. Even the planting together of the same species of fish taken from different sections of the country or from different streams in the same section may be inadvisable. Certain investigators have expressed the belief that such plantings may lead, or in certain instances may have already led, to a form of hybridization which may result in seriously impairing the virility of the progeny.

Many of the more progressive State fish and game commissions have requested that all applications for certain species of nonindigenous or predacious fishes be submitted to them for approval. The bureau commends this policy, and all such applications, including those for carp, are referred before acceptance for the proper State authorities to pass upon. Even with the State's indorsement the bureau reserves the right to exercise its judgment.

In connection with this matter, it appears expedient to continue the policy of refusing to supply the spiny-rayed fishes to applicants in the Pacific coast watershed. This step is essential for the protection of the important salmon and trout fisheries. The planting of the spiny-rayed fishes in the streams of the west coast might result in destroying millions of young salmon inhabiting such waters. The bureau maintains that the interests of the commercial fisheries are paramount to those of the sportsmen.

Eggs of certain species are furnished to State hatcheries where such a course appears to be to the interest of the work and, on rare occasions, to applicants having hatching facilities in cases where the eggs can be delivered more economically than the young fish.

SIZE OF ALLOTMENTS.

In determining the size of allotments of fishes on applications, the bureau is governed by the number and size of the requested species available for distribution in connection with the number of applications received for it, by the extent of water area to be stocked, and by the distance to which the fishes must be transported. It aims in every case to supply only a sufficient number of young fish for a brood stock, and the recipient is expected to provide for their protection until they have had time to mature and stock the waters through natural reproduction. The importance of adequate protection for fish furnished for stocking any body of water is so obvious that the bureau has seriously considered the advisability of curtailing or entirely discontinued the distribution of fish in localities where such protection is not afforded.

It is recognized that the larger bodies of water should receive the larger number of fishes for stocking purposes, but it does not appear judicious to honor applications for such waters to the exclusion of the smaller, though perhaps no less important, bodies of water. It is the policy of the bureau to apportion the output of its hatcheries in such a manner as will permit of filling all applications, so far as such a course may be practicable. Applications are frequently received from persons in sections remote from a fish-cultural station and in a part of the country where it is known that the waters are already abundantly stocked with desirable species. In such instances the bureau does not consider it wise to incur the expense of sending small numbers of artificially reared fishes to a considerable distance, and the applicants are so notified.

TIME AND METHOD OF DELIVERY.

Certain species, notably the brook trout and the rainbow trout, are planted whenever possible during the fingerling stage; but, as the rearing facilities are limited, the stock must be reduced in the early spring to prevent overcrowding. Thus, a part of the output is annually shipped in the fry stage. The distribution of the basses and other pond fishes begins about three weeks after they are hatched and extends over a period of several months, the last lots of fishes sent out ranging from 2 to 4 inches in length. The basses, sunfishes, crappies, yellow perch, and other fishes rescued from landlocked ponds and pools in the Mississippi River Valley are from 3 to 6 inches long when distributed.

It is the policy of the bureau to fill applications in the order of their receipt and to deliver fishes assigned as soon thereafter as possible, but there are certain conditions connected with the distribution work which should be thoroughly understood by prospective applicants.

The cost involved in making shipments of fishes compels the bureau to exercise the utmost economy in arranging its distribution work. The delivery of special consignments and those intended for distant points must be delayed until a sufficient number of applications from the same section of the country have been received to warrant the expense of a messenger shipment. The bureau can not carry a stock of fish for delivery on demand, and when the supply of one year is exhausted no more are available until the crop of the succeeding year is ready to be sent out. The shipment of trout from the bureau's eastern stations begins early in March, and all applications received after that time are carried over until the following year. Trout distributions from stations in the Rocky Mountain regions are made between May and October, and, in order to insure early attention, applications from that part of the country should be in the Washington office of the bureau not later than May 1. The so-called warm-water fishes, including black basses, sunfish, and crappies, are shipped between May and December, and requests for them should be submitted prior to May 1.

The fishes are shipped in railroad cars especially designed for the purpose or in baggage cars, accompanied by a messenger, and the delivery is made at the applicant's railroad station without expense to him. When an application for fish is received by the bureau the person submitting it is immediately notified of the species assigned thereon and the approximate time when delivery may be expected. Full directions for the reception and care of the fish are also sent to him. Prior to the shipment a second notice is sent, usually a telegram, specifying the exact time when the assignment will arrive at his railroad station. If for some unforeseen reason it becomes necessary to postpone the delivery, the applicant is notified accordingly.