DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES

REPORT

OF THE

UNITED STATES COMMISSIONER OF FISHERIES

FOR THE FISCAL YEAR 1925

WITH

APPENDIXES

HENRY O'MALLEY
Commissioner

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DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

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REPORT OF THE COMMISSIONER OF FISHERIES [1]

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[1] Bureau of Fisheries Document No. 982.

Department of Commerce,
Bureau of Fisheries,
Washington, July 1, 1925.

Sir: I have the honor to submit the following summary of the major operations of the Bureau of Fisheries during the fiscal year ended June 30, 1925.

The chief functions of the bureau are to aid in conserving our fish supply and to increase its usefulness. Conservation has been defined to mean "wise use," but to make no use whatever of a resource is not conservation. Neither do depletion or total destruction through selfish disregard of the necessity for maintaining such a resource or the wasteful handling of its products constitute wise use. Any resource may be drawn upon freely so long as we do not endanger the future supply.

In order to make use of our fisheries and yet achieve their conservation the angler should refrain from taking more fish than he can use merely for the purpose of displaying his prowess, the commercial fisherman should minimize the destruction of immature, undersized, or unsalable fish, and the manufacturer and distributor should guard against losses through careless or wasteful practices. All should aid in the protection of a sufficient number of spawning fish to insure a continuing supply, and should do everything possible to prevent the pollution with noxious materials of the waters which sustain our fisheries. The bottom lands, bayous, and swamps, which constitute the nurseries for the young fish and provide their food supply, should not be reclaimed unless it is assured that they will be more productive when put to other uses. When dams or other obstructions are erected in streams supporting important runs of anadromous fishes, fishways should be provided to enable the fish to reach the spawning beds. Screening irrigation ditches is also essential in order that the young fish may not be destroyed or lost.

In the days of the first settlements the fisheries were invaluable, and without them some of the settlements would have been wiped out. Our forefathers found on this continent an abundance of wild game and, to them, unlimited forests and tillable lands, but the inroads made upon these natural resources since then by a rapidly growing population have furnished food for thought as to how we may maintain our food supply. With the situation as it is to-day there has come a growing appreciation of the importance of our fisheries and of the need for assisting nature to increase the supply of fish. To accomplish this task the science of aquiculture—water farming—has been developed, and it devolves upon us to ascertain with greater definiteness its possibilities and its limitations. Some progress has been made in a few fields, such as oyster farming, terrapin culture, fresh-water mussel culture, and the propagation of game fishes, but as a Nation we have advanced less than some European countries, largely because when the natural supply was abundant the impulse to increase it was lacking. The time has come, however, when the development of aquiculture must receive greater attention.

This science differs materially from agriculture and is much more complex. It can not be applied to all fisheries or all waters, especially not to the offshore fisheries, and it is therefore of prime importance that these be so administered as not to endanger their existence. For this reason, also, biological and statistical investigations are necessary, and with the realization of the importance of solving these problems fisheries research has been revolutionized and great advances made in developing methods of evaluating the abundance of commercial species and the drain made upon them by commercial operations. The enlargement of the scope of the bureau's activities in this field has enabled it to make gratifying progress toward a solution of such matters.

The activities of the bureau in relation to the fisheries are widespread, including fisheries biology, technology, statistics, aquiculture (including fish culture), oceanography, marketing and trade practices, and methods of the fisheries. As the administration of the fisheries of Alaska is vested in the Secretary of Commerce, the bureau is afforded the opportunity of directly applying the fruits of its scientific investigations in formulating regulatory measures necessary for their conservation and perpetuation. In the States the bureau acts only in an advisory capacity.

COMMERCIAL FISHERIES AND FISHERY INDUSTRIES

REVIEW

The number of persons engaged in the fisheries and fishery industries of the United States and Alaska exceeds 190,000; the investment amounts to about $200,000,000; the annual production of fishery products by fishermen is about 2,600,000,000 pounds, valued at about $90,000,000; the output of canned fishery products has an annual value of about $72,000,000; and the production of by-products is valued at about $10,000,000. In 1924 the ports of Boston and Gloucester, Mass., and Portland, Me., received from fishing vessels about 183,000,000 pounds of fish, valued at about $7,000,000, and at the port of Seattle, Wash., about 28,000,000 pounds, valued at $2,700,000, were landed.

Comparing the figures on production and value in 1924 with those of 1923 we find that the landings of fish in Boston and Gloucester, Mass., and Portland, Me., increased 4.6 per cent in quantity and decreased 0.8 per cent in value, while the landings at Seattle, Wash., increased 10.2 per cent in quantity but only 3.4 per cent in value. The production of canned salmon in the United States and Alaska decreased 2.3 per cent in quantity and 6.9 per cent in value; canned sardines in Maine and Massachusetts increased 49.3 per cent in quantity and 36 per cent in value; in California canned sardines increased 24.3 per cent in quantity and 18.2 per cent in value; canned tuna and tunalike fishes and oysters decreased in quantity but increased in value; and canned shrimp alone increased in quantity and also commanded a higher price.

The production of menhaden fish meal and oil suffered a decrease of about 50 per cent and a similar decrease in value, but other fish-meal production increased 36 per cent, due largely to increased activity in the sardine industry of California. The value of the latter increased only 9 per cent. The production of fish oils other than menhaden increased 35 per cent in quantity, and the prices were slightly better in general than those of 1923. The total production of canned products decreased 0.4 per cent in value and the total production of by-products decreased 18.4 per cent in value. In general, the production of fishery products in 1924 increased in quantity but commanded lower prices than in 1923, so much lower in some instances that the value was less even though the total volume was greater. This would seem to indicate that the present need of the fisheries is to develop a greater market to absorb the product.

It is gratifying to note that the industry is giving greater attention to the production of better quality fresh fish, and that a definite effort is being made by the fish trades, through fisheries associations, to raise the standards of quality and apprise the public of the value of fish as a regular source of protein in the diet.

The bureau's most direct contact with the fisheries and fishery industries is through its division of fishery industries, which during the fiscal year 1925 has continued to aid the industries by collecting, compiling, and publishing statistics of the fisheries, technical research, and the dissemination of practical information.

Statistics of the landings of fish at the ports of Boston and Gloucester, Mass., Portland, Me., and Seattle, Wash., were collected and published monthly. Data on the cold-storage holdings of fish, which are collected by the Bureau of Agricultural Economics in the Department of Agriculture, were published monthly by the Bureau of Fisheries, as in previous years. Statistics on the canned fishery products and by-products for the calendar year 1924 were collected and published in 1925, and the production, holdings, and consumption of animal and vegetable oils in the fishery industries were tabulated quarterly and furnished to the Bureau of the Census for publication as in previous years. The shad fishery of the Potomac River was canvassed for the 1925 season, and general fishery canvasses were made of the South Atlantic and Gulf States for the calendar year 1923. Statistics of the former have been compiled and published, and those of the latter are now in course of preparation for publication. Statistics of the fisheries of the Pacific coast for 1922, collected during 1924, were published, and another less detailed canvass was made for the calendar year 1923. A statistical bulletin summarizing the most recent statistics on all of the geographical sections also was published. Although the data on many of the sections apply to different years, the summary is useful in establishing approximate totals of the annual fishery production in the United States and Alaska.

As the fisheries of the United States are, for the most part, approaching the limits of exploitation, and as many of our more important littoral fisheries are actually seriously depleted, it is becoming very important that we have more complete information as to what is actually taking place each year. In other words, we need complete annual statistics. The most recent statistics now available on the personnel, investment, and yield of our fisheries are as follows: New England States, 1919; New York, New Jersey, and Delaware, 1921; Maryland and Virginia, 1920; South Atlantic States, 1923; Gulf States, 1923; Pacific Coast States, 1923; Mississippi River and tributaries, 1922; and the Great Lakes, 1922.

With its present funds and personnel it is impossible for this division to cover each of the geographical sections more often than once in five years. Experience in dealing with the fishery problems leads to the belief that such a program is inadequate for present needs, and a serious effort is being made to interest the States in this most important feature of fishery administration. Having well established organizations provided with funds derived directly from the fisheries, it should be possible for the States to undertake this work with a minimum of expense and a maximum of efficiency, leaving the bureau to correlate their activities and advise them in the conduct of their statistical programs.

TECHNOLOGICAL INVESTIGATIONS

The bureau is giving attention to such technological research as limited funds and personnel will permit. The policy is to select broad fundamental studies which are urgently needed, promise to be of greatest value to the largest number, and which the fisheries industries are least capable of undertaking. These industries are in great need of the application of science, and a great deal of research in this field must be conducted before they can be placed on the same plane of efficiency with similar industries in other fields. Few realize, especially in the fisheries industries, the advancement that can be brought about by means of well-directed, adequately supported, technological investigations, and it is important that the bureau demonstrate the possibilities of such research since continued progress in the fisheries industries largely depends upon it and upon the application of sound business principles.

CANNING SARDINES

Sardine canning is an important part of the fisheries industries. In 1924 over 3,250,000 cases were packed, having a value in excess of $12,500,000. These figures indicate that this industry is next to salmon canning in importance and, excluding Alaska salmon, place sardines first among our canned fishery products. This industry, too, could be expanded greatly, there being large supplies of herring, pilchards, and similar fishes that could be drawn on. In time, undoubtedly, this will take place to help meet the increasing world demand for cheap food of high protein content. However, our canned sardines meet very keen competition at home and abroad, and if we are to capture and hold our share of the world markets our products must be high in quality as well as low in price. Since 1920 the bureau has been conducting research upon the preparation of fish for canning as sardines, making available fundamental scientific information upon this important subject and working toward the development of a better and cheaper method of preparing the fish. Considerable success is being achieved along these lines.

In the report for 1924 mention was made of the development and successful operation on small and semicommercial scale of a new process of preparing fish for canning as sardines, originated in the bureau's experimental laboratory at San Pedro, Calif. Since then experiments have been carried out in Maine. The same process was successfully applied to the preparation of Maine sardines.

UTILIZATION OF BY-PRODUCTS

Considerable progress has been made in the last few years in the utilization of the large quantities of waste fish and offal from fish markets and concerns manufacturing preserved products. Oil can be extracted from most fish waste and the residue made into fish meal. These products are very valuable; the oil is used for making soaps and paints, in tanning leather, and for many other purposes, and the meal serves as a stock and poultry food and as a fertilizer. Although a great deal has been accomplished in the matter of eliminating waste, much yet remains to be done. Less than half of the supply of waste products of the fisheries is now being utilized, and present practices of manufacturing fish meal and oil, both from offal and from nonedible fish, are in general quite inefficient. There are also possibilities for producing better and more valuable products. The bureau is especially interested in these problems, since any improvement which may be brought about, either through education or by research, will increase the prosperity of the fisheries industries and contribute to national economy.

Some phases of this problem are of particular importance at this time. Methods should be developed to either eliminate the press liquors or economically recover and utilize the protein matter that is present in them and now discarded. This material not only constitutes a great waste, but it seriously pollutes our coastal waters in some localities. Small inexpensive plants are needed to handle small quantities of offal, such as collect at many places, as well as equipment capable of handling profitably large quantities of material for a period of four to six weeks in each year. At present operations are profitable only when large amounts of fish or offal are utilized and operations are continued over a good part of the year. Research is now being conducted along these lines.

PRESERVATION OF NETS

Very good reports are being received concerning the use of copper oleate as a net preservative. It is proving particularly effective on pound nets, especially in combination with copper paint. On the coasts of Long Island and New Jersey tarred netting ordinarily lasts but two seasons and has to be taken from the water about twice a month during part of the season in order to remove hydroids, barnacles, and other marine growths. With the antifouling copper oleate-copper paint mixture it is only necessary to remove the netting for treatment about every two months. Under such conditions it is proving profitable to use this mixture on pound nets, the twine of which costs about $4,000 per net.

The full value of copper oleate as a net preservative can not be demonstrated accurately until data are available upon the comparative costs of treating netting with various preservatives and the varying length of life of twine so treated. Practical tests of this nature, cooperated in by the fishermen, are now in progress at several points on the Atlantic seaboard and on the Great Lakes. These tests are expected to show the advantages and disadvantages of using copper oleate under practical conditions and to indicate what modifications in its use are necessary for different kinds of gear under the widely varying conditions to which they are subjected.

Cordage manufacturers are finding copper oleate to be a good preservative and anti-fouling agent for rope. At least one company now sells, for marine use, rope treated with this material.

IODINE CONTENT OF PRESERVED SEA FOODS

In a paper published during the last fiscal year (Bureau of Fisheries Document No. 967) it was shown that fresh sea foods contain a higher percentage of iodine than do other common foods. The suggestion was made that since goiter and other thyroid disorders are caused by a lack of ingestion of iodine, the liberal use of sea foods in the diet should be an effective preventive of these disorders, especially in so-called goiterous belts where the iodine content of the water and foods is below normal. The amount of iodine necessary to prevent goiter is very small—only about one part in 3,000,000 parts of the body weight—but it is important that this balance be maintained.

Many of the goiterous belts are so located, however, that it is rather difficult for the inhabitants to obtain marine fish in the fresh condition. Much of the marine fish which they consume has been preserved in some manner, such as canning, salting, or smoking. The question naturally arose as to whether these preserved products contain iodine in quantities comparable to that in fresh fish, and analyses were then made which indicate that they do. The results of these analyses were published in Bureau of Fisheries Document No. 979.

PREPARATION OF STURGEON CAVIAR

During the sturgeon season on the Delaware River the bureau took advantage of an opportunity to give demonstrations, for the benefit of fishermen and others, of the Russian methods of preparing caviar. These were conducted at a number of places by a Russian expert skilled in foreign methods.

Russian caviar is of the highest quality, and a knowledge on the part of our fishermen of the methods used in its preparation should assist them in putting up a first-class product.

CRAB FISHERY OF THE CHESAPEAKE BAY

At the urgent solicitation of men in the crab industry of Chesapeake Bay, who were becoming alarmed by the marked decrease in the stock of crabs, the bureau undertook to investigate their problems. A preliminary survey was made, from which it was found that there is a loss of over 50 per cent in converting the so-called "peeler crab" into the "soft crab," due to careless buying methods. A comparison of the fragmentary information available also indicated a distinct relationship between the catches of crabs in the States of Virginia and Maryland, leading one to believe that the fishery of one State is affected by what occurs in the fishery of the other. The two States involved have accorded the bureau their hearty cooperation, and the investigation is being continued in the hope that a solution of the problem will ultimately be reached.

COOPERATION WITH THE STATES

The various States having the responsibility of protecting their respective fisheries are faced by many problems, one of the most difficult of which is the evaluation of the destructiveness of various types of fishing gear, upon which rests the decision as to which class merits tolerance and which restriction or prohibition.

During the past year the State of Maryland applied to the bureau to determine whether the trawl net used in the Chesapeake Bay and its tributaries is unnecessarily destructive of young and unsalable fish. An investigation, in which the State of Maryland and the bureau cooperated, showed decisively that this gear is destructive of large quantities of young perch and striped bass. As a result, the practice of fishing with this gear has been stopped.

An investigation of the destructiveness of various types of gear is also under way in North Carolina in cooperation with that State.

INFORMATION SERVICE

The fishery industries utilize a great variety of fish, many of them requiring different methods of handling, different processes of smoking, salting, canning, or other mode of preservation. The abundance of fish fluctuates greatly, causing corresponding changes in production and markets. This complexity of methods and change in yield have created an unusual demand for authoritative information on a wide range of fishery subjects, which the bureau is called upon to supply. During the year 16,000 copies of statistical bulletins covering 42 subjects were distributed to interested persons, 1,600 letters were written in reply to specific requests for statistical, technological, or trade information, and foreign trade information on 50 subjects was disseminated in 3,800 letters. That this service is useful to many of those who have received the information is shown by the numerous letters of appreciation received. The service undoubtedly contributes to the stabilizing of production, placing goods in the most favorable markets, and avoiding industrial mistakes that so often result from the trial method in technological processes.

MACKEREL STATISTICS

Upon recommendation of the North American Committee on Fishery Investigation, representing the Governments of Canada, Newfoundland, France, and the United States, the bureau will collect additional statistics on the important mackerel fisheries of the western North Atlantic. The data required are in the nature of continuous statistical records of the sizes of mackerel. It is hoped that such data, collected over a period of years, will explain the severe fluctuations in abundance to which this species is subject, and possibly provide a basis for predicting the character and size of the catch in advance of the fishing season. A preliminary survey of the means and methods to be used in carrying out this program is now being made.

MARKET SURVEY OF NEW YORK CITY

As a continuation of the program of surveying the fish business of various important cities in the United States, a survey of New York City was made during 1925. Cities already surveyed are Seattle, Minneapolis, St. Paul, Chicago, Louisville, Pittsburgh, and Boston. New York City presents the most complex conditions in its fish markets and at the same time it is the greatest of our fish markets. The report on the survey will be an interesting and valuable addition to the series.

CANNED FISHERY PRODUCTS AND BY-PRODUCTS

In 1924 the fish-canning and by-products industries of the United States and Alaska attained a production valued in excess of $82,000,000, of which canned goods amounted to about $72,000,000 and by-products to about $10,000,000. Canned salmon ranked by far the highest, with a value of $42,401,602, constituting over half of the entire production of canned fish. Other canned fishery products were valued as follows: Sardines, $12,636,599; tuna and tunalike fishes, $5,756,586; shrimp, $4,608,950; oysters, $2,478,044; clams, $2,161,389, and miscellaneous fish and shellfish, $2,121,419. Of the by-products, fish oils ranked the most important, with a value of $4,311,733, followed by fish scrap and meal, $2,912,698, crushed oyster shells, $2,019,254, and other by-products, $1,065,305.

The salmon pack, on the basis of 48 one-pound cans to the case, amounted to 6,253,577 cases, valued at $42,401,602. Of this total, 5,294,915 cases, valued at $33,007,135, were packed in Alaska, and 958,662 cases, valued at $9,394,467, were packed in the Pacific Coast States. This is a slight increase over the previous year in the case of the Alaska pack, but a distinct decrease in the Pacific Coast States as compared with 1923. The average price per case has declined in Alaska and increased in the Pacific Coast States.

The pack of sardines in Maine (including one plant in Massachusetts), on the basis of 100 quarter-pound cans to the case, amounted to 1,899,925 cases, valued at $7,191,026, an increase of 49 per cent in quantity and 36 per cent in value over the production in 1923. The average price per case was somewhat lower than in 1923, but higher than the average in 1921 and 1922. The California sardine pack, on the basis of 48 one-pound cans to the case, amounted to 1,367,139 cases, valued at $5,445,573. This is a substantial increase over the production in 1923, and is more than three times as large as the production of 1921. Coincident with the increase in amount, there has been a constant decline in the average price per case during the last four years, the figures for 1921, 1922, 1923, and 1924 being $5.89, $4.70, $4.19, and $3.98, respectively.

The production of canned tuna and tunalike fishes in California, on the basis of 48 half-pound cans to the case, amounted to 652,416 cases, valued at $5,756,586. This is a decrease of 20 per cent in amount and 17 per cent in value, and is due, in part at least, to the occurrence of a fishermen's strike at the height of the albacore run, which was unusually large in this year. The average price per case of the tunas has been increasing since 1922, being as follows: 1922, $4.79; 1923, $8.45; 1924, $8.80.

The production of canned shrimp, on the basis of 48 No. 1 cans to the case, amounted to 718,517 cases, valued at $4,608,950, which marks a continuous increase in both amount and value since 1922. The average price per case has constantly increased since 1922, being $5.28, $6.26, and $6.41 in 1922, 1923, and 1924, respectively.

The production of canned oysters, on the basis of 48 five-ounce cans to the case, amounted to 447,481 cases, valued at $2,478,044. This is a decrease of 15 per cent in quantity and 9 per cent in value as compared with 1923. The average price per case in the last three years has increased from $4.79 to $5.54.

The production of canned clams amounted to 389,435 cases of various sizes valued at $2,161,389, made up of 113,717 cases of razor clams, valued at $863,684; 38,544 cases of hard clams, valued at $271,911; 80,561 cases of soft clams, valued at $459,882; and 156,613 cases of chowders, broths, bouillon, and juices of soft and hard clams, valued at $565,912.

Other canned fish, shellfish, fish roe, caviar, etc., were valued at $2,121,419.

The menhaden industry suffered a serious shortage of raw material during 1924, which resulted in a 50 per cent reduction in the volume of the products as compared with the previous year. The output of this industry was valued at $3,310,176, and comprised 21,008 tons of dried scrap and meal, valued at $996,866; 24,409 tons of acidulated scrap, valued at $495,684; and 3,923,904 gallons of oil, valued at $1,817,626.

The production of dried scrap and meal from other fishes and fish offal amounted to 30,847 tons, valued at $1,373,351, which is an increase of 36 per cent in quantity and 9 per cent in value as compared with 1923. Fish and whale oils, exclusive of menhaden oil, totaled 5,287,391 gallons, valued at $2,494,107, which is an increase of 35 per cent in quantity and 40 per cent in value as compared with 1923. There was a decrease in quantity of crushed oyster shells produced, as well as in value, the 1924 figures showing 219,211 tons, valued at $2,019,254.

Other by-products were valued at $1,065,305, which is somewhat below the value of the output in 1923.

FROZEN-FISH TRADE

As in previous years statistics of the cold-storage holdings of frozen fish and the quantities frozen in the United States and Alaska were collected by the Bureau of Agricultural Economics, Department of Agriculture, and published by the Bureau of Fisheries in the form of a monthly statistical bulletin. The reports for 1925 show that the holdings were smallest in April, with 21,488,525 pounds, and largest in November, with 70,405,786 pounds. The average monthly holdings amounted to 45,041,000 pounds, as compared with 36,202,000 pounds in 1923, an increase of 24.41 per cent. The increase in any single month, as compared with the corresponding month in the previous year, varied from 6 to 103 per cent. Compared with the 5-year average, the increase in 1924 holdings was comparatively insignificant, running slightly below that average from January to

July and above it from August to December. The average monthly holdings were one-half of 1 per cent greater than shown in the 5-year average.

The quantity of fish frozen during 1924 was 97,324,144 pounds, as compared with 91,548,643 pounds in 1923, an increase of 6.3 per cent. The principal species frozen were halibut, 14,650,787 pounds; salmon, 14,309,666 pounds; ciscoes, 13,195,023 pounds; herring, 8,695,698 pounds; whiting, 7,528,339 pounds; and mackerel, 5,457,696 pounds.

NEW ENGLAND VESSEL FISHERIES

Statistics of the vessel fisheries at Boston and Gloucester, Mass., and Portland, Me., collected by the bureau's local agents, have been published monthly. Two annual bulletins were issued—one showing the catch by fishing grounds and the other by months.

The total landings by vessels at these ports in 1924 amounted to 7,475 trips, aggregating 182,948,194 pounds of fresh and salted fish, having a value to the fishermen of $6,992,952. There was an increase over 1923 of 4.6 per cent in quantity and a decrease of 0.8 per cent in the value of the products landed. The product was caught by 12.1 per cent more vessels and 14.4 per cent more trips than in 1923. Of the total quantity, 71.6 per cent was landed at Boston, 19.6 per cent at Gloucester, and 8.8 per cent at Portland. These fish were taken chiefly from fishing grounds off the coast of the United States, about 81 per cent coming from these waters and 3 per cent and 16 per cent, respectively, from fishing banks off the coasts of Newfoundland and Canadian Provinces.

The catch of cod and related species amounted to 157,126,008 pounds, valued at $4,860,564. Of these, the haddock ranked first in both quantity and value, with cod next. The combined catch of these two species comprises about 90 per cent of this category of fish. The catch of halibut, amounting to 4,422,146 pounds, valued at $789,609, registers a decline in both quantity and value as compared with the previous year.

The total catch of fresh mackerel taken by the American fishing fleet in 1924 was 102,067 barrels, or 15,310,050 pounds, compared with 121,982 barrels, or 18,297,300 pounds, in 1923; the salted mackerel landed amounted to 10,841 barrels, or 2,168,200 pounds, compared with 3,864 barrels, or 772,800 pounds, in 1923. Of the total quantity in 1924 there were landed by fishing vessels at Boston and Gloucester, Mass., and Portland, Me., 9,757,509 pounds, valued at $541,784.

FISHERIES AT SEATTLE, WASH.

Statistics of the fish landed at Seattle, Wash., which were collected by the local agent, were published as monthly and annual statistical bulletins giving the quantity and value of fishery products landed at that port by fishing and collecting vessels during the year. In 1924 this fleet landed 28,232,720 pounds, valued at $2,719,222.

The catch by fishing vessels, which consisted largely of halibut, amounted to 10,066,010 pounds, valued at $1,329,957. This registers a decrease in the catch at Seattle, which has been continuous since 1920 and is due largely to the failing supply of halibut. The quantity of this fish landed in 1924 was 7,362,960 pounds, as compared with the average of 11,566,262 pounds for the previous eight years.

The fish landed by collecting vessels amounted to 18,166,710 pounds, valued at $1,389,265, showing an increase of 779,232 pounds over last year.

SHAD AND ALEWIFE FISHERIES OF THE POTOMAC RIVER

The regular annual statistics of the shad and alewife fisheries of the Potomac River were taken for the season of 1924. They show that the shad fishery yielded 172,310 fish, weighing 578,210 pounds and valued at $88,450 to the fishermen. This marks an unprecedentedly small catch, amounting to only 49 per cent by number and 45 per cent by value of the 1923 catch, which itself was less than half as large as the preceding year's catch.

The catch of alewives, amounting to 15,133,388 fish, weighing 6,052,756 pounds and valued at $56,552 to the fishermen, was greater than the 1923 catch by 32 per cent in number and 14 per cent in value and was the largest catch in recent years.

FLORIDA SPONGE FISHERY

In 1924 the quantity of sponges sold at the Sponge Exchange, Tarpon Springs, Fla., was 425,305 pounds, valued at $714,760, of which 265,392 pounds, valued at $599,221, were large wool; 58,021 pounds, valued at $72,652, small wool; 81,420 pounds, valued at $37,996, yellow; 14,898 pounds, valued at $2,661, grass; and 5,574 pounds, valued at $2,230, wire. It is estimated that sponges to the value of $50,000 were sold outside of the Exchange at Tarpon Springs.

Compared with the production in 1923 this indicates a decrease of 13 per cent in total quantity and 3 per cent in total value. When compared with the annual production from 1919 to 1923, however, it is apparent that the 1924 output was only slightly below normal in quantity and above normal in value.

FISHERIES OF THE SOUTH ATLANTIC STATES

A canvass of the fisheries of the South Atlantic States was made for the calendar year 1923, and the statistics were published in condensed form as Statistical Bulletin No. 652. The results of this canvass show that there were 16,298 persons engaged in the fisheries and fishery industries, the investment was $8,505,223, and 228,747,930 pounds of fishery products, having a value to the fishermen of $5,087,340, were produced.

Some of the more important species taken, arranged in the order of their value, were shrimp, 23,705,901 pounds, valued at $821,861; menhaden, 148,180,970 pounds, valued at $752,026; shad, 3,190,666 pounds, valued at $716,649; oysters, from public and private beds, 11,172,336 pounds or 1,596,048 bushels, valued at $448,137; squeteagues, or "sea trout," 5,258,047 pounds, valued at $381,155; mullet, 7,734,412 pounds fresh and 622,000 pounds salted, valued together at $378,301; bluefish, 2,004,244 pounds, valued at $214,826; Spanish mackerel, 2,652,341 pounds, valued at $205,987; cero and kingfish, 1,966,596 pounds, valued at $161,201; and alewives or river herring, 2,609,347 pounds fresh and 4,961,050 pounds salted, valued together at $146,104.

Compared with 1918, the next previous canvass, there was an increase in the number of persons employed of 1,252, or 8.32 per cent, and an increase in the investment of $1,081,252, or 14.56 per cent. There was a decrease in the products of 103,866,193 pounds, or 31.23 per cent, in quantity and $261,276, or 4.88 per cent, in value. Practically all of the decrease may be attributed to a smaller catch of menhaden, which amounted to only 148,180,970 pounds in 1923 as compared with 257,757,799 pounds in 1918. There was also a large decrease in the catch of alewives, cero and kingfish, red and black drum, mullet, and Spanish mackerel, but an increase in the yield of shad, squeteagues or "sea trout," shrimp, and oysters.

FISHERIES OF THE PACIFIC COAST STATES IN 1922

The statistics of the fisheries of the Pacific Coast States for the calendar year 1922 were obtained from a canvass made during the year 1923, but due to the limited clerical force tabulations were not completed until the latter part of the fiscal year 1925. A summary statement has been published as Statistical Bulletin No. 647.

The statistics show that the Pacific Coast States, with their valuable salmon, halibut, tuna, and sardine fisheries, constitute one of our most important fishery sections. In 1922 there were 22,270 persons engaged in fishing and fishery industries; 698 vessels fishing and transporting fish; 4,173 power boats and 1,041 sail and row boats fishing; $28,651,490 investment in vessels, boats, gear, and shore property connected with the fisheries; and a production of 282,968,421 pounds of fish, shellfish, and whale products, valued at $12,983,583 to the fishermen. Judging from the value of the products to the fishermen, the salmon fishery, which is prosecuted on the coast and rivers from Monterey, Calif., to Seattle, Wash., was the most important of the Pacific coast fisheries, producing 62,685,475 pounds, valued at $3,768,988. Next in importance was the halibut fishery, prosecuted principally from the port of Seattle, which in 1922 produced 18,706,517 pounds, valued at $1,925,482. Third in importance was the tuna fishery of California, which produced 36,900,805 pounds of albacore, tuna, bonito, and skipjack, valued at $1,847,567.

The statistics for 1922, compared with those available for former years, strikingly reveal the changes taking place in the Pacific coast fisheries. With the development during the last decade of the tuna and sardine fisheries, California has forged ahead to the leading place among the Pacific Coast States. The number of persons engaged in her fisheries increased from 4,129 in 1908 to 8,452 in 1915 and 9,173 in 1922. The investment increased from $1,659,000 in 1908 to $5,824,263 in 1915 and to $13,047,414 in 1922. The value of her products increased from $1,970,000 in 1908 to $2,506,702 in 1915 and to $6,773,981 in 1922.

Washington, having passed the peak of her development in the salmon and halibut fisheries, took second place on the Pacific coast in 1922. The number of persons engaged in the fisheries dropped from 14,645 in 1915 to 7,600 in 1922; the investment in fisheries and fishery industries dropped from $14,129,553 to $10,711,500; and her production from $5,320,725 to $4,953,913.

The fisheries of Oregon in 1922 employed 5,497 persons; the investment amounted to $4,892,576 and the product totaled 22,371,764 pounds, valued at $1,255,689. The decline in the Oregon fisheries is less severe than that in the Washington fisheries. The number of persons engaged therein was somewhat lower in 1922 than in 1915, the investment was slightly higher, and the value of products was lower.

INQUIRY RESPECTING FOOD FISHES

INTRODUCTION

The investigations conducted by the division of scientific inquiry are designed to produce information that may be made use of in the conservation and development of our various fishery resources. For several years past a definite effort has been made to develop these investigations along the lines of greatest practical value, and it is felt that increased progress has been shown during the past year. Coincident therewith has been an awakening of the public to the necessity for adequate care of our fishery resources and to the importance of properly planned and executed biological investigations on which to base measures of conservation.

This greater appreciation of the necessity for conserving our fisheries has undoubtedly been brought about by the serious depletion of some of the most important of them. The sturgeon have all but disappeared from both coastal and inland waters; the salmon of the Atlantic coast have been entirely exterminated in many streams, and in others only a small remnant of the former runs remains; in certain streams on the Pacific coast the salmon are much reduced; the halibut on both coasts have been distinctly reduced in numbers, unquestionably as a result of overfishing; the shad and mullet of the east coast and the whitefishes and related forms of the Great Lakes have been affected; and the production of oysters is much reduced. Many other examples of depletion might be cited, but these will suffice to show the seriousness of the situation.

The reasons for the depletion are different in each of these cases. In some the condition may be ascribed definitely to overfishing, but in others the increasing pollution of coastal and inland waters is equally if not more to blame. Dams and other obstructions erected in the rivers reduce the areas available for spawning, and thousands of young fish are lost annually through unscreened irrigation ditches. Pollution, dams, and irrigation ditches are the results of the increased industrialization of the country, a process which is still far from having reached its height, and unless adequate remedies are provided in the very near future many of our fisheries will go to their commercial destruction. In addition to these factors there must be considered the constantly increasing demand of a growing population for the products of the commercial fisheries and for a greater supply of game fish.

The result of all these forces has been to put a strain upon our fishery resources which will require the best efforts of all concerned to overcome. Aquatic resources such as these may, if properly used, be made perpetual, but measures for their care must be based upon a broad knowledge of the many factors that tend to cut down or increase the abundance of the various species of fish involved. The object to be sought for is the utilization of the fisheries to the fullest extent compatible with their maintenance. Just what the limit may be and the means for preventing excessive exploitation or for further development of resources not now fully utilized are mainly problems for the biologist. The general nature of the fishery investigations conducted by the division of scientific inquiry and their bearing upon the problems of conservation have been adequately outlined in the report for the fiscal year 1924 and need not be repeated here.

Within the past few years there has been a most remarkable increase in the recognition of the importance of biological investigation in fishery conservation, and, as a result, there have been numerous requests from States, cities, and private organizations for investigation of their fishery problems. These have been met so far as the limited funds and personnel of the bureau would permit, but it has not been possible to undertake all of the investigations asked for. In certain instances cooperative arrangements were entered into which have proved most satisfactory. It is believed that such arrangements as these offer an avenue for the expansion of the scientific activities of the bureau without materially increasing present expenditures.

An outstanding feature of the year's activities was the Fisheries Conservation Conference called by the Secretary of Commerce and attended by representatives of the fish commissions of the Atlantic and Gulf States. This conference was held on May 22 and had for its object the consideration of procedures for saving certain of our Atlantic coast fisheries from further depletion. Among the important matters discussed were the destruction of small, immature fish, the control of fisheries in boundary waters, and the rehabilitation of the shad, sturgeon, and lobster fisheries. The following resolution was adopted:

Whereas the necessity for concerted action by the coast States to protect national fisheries has been forcefully called to our attention by Secretary Hoover; and

Whereas the Secretary has seen fit to call this conference for the purpose of devising ways and means for rehabilitating these fisheries: Be it

Resolved, That the representatives here assembled go on record as indorsing the purpose of the conference and expressing on behalf of our various States our gratitude for Mr. Hoover's intelligent and patriotic interest in calling the conference; be it further

Resolved, That it is the desire of the representatives here assembled that the Secretary shall, with the approval of the governors, appoint a commission composed of representatives from each of the fish commissions of the Atlantic States to work out various problems relating to the lobster, shad, and other anadromous fishes of our coastal waters; be it further

Resolved, That in considering means of improving fishing conditions we particularly indorse and recommend any and every action that may be taken to subserve the welfare, comfort, and material success of the commercial fishermen.

There follows a brief résumé of the more important activities of the division of scientific inquiry during the past year.

ATLANTIC COAST FISHERIES

The cod, pollock, and haddock fisheries of the western north Atlantic are of prime importance. There are landed annually, at American ports alone, about 140,000,000 pounds of these fish, with a value to the fishermen approximating $4,500,000. One of the greatest of all our fishery resources, it has been exploited since the time of the first settlements in New England, when it proved to be an important factor in the success of the newly established colonies. In spite of an extensive fishery, which has been maintained for many years, this resource has shown no definite signs of depletion, but the intensity of the fishing is being constantly increased by the addition of fleets from the European side of the Atlantic. At the present time the banks are being fished by ships from the United States, Canada, Newfoundland, Spain, Portugal, France, and probably other nations. Adequate statistics of the total catch are not available, since we have no data for several of the countries engaged.

The results of this increase in the intensity of fishing can not be foretold, but the importance of the industry to the American people and the desirability of maintaining the resource unimpaired are such that an investigation of the biology of the cod, pollock, and haddock has been undertaken with the idea of determining the factors responsible for any fluctuations in abundance which may become apparent. It is important for an understanding of the general principles of fishery conservation to know how such a great fishery can withstand intensive exploitation over a long period of time without depletion. Such knowledge should throw much light on the problem of maintaining other fisheries which do show signs of depletion due to overfishing, and the data would be invaluable if the bank fisheries themselves should become reduced.

The program includes extensive tagging experiments for the purpose of discovering the extent and nature of the migrations of the adult fish. Over 10,000 fish, principally cod, were tagged during the season of 1924, and nearly 5,000 during the first part of the season of 1925. Approximately 800 tags have been recovered since the beginning of the operations in 1923, and many important data have been secured on the migrations and rate of growth. Evidence of a winter migration southward along the coast, which was given by tagging done during 1923, was confirmed in 1924, and additional data were secured which make it appear certain that there is very little interchange between the populations of the various banks. In connection with the tagging operations, scales have been secured from nearly every fish tagged and from several hundred others. These are being studied to determine age, rate of growth, and any peculiarities that may be found between the fish on the various banks.

An investigation of the early history of the cod, designed to supplement and complete the studies of the adults, has been underway during the past year. The work was done in Massachusetts and Ipswich Bays and along the coast of Maine. The main problem involves a study of the spawning of the cod, the conditions existing during the period of incubation of the eggs, the early larval history, food habits of the larvæ and young fish, their enemies, and the gradual changes in the feeding habits and migrations during the first year. It has been found that after completing their larval development the young cod and pollock seek shallow water and in April and May are to be taken along the shores. As the temperature rises in June they leave the shallow water and seek deeper areas. Just where they go at this time has not yet been discovered.

The mullet fisheries of the South Atlantic and Gulf States are to these waters what the cod fisheries are to the North Atlantic. The annual catch in 1923 approximated 40,000,000 pounds and was valued at over $1,500,000. In certain districts, notably in North Carolina, there has been an alarming decrease in productivity of the mullet, and an investigation has been started to determine the causes for this apparent depletion and if possible to devise means for remedying the situation. The sizes of the fish taken in the region about Beaufort, N. C., were studied during the fall in order to determine the relative abundance of the various size groups. Scales were also taken as an aid in the analysis, and a study of the catch for age composition has been undertaken. The question of the interdependence of different fishing areas is an important one, since, if the areas are independent, measures applied in one locality would have no effect upon another. Considerable attention has been devoted to this question and several thousand measurements of the physical proportions of mullet from different localities have been made. Although the study has not yet been completed it has become quite apparent that there are differences in certain localities which can be explained only by assuming that the races have not mixed. The data indicate the existence of at least two races entering into the fishery in North Carolina and several along the coast of Florida.

As a result of these investigations definite proof of depletion in certain localities has been obtained. This has been presented to the State fishery officials, together with specific recommendations which it is hoped will prove the means for rehabilitating the fishery. The State officials concerned have cooperated with the bureau in every way, and it is expected that the recommendations will be acted upon and that important results will follow.

An investigation of the salmon and smelt fisheries of the New England States has been continued, and a report thereon has been completed. More detailed studies of the smelt are underway, and many data bearing on the salmon and trout of New England have been secured and are being compiled for analysis.

Near the close of the fiscal year an investigation of the mackerel fisheries of the north Atlantic was begun. While the mackerel fishery does not approach that of the cod in total value, it is important because of the high esteem in which the product is held. During 1923 the total landings in New England exceeded 10,000,000 pounds, valued at nearly $500,000. This fishery is noted for the great fluctuation in the abundance which occurs from year to year, and it is important to know what is responsible for this fluctuation, whether it can be controlled, and whether the abundance can be predicted. As an initial step in this study tagging operations have been undertaken in Massachusetts Bay, Cape Cod Bay, and near Woods Hole, and about 1,000 fish had been tagged by the close of the fiscal year. A few recaptures had been reported, but these showed no definite indication of a directed migration. The division of fishery industries is cooperating in this work and steps have been taken to gather vital statistics of the mackerel catch in various localities.

PACIFIC COAST FISHERIES

A large part of the scientific work of the bureau on the west coast has been devoted to the salmon fisheries of the coastal States and Alaska. These are among the most valuable fisheries of the world, producing annually from five to seven million cases of the canned product, valued at from forty to fifty million dollars. They have been prosecuted with growing intensity for many decades, and the serious results of overfishing are all too apparent in many places. In certain streams the runs have been practically wiped out, and in others they have become so reduced that it has seemed desirable to entirely close certain areas to fishing for a length of time sufficient to permit the building up of the runs. If these fisheries are to be properly conserved for future generations prompt action is necessary, and such action must be based on reliable biological information. In the case of the salmon fisheries of Alaska the entire care of these resources is vested in the Department of Commerce, acting through the Bureau of Fisheries, and it is especially incumbent upon us to provide protection that will be ample and yet interfere as little as possible with the industry. The regulations that have been imposed were based on the best biological information available, and at the same time an effort has been made to increase this knowledge to the end that the regulations may better fit the needs. It is especially necessary to determine which streams contain the more important spawning areas and to establish the relation of these to the productive fishing centers.

In order to ascertain these facts extensive tagging experiments have been conducted since 1922. During that year and the following one such experiments were carried on in the Ikatan–Shumagin Island district, with the result that the runs of red salmon in this region were found to originate in Bristol Bay, where a very intensive fishery is conducted. This fact was given consideration in the regulations.

During 1924 tagging operations were conducted in southeastern Alaska, where the relationship between the various runs is extremely complicated. The results were not entirely satisfactory, due in part to the relatively small number of fish tagged. These experiments are being repeated during the season of 1925, when it is planned to attach 20,000 tags.

For a number of years weirs have been maintained in several important salmon streams for the purpose of determining the escapement to the spawning grounds. During 1924 such weirs were maintained in Karluk, Letnik (Afognak), and Chignik Rivers, and in streams tributary to Alitak and Yes Bays. Distinct fisheries are maintained near the mouths of the rivers named, and accurate data are available as to the catch. These data, together with the escapement counts, give a reliable measure of the total run, and from such experiments as these we may expect ultimately to learn the percentage of escapement necessary to maintain the stock.

In several of the more important streams extensive scale samples were taken, and a study of these should provide important information as to the relative success of the various spawning seasons. An especially intensive study has been undertaken of the Karluk River, one of the more important of the salmon streams of Alaska. Conditions here are in many respects exceptionally favorable for study, and it is planned to continue the work for a number of years. Special attention is being given to the efficiency of natural propagation and to what constitutes a reasonable expectation for future runs based on a known volume of spawning fish. The size of the runs has fluctuated from year to year in the past, and the escapement has varied proportionately from 1,330,000 spawners in 1921 to only about 330,000 in 1922. Such widely differing brood years should produce equally differing results when their progeny reach maturity, unless other factors interfere. This is a problem that has never been investigated, and it is expected that the results of the Karluk experiment will throw much light upon it.

On the Columbia River the marking experiments conducted since 1916 were continued and interesting results were secured. A report presenting the data secured up to 1924 is now in course of preparation. These relate to the relative efficiency of various hatchery methods and will doubtless prove to be of great practical value in developing such methods. An investigation of the spawning grounds of the blueback salmon resulted in the discovery of a spawning bed in the Okanogan River, which is of considerable interest because little is known of the present spawning areas of these fish and, lacking such information, it has been impossible either to give them adequate protection or to secure their eggs for artificial propagation.

On March 16 and 17, 1925, a meeting of the fisheries executives of the Pacific coast was held in Seattle and was attended by representatives of the Bureau of Fisheries, the Departments of Fisheries for Canada and for British Columbia, the State fish commissions of Washington, Oregon, and California, and the Territorial Fish Commission of Alaska. As a result of this meeting there was formed the International Pacific Salmon Investigation Federation, the object of which is to foster and coordinate researches bearing on the salmon resources. Recommendations were made looking toward the negotiation of a treaty between the United States and Canada which would provide for the investigation of the salmon fisheries.

The halibut fisheries of the north Pacific have shown marked signs of depletion, which has occasioned much concern. The annual yield of this fishery is over 50,000,000 pounds, valued at over $5,000,000, and approximately 80 per cent of this catch has been taken by American vessels. Under the terms of the north Pacific halibut treaty between the United States and Canada, consummated during the preceding fiscal year, the International Fisheries Commission was established and has begun an intensive investigation of the halibut resources. This work has been placed in charge of W. F. Thompson, a capable and experienced investigator of fishery problems, and rapid progress is anticipated. Plans and organization were perfected during the winter, and active work has already begun.

FISHERIES OF INLAND WATERS

A statistical canvass of the fisheries of the Great Lakes conducted during 1922 disclosed the fact that the total production of fish in these waters exceeded 110,000,000 pounds, valued at $6,799,633. Whitefish and cisco were the most important items, over 40,000,000 pounds, valued at over $2,000,000, having been taken. While the total yield of the Great Lakes fisheries has not declined appreciably, there has been a noticeable reduction in the take of whitefishes and ciscoes, their place having been taken by other less desirable species. An investigation of the more valuable species was undertaken several years ago and was continued during the past year.

Two lines of investigation have been followed—one dealing with the systematic relationships of the various coregonine fishes (the whitefishes, ciscoes, and related forms), and the other with the life histories and ecology of some of the more important species. The study has been brought to an advanced stage and much of the material is already in manuscript form. The life-history studies are also well advanced, and much information has been obtained from an analysis of the scales, including rates of growth in different localities, age composition of the commercial catches, age at sexual maturity, and other related matters. It was found that in the region of Alpena 70 per cent of the commercial take during the summer consisted of fish in their fifth year. It has further been shown that the whitefish in Lake Huron do not ordinarily reach the spawning stage before their fifth year, while the majority do not spawn before the sixth year. At Alpena only 45 per cent of the females taken during the summer were sexually mature, in spite of the fact that none of the fish were below the legal size limit. It is apparent from these facts that the commercial catch draws to an alarming extent upon the immature fish, which are thus prevented from participating in the maintenance of the species. Some additional regulation of this fishery obviously is necessary if it is to be maintained.

OYSTERS

For many years the oyster resources of the Atlantic coast constituted our most valuable fishery, but recently the supply in certain important localities has declined to an alarming extent. In spite of this, however, the annual yield approximates 20,000,000 bushels, valued at $14,000,000. The serious depletion of such an important resource as this naturally occasions general concern, and for a number of years investigations have been conducted for the purpose of discovering the cause for it and, if possible, means whereby the situation might be remedied.

During the past year the organization of this work has been entirely revised, and it is believed that more rapid progress will be achieved than ever before. Particular attention has been given to conditions in Long Island Sound, where the greatest mortality has occurred, due to excessive pollution and the serious overfishing of certain of the inshore areas that were of special importance in the production of spawn. The effect of various pollutants on the fertilization and development of the eggs was studied and extensive experiments in the artificial propagation and culture of oysters carried on. A small hatchery was built at Milford, Conn., and various types of apparatus for rearing the larval oysters were tested out. A new method was perfected, by means of which oyster larvæ were reared from the egg until they attached to the collectors. The oysters artificially propagated by the bureau during the summer of 1923 were placed on suitable inshore beds, and by August, 1924, had attained an average size of two and one-half inches. It is expected that by the fall of 1925 they will make an excellent half-shell stock.

In cooperation with the State fisheries authorities the bureau has made a careful preliminary survey of the oyster resources of Georgia. Although there is a heavy production of oysters on the natural beds, these are of inferior quality and have relatively little commercial value. There appears to be no reason, however, why the best type of oysters can not be produced in Georgia waters, and a number of specific recommendations were made, which, if followed, will aid materially in the development of this industry.

An important event during the year was the conference of oyster producers and distributors and State shellfish commissioners, which was called by the commissioner and held in Washington on January 9, 1925. Representatives of the Public Health Service and the Bureau of Chemistry were present and discussed the work of their respective organizations in relation to the oyster industry. The conference was called to discuss the set-back received by the industry because it was alleged that typhoid was being spread by oysters. Resolutions were passed urging closer cooperation between producers and the State authorities to insure the taking of oysters from sanitary beds only, the development of uniform sanitary standards, and the issuance of certificates of approval similar to those used in the handling of milk, canned foods, etc.

FRESH-WATER MUSSELS

One of our largest fresh-water fisheries is that for mussels in the Mississippi drainage. The shells are used in the manufacture of pearl buttons and novelties. During 1922 the yield was approximately 52,000,000 pounds, with a value of over $1,000,000. The manufactured products were valued at nearly $8,000,000.

Investigations pertaining to fresh-water mussels have been carried on for a number of years by the staff of the Fairport (Iowa) biological station, numerous surveys having been made and experiments in artificial propagation conducted. In this work the bureau has been closely associated with the various States, and has been instrumental in developing needed protective legislation. As a result of the work of the bureau, Lake Pepin, a widened portion of the Mississippi River lying between Minnesota and Wisconsin, was divided into four approximately equal sections in 1920, two of which were closed to shelling for a period of four years. These two divisions of the lake were reopened in 1924, when the remaining two divisions were closed for a like period.

It has been a matter of more than usual interest to trace the results of this action. A survey conducted in 1924 showed that the two divisions which had just been opened produced 4,000,000 pounds of shells—more than twice the production of the entire lake for any one of the 10 preceding years. Information obtained indicated that when the shellers started working the newly opened beds they found the mussels apparently as plentiful as when the lake was first fished. It is realized that the heavy shelling now carried on will again greatly deplete the beds, but in the meantime the remainder of the lake, now closed, is recovering its mussel population and will be ready, when opened in 1929, to relieve the strain on the beds now open.

Experiments in the artificial propagation of mussels were continued, and progress was made in perfecting the use of hatchery troughs for this purpose. An investigation bearing on the relationship between fish slime and the attachment of the larval mussels to the fish on which they are parasitic during the early stages of their development was undertaken by Dr. M. M. Ellis, of the University of Missouri, and promises to yield results of the greatest importance to the success of the experiments in artificial propagation.

ALASKA CLAMS

The utilization of the clam resources of Alaska has been of recent development but already there is ample evidence of the serious depletion of some of the most productive beds. An investigation of these resources and of the biology of the clams was begun during 1923 and continued during the past year. Surveys were made of the beds in the region around Cordova and at Kukak in Shelikof Straits. Observations were also made on other mollusks in Alaska and on certain of the beaches in the State of Washington. Age determinations were made and the rate of growth determined for several localities, and data were secured on the time of spawning and its relation to water temperature. Many data showing the relation of size and age to sexual maturity have been worked out, making possible the determination of proper size limits.

These investigations have shown that Alaska clams grow much more slowly than do the clams on the coast of Washington, requiring about twice as much time to reach a marketable size. At Cordova, Alaska, a length of 4½ inches is attained in about 6 years, while at Copalis, Wash., only 3 years are required.

The Washington clam beds were found to be much more heavily seeded than those of Alaska. In 1923 the set of small clams at Copalis averaged over 1,400 per square foot, but in Alaska the average number of small clams in 1923 and 1924 was less than one per square foot.

Clam canning was begun in the Cordova district in 1916. An analysis of about 150 clams taken showed that over 100 of them were young when canning began eight years before. Under such conditions it is patent that the fishermen are drawing heavily on their capital stock, and the need for regulation is evident. A size limit of 4½ inches has been placed on all the Alaska beds to reduce the intensity of digging and thus prevent depletion. A report has been published giving the results of the investigations made during 1923 and 1924.

INVESTIGATIONS RELATING TO FISH CULTURE

The importance of artificial propagation as an aid in the conservation of our fishery resources is generally recognized. In addition to the extensive fish-cultural operations conducted by the bureau, nearly all of the States and many private agencies maintain hatcheries for the purpose of stocking their waters with food and game fishes. The biological principles involved in artificial propagation are not yet thoroughly understood, and difficulties frequently arise which demand study that can be given only by a competent biologist. In pond culture a knowledge of pond ecology is essential if the work is to be efficiently done, and in nearly every case a knowledge of the life histories of the fishes involved is important. In hatchery operations also it is necessary to know the proper treatment for the various diseases that frequently cause great mortality and what constitutes the best composition for the artificial foods that must be used. Such investigations are carried on by the staff of the division of scientific inquiry.

During the past year several fish parasites that have caused serious losses in many of the hatcheries were investigated. A study of *Octomitus salmonis*, a microscopic organism infesting trout, has been completed and a report thereon has been published. This parasite is so common that in some hatcheries it is hard to find trout less than 1 year old that do not contain considerable numbers in their intestines. The manner in which the disease is transmitted has been worked out, and methods that will doubtless do much to reduce the mortality caused by it have been prescribed.

A study of the importance of vitamines in the dietary of artificially reared fishes was continued, and the results were in complete accord with those obtained during 1923. It was found that the addition of cod-liver oil and yeast to beef heart noticeably increased growth and decreased mortality. Beneficial results could be obtained as readily with small amounts of the dietary accessories as with larger amounts. In many instances the mortality of fish fed a ration of heart to which a small amount of oil and yeast had been added was less than half as great as among those reared under identical conditions but without the addition of these items to the diet. Results were not so apparent in the case of fish fed liver, presumably because liver is much richer in vitamines than was formerly thought to be the case.

At the Fairport biological laboratory experiments were continued in the artificial propagation of the sturgeon, sheepshead, silver carp, and paddlefish. Many data have been obtained but progress has necessarily been slow, due to the lack of adequate information on the life histories of these species. The "farm pond" was continued as in previous years and a comprehensive study of pond ecology has been planned, which it is hoped will provide information of value in the development of methods whereby small ponds may be made productive of fish for food.

During the past year arrangements were made for the utilization of the Holden (Vt.) fish-cultural station for investigations and experiments dealing with hatchery problems. The need for such an experimental station has long been felt, as there are many important problems to solve in connection with artificial propagation. In connection with the experimental work at Holden it is planned to conduct field investigations, for which the numerous trout streams in the vicinity afford an excellent opportunity. This work will be undertaken with the cooperation of the State department of fish and game, the officers of which have offered to assist the bureau in every possible way.

MOSQUITO CONTROL BY MEANS OF FISH

The prevalence of malaria in the Southern States annually causes, directly and indirectly, many deaths and much suffering. It is also responsible for a marked degree of inefficiency among those affected.

The total economic loss due to this factor is incalculable, and much effort has been expended in an attempt to control the mosquitoes, which are responsible for the spread of the disease.

For a number of years the bureau has been conducting experiments in the use of certain small fishes (*Gambusia affinis*) in the control of mosquito production with marked success. At the present time this method is used extensively and is considered to be the best under a variety of circumstances. During the past year special attention was given to the propagation of these fishes on large tracts of land that were to be flooded. By properly stocking the small, natural bodies of water found in the areas to be flooded it is expected that efficient control may be secured from the very first in the artificially formed lakes. A paper giving the results of this work has been prepared.

Experiments on the effects of variations in temperature and rainfall on the efficiency of Gambusia in controlling mosquito production were continued at Augusta, Ga. The season was unfavorable on account of periods of heavy rainfall, which caused flood conditions to prevail. Some valuable information was secured, however, and a comprehensive report has been prepared for publication. Arrangements have been made to conduct similar experiments in the region about Greenwood, Miss., and a field laboratory has been established at that place.

This work has been carried on in cooperation with the United States Public Health Service and the Board of Health of Augusta, Ga.

OCEANOGRAPHIC AND LIMNOLOGICAL INVESTIGATIONS

In connection with the investigations into the cause of the marked depletion of the oyster resources in Long Island Sound studies have been made of certain conditions to be found there which are inimical to the growth and survival of the larval oysters. A considerable increase in the acidity of the water was observed in the Housatonic River and in Bridgeport and New Haven Harbors. Other oceanographic observations were made in connection with the survey of the oyster resources of Georgia and the study of the spawning and early history of the cod. Serial temperatures were taken and horizontal and vertical tows made along the coast of Maine, in Massachusetts and Cape Cod Bays, and on Nantucket Shoals. Arrangements for taking an extensive series of temperatures at a number of selected lightships and lighthouses along the Atlantic coast have been completed. Work on the preparation of the report on the oceanography of Chesapeake Bay was continued, and it is expected that this will be completed in the near future.

Various studies pertaining to the physical and biological conditions existing in certain fresh-water lakes in Wisconsin have been continued.

FOULING OF SHIPS' BOTTOMS

An investigation of the nature and extent of the fouling of ships' bottoms was begun in 1922 in cooperation with the Bureau of Construction and Repair of the Navy Department. It was continued during the past year at New York, Norfolk, Va., and Beaufort, N. C. During the course of the investigation 225 ships were examined and data on the length of voyage, routes covered, and ports visited were secured for each ship. These are now being studied and a report on the work is nearly completed.

It has been found that the fouling organisms are almost exclusively those found on rocks and other submerged structures near shore, which bears out the earlier conclusion that fouling occurs mainly when ships are in harbor. The seasonal periodicity for the attachment of many of the organisms has been studied in different harbors in order to correlate the fouling that occurs with the place of attachment. It is believed that the results of this study will make it possible to determine, from a knowledge of the cruising done by the ship and the time spent in various ports, when she should be sent to the dry dock for cleaning. If this can be done it will mean a distinct saving in expense for the maintenance of both Navy and commercial vessels.

ACTIVITIES OF THE BUREAU'S INVESTIGATORS

During the past year the bureau has been requested to assign trained scientists to several important investigations of great general interest. Dr. C. J. Fish, general assistant, and Marie D. P. Fish, junior aquatic biologist, accompanied the oceanographic expedition of the New York Zoological Society under the direction of William Beebe. The steamship *Arcturus* was fitted out for oceanographic work and made extensive observations in the region of the Sargasso Sea and in the Pacific Ocean between Central America and the Galapagos Islands. The two representatives of the bureau had entire charge of the work in physical and chemical oceanography and of the plankton, including the eggs and larvæ of fishes. At the close of the fiscal year the expedition was still in the field, but preliminary reports submitted indicate that the results will be of more than usual interest and importance. The larval histories of a number of fishes have been worked out, and valuable observations were made on the tuna of the Pacific.

Dr. Walter Koelz, associate aquatic biologist, left in June with the MacMillan Arctic Expedition, which will explore the region to the north of Greenland. Doctor Koelz will make collections and observations on the fishes of that region and will also secure oceanographic data and collections of the plankton. This is the first time that a trained ichthyologist has accompanied such an expedition, and interesting results are anticipated.

At the request of Dr. E. L. Mark, of the biological station at Bermuda, Dr. P. S. Galtsoff, naturalist, made a short visit to Bermuda in June for the purpose of securing oceanographic data across the Gulf Stream in a line from New York to Bermuda. The Gulf Stream has great influence on the distribution and life of all the organisms of the north Atlantic, but our knowledge of this most important factor of the ocean, especially as it affects the life of our food fishes, is very inadequate. Observations were made on temperature, salinity, and color of the sea water. It is expected that similar observations will be conducted under the direction of Doctor Mark.

NORTH AMERICAN COMMITTEE ON FISHERY INVESTIGATION

The committee held two meetings during the year—one at Montreal, Canada, on November 7, 1924, and the other in New York City, on May 8, 1925. These were attended by Henry O'Malley, Dr. H. B. Bigelow, and Dr. W. H. Rich, representing the United States.

At both meetings consideration was given to coordinating the statistical work of the various Governments represented, especially in so far as the bank fisheries are concerned. Arrangements were made for the exchange of statistical data between the United States and Canada, and it is expected that the committee will be able to prevail upon other Governments to supply similar data. Only in this way will it be possible to obtain complete information regarding the productivity of these fisheries. In this connection steps were taken to inaugurate a system of fish measuring, which will provide vital statistics for some of the more important species. It was decided that the initial efforts should be directed toward the mackerel, and the bureau has begun to gather these data for the American fishery. The collection of temperature data along the Atlantic coast, mentioned above, was begun at the suggestion of the committee. Further cooperation between the United States and Canada in oceanographic studies and cod-tagging operations was arranged, and plans were made for the extension of both these lines of investigation.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

FISH-CULTURAL OPERATIONS

The increasing interest on the part of the general public in the stocking of interior waters with suitable species of fish is clearly shown by the numerous letters that are being received from all parts of the country expressing appreciation of the results attained with fish distributed by the bureau's hatcheries. These letters indicate that the people are becoming more appreciative of the importance of stopping the destruction of fish caused by their indiscriminate introduction into waters to which they are not adapted and by planting harmful, nonindigenous species. The heavy demands made upon the bureau by schools throughout the country for information on fish life and fish-cultural methods is another indication of this interest. Civic organizations all over the country are also asking for advice along this line.

Inadequate protection or a total lack of protection menace the future fish supply. Probably the most destructive factor encountered in connection with the maintenance of the fresh-water fisheries is the widespread practice of dumping trade wastes and sewage into public waters. Much of this material is harmful to adult fish, and very often it destroys the minute organisms upon which the young fish subsist. Nature supplies a very complete series of fish foods, ranging from the lowest and most microscopic forms of vegetable and animal life to the higher organisms, and in order to attain success in fish culture serious study of these organisms and their interrelations is essential.

It is quite obvious that the general trend of public sentiment is toward greater conservation of all natural resources, and a realization of the importance of fish culture is one of the most interesting phases of this. An organization of national renown has adopted for its slogan "Plant the bass" and has built up a membership of approximately half a million persons. Numerous other organizations are making a close study of fisheries problems and are extending all possible aid to the bureau in an effort to secure better results in the stocking of public waters. It is believed that these organized bodies of men and women will be able to accomplish a great deal more in this direction than can be expected from individual effort, as the interest of the individual is more apt to be confined to securing fish merely for personal use, while that of the organization is for the general good.

In the course of the past year the bureau has received several hundred letters from clubs and associations requesting information as to how existing facilities might be utilized in the production of fish on a cooperative basis. The bureau has given material assistance in the establishment of as many projects of this kind as it could, and in practically every instance the association aided is now producing fish under Government supervision with the purpose of distributing the output as large fingerling fish during the fall months. This cooperative work will be extended as rapidly as the bureau's facilities will permit.

The future welfare of the commercial fisheries has not been of as much concern as the stocking of interior waters with game fishes. This is undoubtedly due to the manner in which this industry is conducted. Making as large a catch as possible for the market is the primary object of the commercial fishermen, and such matters as the conservation of eggs and immature fish for the purpose of maintaining the supply are commonly regarded as of minor importance. For this reason it is highly important that the Federal Government extend its fish-cultural activities to include the commercial species.

With that object in view spawn takers have been sent to the various fields where the commercially important fishes are captured to take the ripe spawn of the market fish and transfer it to the hatcheries for incubation. In this way immense numbers of valuable eggs have been saved which would otherwise have been lost in dressing the fish for the market.

The work of planting on the spawning grounds on Georges Bank, off the New England coast, the fertilized eggs of cod and haddock taken in that field by the fishing fleet from Gloucester, Mass., which was instituted a few years ago, has been extended so far as facilities permit. Operations of the same character have been successfully undertaken in connection with the propagation of buffalofish in Louisiana and at certain points along the upper Mississippi River, also, where ripe fish are taken for the markets at points too remote from a hatchery to permit of the successful transportation of the eggs.

The fish-cultural methods employed by the bureau during the fiscal year 1925 were in the main along previously established lines. Appropriations have not been adequate for making needed improvements at some stations and have lowered the efficiency of other stations at which funds had to be used for improvements, with a corresponding reduction in the stations' activities. The output of eggs, fry, and fingerling fish totaled in excess of 5,300,000,000, as compared with about 5,360,000,000 during the preceding year. Winter flounder ranked first in numbers, exceeding 2,640,000,000; cod were second, with more than 1,000,000,000; and pike perches were third, with 238,000,000. The output of salmons exceeded 133,000,000; trouts amounted to 92,000,000, and basses and sunfishes approximated 34,000,000.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1925

Species	Eggs	Fry	Fingerlings	Total
Catfish			14, 310, 290	14, 310, 290
Buffalofish	127, 400, 000	12, 562, 500	4, 261, 430	144, 223, 930
Carp		31, 500, 000	10, 959, 465	42, 459, 465
Shad		17, 158, 671		17, 158, 671
Glut herring		92, 000, 000		92, 000, 000
Whitefish	340, 000	172, 630, 000		172, 970, 000
Cisco	8, 000, 000	118, 900, 000		126, 900, 000
Chinook salmon	7, 504, 880	2, 528, 800	42, 684, 200	52, 717, 880
Chum salmon		16, 051, 650		16, 051, 650
Silver salmon	862, 000	10, 177, 650	3, 797, 639	14, 837, 289
Sockeye salmon	3, 150, 000	28, 070, 000	3, 891, 700	35, 111, 700
Humpback salmon		10, 892, 500		10, 892, 500
Steelhead salmon	604, 000	124, 580	1, 327, 184	2, 055, 764
Atlantic salmon		1, 410, 000	12, 500	1, 422, 500
Landlocked salmon	81, 000	816, 621	219, 825	1, 117, 446
Rainbow trout	3, 008, 754	1, 989, 500	2, 326, 485	7, 324, 739
Black-spotted trout	16, 802, 060	4, 776, 100	1, 584, 817	23, 162, 977
Loch Leven trout	8, 803, 000		784, 341	9, 587, 341
Lake trout	2, 940, 000	32, 822, 613	309, 815	36, 072, 428
Brook trout	500, 000	2, 776, 469	12, 755, 628	16, 032, 097
Silver trout			100, 000	100, 000
Grayling		4, 877, 000	29	4, 877, 029
Pike and pickerel			709, 077	709, 077
Mackerel		3, 517, 000		3, 517, 000
Crappie			16, 884, 251	16, 884, 251
Largemouth black bass		1, 135, 100	1, 615, 021	2, 750, 121
Smallmouth black bass		545, 400	41, 927	587, 327
Rock bass			60, 560	60, 560
Warmouth bass			5, 370	5, 370
Sunfish			13, 894, 947	13, 894, 947
Pike perch	122, 450, 000	116, 100, 000	141, 584	238, 691, 584
Yellow perch	5, 850, 000	83, 988, 800	555, 340	90, 394, 140
White bass			4, 425	4, 425
Fresh-water drum			19, 590	19, 590
Cod	598, 065, 000	462, 712, 000		1, 060, 777, 000
Haddock	139, 366, 000	24, 511, 000		163, 877, 000
Pollock		222, 890, 000		222, 890, 000
Winter flounder	4, 667, 000	2, 637, 051, 000		2, 641, 718, 000
Miscellaneous fishes			3, 696, 495	3, 696, 495
Total	1, 050, 393, 694	4, 114, 514, 954	136, 953, 935	5, 301, 862, 583

It became evident shortly after the close of the World War that the salmon fisheries of the three West Coast States and Alaska were being so heavily drawn upon that their early depletion was threatened, and prompt action for their preservation became imperative, especially in Alaska, where stringent regulations have been required to prevent the extinction of the parent stock. Such measures have consisted in the establishment and enforcement of regulations which permit the escape of the fish to the streams for the purpose of spawning. Actual counts of salmon in various streams have been made, with the view of securing definite information as to the numbers required to properly seed the beds.

The prevalence of adverse weather in some of the principal fields in the Great Lakes region made it impossible for the fishermen to attend their nets regularly during the spawning season, and as the hatcheries engaged in the propagation of the commercial fishes of these waters are wholly dependent for their egg supplies upon the fishermen's catch, the output of these stations was materially reduced.

The propagation of the marine species of the New England coast was prosecuted under varying natural conditions. The principal difficulty encountered was the partial or entire failure of the run of cod in some of the fields ordinarily frequented. Taken as a whole, the results in this branch of the work may be considered gratifying, both the egg collections and the output exceeding in the aggregate those of the preceding year by a substantial margin.

A very successful season was experienced in the collection of eggs of the black-spotted trout in the Yellowstone Park. Weather and water conditions were generally favorable and the fish appeared to be plentiful in all the streams entering Yellowstone Lake. A large collection of Loch Leven trout eggs was secured at the bureau's field station in the Madison Valley, Mont.

As the Mississippi River failed to attain its usual high stages the spawning grounds of the river fishes were greatly restricted and they were found in comparatively few pools. Rescue operations were conducted from early July to the latter part of November, and more than 62,000,000 fish were collected and returned to the open waters of the river, as compared with 150,000,000 fish rescued in the preceding year. In connection with this work the rescue crews inoculated the salvaged fishes with the glochidia of the fresh-water mussels. Judging from the reports received from the pearl-button manufacturing industry and the local fishermen, this work is considered a very important factor in the maintenance of the fresh-water mussels.

RELATIONS WITH STATES AND FOREIGN GOVERNMENTS

There is a well-developed and growing movement in many States toward the improvement of the interior fisheries through the extension of fish propagation and distribution and by the establishment of more effective measures for the protection and development of fish life. The increased interest shown by the States in developing their resources is prompting them to seek closer cooperation with the Bureau of Fisheries, and is having a most wholesome effect in increasing the bureau's fish-cultural activities. One of the most beneficial results of this harmonious relation has been the elimination, to a large extent, of heretofore wasteful duplication of effort on the part of the States and Federal Government in the distribution of fish, but the most valuable outgrowth of this cooperation has been a more effective stocking of waters with fish adapted to them and the discontinuance of the introduction of nonindigenous or harmful species. The results of stream investigations made by many of the States have been placed at the bureau's disposal, which has made possible a more intelligent stocking of waters.

The interchange of ideas between the States and the bureau has developed higher efficiency throughout the service by the adoption of more improved methods. In many instances the bureau has lent the services of its employees to the States to investigate fish-cultural sites and aid them in the establishment of hatcheries. The States have borne the entire expense of the work, so that this service has been performed without cost to the Government. It is felt that by helping the States in this way and by assisting them in initiating a fish-cultural and propagation program the present drain upon the bureau's resources, which are now overtaxed to meet the public demand for fish, will be relieved. Aid was given to the States of West Virginia, North Carolina, and Georgia by detailing experienced men to assist them in locating hatcheries.

During the fall of 1924 the State of Michigan enacted legislation requiring that fishermen engaged in the capture of fish of the important commercial species in the Great Lakes region turn over to the bureau's agents, without cost, all the ripe spawn obtained. If this law can be enforced it will, in effect, secure the cooperation of all commercial fishermen in the maintenance of the fish supply in the waters of Michigan. In this respect the State of Michigan has taken the lead by establishing a policy which should be followed by all States having commercial fishing, especially where the eggs of the commercial species are taken. The State and Federal Governments should not be required to pay for ripe spawn obtained from the commercial species, since they are endeavoring to maintain the supply of these fishes for the benefit of the fishermen. Information received from other States indicates that they are beginning to realize that the commercial waters along their boundaries are the property of the general public, and that those who derive benefit from the fisheries should be required to assist in their maintenance.

During the fiscal year 1925 the bureau effected a very advantageous exchange of eggs with the Canadian fisheries authorities, receiving eggs of the Atlantic salmon in return for an equal number of trout eggs.

A very favorable report has been received from Chile as to the success attained with chinook-salmon eggs forwarded to that country from one of the bureau's Washington hatcheries during the fiscal year 1924.

By means of several shipments of eggs furnished in recent years to the Hawaiian Government from the bureau's stations in the Rocky Mountain region, the rainbow trout has become successfully established in that country, and reports indicate that the fish have made a remarkable growth in a number of the mountain streams.

In the course of the past year the fisheries authorities of State and foreign governments and the Canal Zone were supplied with fish and fish eggs in the following numbers:

Allotments of fish eggs to State and Territorial fish commissions, fiscal year 1925

State and species	Number
Arizona:	
Black-spotted trout	200, 000
Rainbow trout	220, 000
California: Black-spotted trout	300, 000
Colorado:	
Black-spotted trout	100, 000
Lake trout	25, 000
Rainbow trout	25, 000
Connecticut: Loch Leven trout	50, 000
Hawaii: Rainbow trout	50, 000
Idaho:	
Black-spotted trout	175, 000
Lake trout	100, 000
Landlocked salmon	25, 000
Rainbow trout	30, 000
Steelhead salmon	46, 000
Illinois:	
Black-spotted trout	25, 000
Pike perch	37, 800, 000
Rainbow trout	170, 000
Silver salmon	100, 000
Steelhead salmon	25, 000
Iowa: Rainbow trout	143, 000
Maine: Lake trout	100, 000
Maryland: Rainbow trout	277, 980
Massachusetts: Loch Leven trout	50, 000
Michigan:	
Cisco	8, 000, 000
Whitefish	200, 000
Minnesota:	
Lake trout	500, 000
Loch Leven trout	3, 000, 000
Missouri: Yellow perch	5, 850, 000
Montana:	
Black-spotted trout	1, 485, 000
Loch Leven trout	1, 413, 000
New Hampshire:	
Chinook salmon	450, 000
Lake trout	75, 000
Landlocked salmon	20, 700
Pike perch	500, 000
New Jersey: Loch Leven trout	500, 000
New Mexico:	
Rainbow trout	117, 000
Steelhead salmon	50, 000
New York:	
Black-spotted trout	10, 000
Lake trout	515, 000
Whitefish	140, 000
North Carolina: Rainbow trout	588, 430
Oregon:	
Black-spotted trout	2, 000, 000
Chinook salmon	7, 044, 880
Loch Leven trout	2, 185, 000
Silver salmon	762, 000
Sockeye salmon	3, 000, 000
Pennsylvania:	
Lake trout	50, 000
Loch Leven trout	300, 000
Pike perch	84, 150, 000
Utah: Lake trout	250, 000
Washington: Black-spotted trout	2, 000, 000
Wisconsin: Lake trout	500, 000
Wyoming:	
Black-spotted trout	425, 000
Loch Leven trout	500, 000
Rainbow trout	350, 000
Steelhead salmon	50, 000
Total	167, 017, 990

Shipments of fish and fish eggs to foreign countries and the Canal Zone, fiscal year 1925

Country and species	Eggs shipped	Fish shipped
Canada:		
Lake trout	500, 000	
Loch Leven trout	500, 000	
Canal Zone:		
Largemouth black bass		2, 250
Bream		500
Crappie		500
Colombia: Loch Leven trout	50, 000	
Netherlands: Rainbow trout	50, 000	
Panama: Rainbow trout	25, 000	
Total	1, 125, 000	3, 250

PROPAGATION OF PACIFIC SALMONS

As the number of sockeye salmon ascending to spawning grounds in the vicinity of the Afognak (Alaska) station was comparatively small, it was deemed advisable to defer active salmon propagation during the year and devote all available funds to repairs, of which the station was in need. The station's work was therefore limited to the making of these repairs and to the care and supervision of the weir in Letnik River. At the Yes Bay (Alaska) station, where fish-cultural work was confined to the sockeye salmon, 30,000,000 eggs of that species were collected and incubated.

COMMERCIAL FISHES OF THE GREAT LAKES

In securing eggs for stocking its Great Lakes hatcheries the bureau is confined to collections made from ripe fish obtained in the nets of the commercial fishermen, the spawn being taken by experienced men sent out in the fishing boats. The degree of success attained in this work is in the main dependent upon the size of the fishermen's catch, which is governed largely by prevailing weather conditions. The species handled at these hatcheries are the lake trout, whitefish, pike perch, cisco, and carp. A fairly successful season was experienced in the work with the pike perch, but with this exception the egg collections of all species were smaller than in the preceding year. Adverse weather was encountered in practically all the fields covered, especially in Lake Michigan during the lake trout spawning season and in Lake Ontario while eggs of the whitefish and cisco were being collected.

MARINE SPECIES OF THE NORTH ATLANTIC

The more important commercial species propagated at the coastal hatcheries in New England are the cod, haddock, pollock, and winter flounder. In the cod work at the Woods Hole (Mass.) station the brood fish are purchased from fishermen in the fall months and held in a specially prepared tank in the basement of the hatchery until they have spawned. The eggs float with the current and are gathered up in specially constructed boxes and installed in the hatchery for incubation. During the fall and winter of 1924 the run of cod at all points along the southern coast of Massachusetts was so light that no brood fish were obtainable for the work at that station. Cod were very plentiful in the vicinity of Gloucester, Mass., however, and the eggs collected at the Gloucester hatchery were considerably in excess of 1,000,000,000, being the greatest number it has ever taken. The propagation of winter flounder was notably successful. The southwestern coast of Maine was visited by a very heavy run of that species, enabling the Boothbay Harbor station to secure a record collection of eggs, the total for the season aggregating 2,027,901,000. Very satisfactory results attended the efforts to salvage eggs of the cod and haddock in the distant offshore fisheries. This work extended from the middle of February to early April, during which period 137,355,000 eggs of the cod and 42,222,000 haddock eggs were fertilized and planted on the spawning grounds from which the fish were taken.

MIGRATORY FISHES OF ATLANTIC RIVERS

The principal species in this group—the shad—is holding its own in the Potomac River with difficulty, and the protection it receives during its short spawning season is inadequate. The state of the weather has considerable influence on the run of shad. The most suitable combination for enabling a large body of fish to reach the spawning grounds appears to be a cold, backward spring, with floods of cold water flowing from the principal rivers into the sea. Under such conditions the fish apparently keep to the main channel or bed, thus escaping many of the nets set on the shoals in the lower bays, and large numbers ascend well above brackish water to their natural spawning grounds in the streams.

SALVAGE OF FOOD FISHES FROM OVERFLOWED LANDS

High-water conditions during the spawning season in the Mississippi River rescue territory limited the possible amount of salvage work, and while the operations were prosecuted for the usual length of time—from the beginning of July to the end of November—the results were greatly curtailed as compared with those of an average season. Rains and abnormally cool weather prevailed throughout most of the summer and fall, providing extensive feeding grounds, and in many instances the rise and fall of the river afforded avenues for the ready access of the fish to the river channels. Over an area extending from Prescott, Wis., on the north, to Andalusia, Ill., on the south, 62,220,565 fish were salvaged, of which 911,416 were shipped to applicants. All of the remainder were released in the Mississippi River and its adjacent tributaries.

The customary mussel-infection work was conducted in connection with the rescue operations. The unusual weather and water conditions existing had the effect of producing stronger and better fish to serve as hosts for the larval mussels, and a total of 1,783,561,850 of the latter were used in the inoculations, this number exceeding the total of the preceding season by more than 33 per cent.

PROPAGATION OF FISHES OF INTERIOR WATERS

The results of the year's work with the brook, rainbow, and black-spotted trouts were fairly satisfactory. Eggs from wild fish of one or more of these species were taken in considerable numbers in fields adjacent to the stations located at Leadville, Colo., Springville, Utah, Saratoga, Wyo., and Bozeman, Mont., as well as in the Yellowstone Park. A record collection of rainbow-trout eggs from domesticated stock was made at the Manchester (Iowa) station. A second successful season's work was accomplished in the propagation of Loch Leven trout in the Meadow Creek (Mont.) field during the fall of 1924, and the collection of rainbow-trout eggs there during the spring of 1925 exceeded that of any year since this substation was established. In making field collections in Utah the employees of the Springville station worked in conjunction with and under the immediate supervision of the Utah State officials, and the station received as its share of the output approximately 1,341,000 brook-trout eggs, 700,000 rainbow-trout eggs, and 300,000 eggs of the black-spotted trout.

Fish-cultural operations in the Yellowstone Park field were conducted under the direction of the district supervisor of the Mississippi River rescue station, and 25,950,500 black-spotted trout eggs were secured in the course of the fiscal year.

Approximately 140,000,000 buffalofish eggs were collected on the Atchafalaya River in Louisiana between March 7 and April 4, 1925.

ALASKA FISHERIES SERVICE

EFFECT OF THE NEW FISHERY LAW AND REGULATIONS

Alaska fishery operations in 1924 were conducted in accordance with the terms of the several acts applicable thereto, including the new law approved June 6, 1924. It became necessary to revise existing regulations because of the new act, and this was accordingly done on June 21. In certain specified localities commercial fishing for salmon was entirely prohibited, and in other waters where the runs were badly depleted drastic limitations were put into effect. Restrictions were also imposed upon herring fishing in certain localities. The commissioner was on the ground most of the season to personally observe the working of the new law and regulations, and pursuant to his recommendations some changes were made in them while fishing operations were in progress. Beneficial effects in the way of larger escapements of salmon to the spawning grounds resulted in various places, and it is expected not only that depletion will cease but that eventually the runs in most waters will be restored to their former proportions.

As a result of observations and experience during the season of 1924 general regulations, effective in 1925, were issued by the Secretary of Commerce on December 2, 1924. In the 12 fishing areas provided by these regulations commercial fishing is limited or prohibited as the circumstances necessitate, while in 76 specific localities included within these areas no commercial salmon fishing whatever is permitted. The limitations upon fishing are chiefly in the form of closed seasons and restrictions as to the kind and amount of fishing gear to be used. Regulations with respect to the herring, clam, crab, and shrimp fisheries also were promulgated. Supplemental orders making slight modifications of these regulations have been issued from time to time as appeared desirable. The Alaska Fisheries Advisory Committee, appointed in the summer of 1924 by the Secretary of Commerce, cooperated by making recommendations in regard to the regulations.

A greatly expanded patrol was maintained in 1924 for the protection of the fisheries of Alaska and the enforcement of the law and regulations. In addition to the 16 statutory employees 103 temporary employees were engaged in stream guard work, of whom 79 were stationed in southeastern Alaska, 13 in central, and 11 in western. Ten vessels of the bureau, with a combined crew of 27 men, were engaged in patrol operations, and in addition nine vessels were chartered for varying periods and a number of small launches were likewise used.

An innovation in connection with prosecutions for fishery violations was the authority given by the act of June 6, 1924, for the seizure and confiscation of vessels, fishing apparatus, and all appliances used in violation of the law or regulations. Under this authority a number of salmon traps in southeastern Alaska were seized and sold after appropriate judicial proceedings. Small quantities of gear were seized in both the central and western districts. Four vessels seized in southeastern Alaska were released by the court, as the evidence was insufficient to prove illegal fishing. Cases in connection with the seizure of five vessels in Cook Inlet have not been decided.

Operators expressed considerable dissatisfaction over the requirement of the bureau for closer compliance with the terms of the law in regard to adjustment of salmon traps during the weekly closed period, and several traps were seized for noncompliance with the law. A number of operators joined in an application for an injunction against the Commissioner of Fisheries, the United States attorney, the United States marshal, and certain employees of the Bureau of Fisheries to enjoin them from enforcing the law in regard to opening the heart walls of traps in the manner described in instructions issued by the bureau to its employees. The judge of the district court denied a temporary restraining order and on appeal his decision was confirmed by the Circuit Court of Appeals for the Ninth Circuit. As the season progressed it became apparent that with slight alterations traps already constructed could be operated lawfully.

ALASKA SALMON HATCHERIES

At the Government hatchery on McDonald Lake 30,080,000 red-salmon eggs were collected in 1924. The Afognak hatchery was closed for repairs. At two private salmon hatcheries operated under the provisions of the act of June 26, 1906, there were collected 31,690,000 red-salmon eggs.

The Alaska Territorial Fish Commission carried on hatchery operations in 1924 at its stations at Ketchikan, Cordova, and Seward, handling a total of 16,352,000 humpback, chum, red, and chinook salmon eggs. All of the chinook eggs were received from the State of Washington.

SPECIAL STUDIES AND INVESTIGATIONS

In 1924 counts of red salmon ascending to spawning grounds were made in two small streams entering Olga Bay, Kodiak Island, and in the Chignik and Karluk Rivers. These weirs are being maintained again in 1925, and in addition weir operations are being undertaken for the first time at Anan Creek in the southeastern district.

The tagging of salmon to determine their migration routes in the waters of southeastern Alaska was undertaken for the first time in 1924. Five localities were selected and 2,716 salmon were tagged, of which 662 were later recaptured. Studies of the data are being made and a special report on the results will be published.

EXTENT OF THE ALASKA FISHERIES

In 1924 the Alaska salmon industry as a whole showed a slight increase in number of persons employed, investment, production, and value. A notable feature was the greatly increased catch of salmon in the central district, amounting to 161 per cent, which more than offset the losses in the southeastern and western districts, where the catches declined 18 and 32 per cent, respectively, from the figures for 1923. The net increase in the catch of salmon for Alaska as a whole in 1924 was about 3 per cent.

A comparison of Alaska salmon-canning operations in 1923 and 1924 is as follows:

Item	1923	1924	Percentage of increase (+) or decrease (−)
Canneries operated	130	130	----------
Cases of salmon packed	5,035,697	5,294,915	+5.15
Value	$32,873,007	$33,007,135	+.41
Persons employed	19,439	20,107	+3.44
Cases of salmon packed, by species:			
Coho	164,107	183,601	+11.88
Chum	525,622	1,028,488	+95.67
Humpback	2,448,129	2,601,283	+6.26
King	38,343	33,648	−12.24
Red	1,859,496	1,447,895	−22.14
Number of salmon caught	77,422,311	79,477,600	+2.65

Other salmon products were: Mild cured, 5,187,200 pounds, valued at $1,137,301; pickled, 1,362,952 pounds, valued at $132,223; frozen, 2,287,666 pounds, valued at $165,809; fresh, 2,206,944 pounds, valued at $203,624; dry salted, dried, and smoked, 1,633,968 pounds, valued at $82,209; fertilizer, 1,759,300 pounds, valued at $43,370; and oil, 49,033 gallons, valued at $21,833. The total value of these minor salmon products in 1924 was $1,786,369. The value of similar products in 1923 was $1,365,756.

The products of the herring fishery were as follows: Bait, 3,599,350 pounds, valued at $35,033; Scotch cured, 19,020,650 pounds, valued at $1,660,991; Norwegian cured, 18,600 pounds, valued at $1,826; spiced, for food, 9,600 pounds, valued at $1,000; dry salted, 92,450 pounds, valued at $6,901; bloaters, 770,500 pounds, valued at $25,790; fertilizer, 9,359,625 pounds, valued at $222,720; and oil, 1,144,672 gallons, valued at $504,109. The total value of herring-fishery products in 1924 was $2,458,370, as compared with $1,602,571 in 1923.

The halibut industry produced 4,398,528 pounds of fresh fish, valued at $528,023, and 10,639,088 pounds of frozen fish, valued at $1,091,420, a total of 15,037,616 pounds, valued at $1,619,443.

The shore-station cod fishery yielded 1,580,026 pounds of products, valued at $100,777. The whaling industry produced oil, fertilizer, whalebone, and pickled meat, valued at $391,781.

The pack of clams amounted to 83,161 cases, valued at $629,412. The output of shrimps was 528,432 pounds, valued at $227,979. Crab products were valued at $48,727. The output of trout was 61,262 pounds fresh and frozen, valued at $6,741. There were also produced 227,350 pounds of sablefish, chiefly frozen, valued at $9,808; 24,484 pounds of smelts, valued at $2,348; 6,993 pounds of flounders, valued at $349; and 1,175 pounds of red cod, valued at $34.

The total value of the manufactured fishery products of Alaska in 1924 was $40,289,273. The value of the catch to the fishermen was approximately $10,400,000.

The entire Alaska fishery industry gave employment to 25,194 persons and represented an investment of $62,660,637.

The extent and condition of the Alaska fisheries in 1924 and of the activities of the bureau under the laws and regulations for the protection of the fisheries are covered in detail in the annual report of the Alaska service for that year.[2]

[2] Alaska Fishery and Fur-seal Industries in 1924. By Ward T. Bower. Bureau of Fisheries Document No. 992.

ALASKA FUR-SEAL SERVICE

GENERAL ACTIVITIES ON THE PRIBILOF ISLANDS

The North American fur-seal herd, which resorts to the Pribilof Islands in Bering Sea, Alaska, now numbers well over 700,000 animals, comprising probably 90 per cent of the fur seals of the world. It produces by far the greater part of the fur-seal skins that enter the fur markets.

The chief activities in connection with the fur-seal herd center at the Pribilof Islands. Here all sealskins taken by the Government are secured, the work of taking and curing the skins being performed largely by the resident natives under the direct supervision of employees of the bureau. The resident natives number in all about 300, and in return for services rendered to the Government they are provided with houses, food, clothing, schools, and medical attention. In addition, they receive 75 cents in cash for each sealskin taken.

Transportation for the regular annual shipment of supplies for the islands was provided through cooperation of the Navy Department on the U. S. S. *Gold Star*, but small quantities of freight were carried at times on other vessels. Employees were also transported by the *Gold Star* and vessels of the United States Coast Guard.

Sealing operations were carried on in the same manner as in the previous season, practically all of the skins procured on St. Paul Island being taken by the stripping method and then blubbered before salting, while on St. George Island the skins were taken as usual by skinning with knives.

Progress was made on both islands in the installation of improved water-supply systems, that on St. George Island being nearly completed. A warehouse was completed on St. Paul Island, and considerable work was done on other buildings.

SEAL HERD

Computations showed a total of 697,158 fur seals in the herd on August 10, 1924. This was an increase of 44,150 over the figures for the corresponding date in 1923 and is regarded as showing a satisfactory increase in numbers.

TAKE OF SEALSKINS

In the calendar year 1924 there were secured on the Pribilof Islands 17,219 sealskins, of which 13,453 were taken on St. Paul Island and 3,766 on St. George Island.

MARKING OF RESERVED SEALS

In 1924 a breeding reserve of 8,572 3-year-old male seals was marked by shearing a patch of fur from the top of the head. While marking the reserve of 3-year-old seals it was noted that 3,718 4-year-old males appeared. These were given a distinguishing mark to enable recognition during the season.

SALES OF SEALSKINS

In the fiscal year 1925 two public auction sales of fur-seal skins taken at the Pribilof Islands were held at St. Louis, Mo. The first was on October 15, 1924, when 14,136 black-dyed, 1,845 brown-dyed, 1,010 raw-salted, and 17 miscellaneous skins were sold at a gross price of $470,447.15. In addition, four confiscated sealskins were sold for $16.50, and four confiscated sea-otter skins brought $1,020. At the second sale, on May 25, 1925, 5,839 black-dyed and 2,186 brown-dyed skins were sold for $225,994. At this time there were also sold 4 skins from seals that died at the Steinhart aquarium, 1 confiscated sealskin, and 2 confiscated sea-otter skins. The five sealskins brought a total of $49.50, and the sea-otter skins brought $395. During the fiscal year the Secretary of Commerce authorized the further sale of 362 sealskins, the sum realized being $16,835.13.

The United States Government's share of fur-seal skins taken by the Japanese Government on Robben Island in 1923 was 82 skins, and 94 skins in 1924. The skins taken in 1923 were in process of being dressed and dyed for market at the end of the year, but those taken in 1924 had not been received.

FOXES

A special study of the fox herds of the Pribilof Islands was made in the seasons of 1923–24 and 1924–25 to develop better methods of feeding and handling the animals. More satisfactory food supplies have been developed, and a regular system of feeding has been inaugurated on St. Paul Island.

The 787 blue and 15 white foxes taken on the Pribilof Islands in the season of 1923–24 were sold at public auction at St. Louis on October 15, 1924. The blue pelts brought $49,755.50 and the whites $630, a total of $50,385.50. In the season of 1924–25, 709 foxskins were secured, of which 81 blue and 26 white pelts came from St. Paul Island and 600 blue and 2 white pelts were taken on St. George Island. On St. Paul Island 167 animals were marked and released for breeding purposes, and on St. George Island 541 were marked. On each island there are animals that are not handled during the foxing operations, which, when added to the known reserve, considerably increase the available breeding stock.

FUR-SEAL SKINS TAKEN BY NATIVES

It is reported that in the spring of 1925 Indians secured 1,751 fur-seal skins in the waters off the coast of Washington. These were authenticated for the bureau by the superintendent of the Neah Bay Indian agency, of the Department of the Interior. In southeastern Alaska Indians took 279 fur-seal skins, including 40 from unborn pups, which were duly authenticated by an employee of the bureau. A number of fur-seal skins were taken also by natives of British Columbia.

FUR-SEAL PATROL

The usual patrol of waters off the Pacific Coast States, British Columbia, and Alaska during the annual migration of the American fur-seal herd was maintained by Coast Guard vessels, which also patrolled in Bering Sea and along the Aleutian Islands during the season. Patrol vessels of the bureau stationed in southeastern Alaska were assigned to the same duty in that district during the migration, giving particular attention to sealing operations by the Indians.

PROTECTION OF WALRUSES AND SEA LIONS

No change was made in the regulations for the protection of walruses and sea lions in Alaska during the fiscal year.

VESSEL SERVICE NOTES

During the first three months of the fiscal year the steamer *Fish Hawk* was undergoing repairs at Brooklyn. In October she completed the biological survey of Long Island Sound, and in November was sent to New England waters, where, basing at the Boston Navy Yard, she has been continuously engaged in the fishery investigations of the Gulf of Maine. During the year the *Fish Hawk* steamed 2,395 miles and covered 202 stations.

The fishery investigations of the Gulf of Maine were continued by the steamer *Halcyon*, excepting during the winter months, when this vessel was utilized for fish-cultural work in connection with the Gloucester (Mass.) hatchery. The *Halcyon's* operations extended from Nantucket Shoals to Mount Desert, Me., and consisted chiefly in tagging cod, haddock, and pollock in order to determine their migrations. Some temperature stations were made and shore fishes were collected. Over 16,000 fish were taken, tagged, and returned to the ocean. The steamer cruised 5,143 miles.

The steamers *Gannet*, *Shearwater*, and *Phalarope* and several motor vesels have been used for fish-cultural work on the New England coast, in the Great Lakes, on the Potomac River, and in connection with the biological laboratory at Woods Hole, Mass.

The *Eider* was used chiefly as a local tender for the Pribilof Islands, although some incidental service was rendered the salmon fishery investigations for a few weeks during the summer, and in the late fall and winter she was at Seattle for the annual overhauling. Since the installation of a Diesel engine, this vessel has rendered particularly excellent and economical service.

Four vessels—the *Widgeon*, *Murre*, *Auklet*, and *Petrel*—were assigned to patrol work in southeast Alaska, remaining in commission practically throughout the fiscal year. The *Kittiwake* was on duty in Cook Inlet and to some extent in Prince William Sound waters. The *Ibis* was at Chignik, the *Merganser* at Ikatan and vicinity, the *Scoter* was in Bristol Bay waters, and the *Tern* on the Yukon River. The last four vessels were used for a few months only during the active salmon-fishing season and were hauled out of the water for the balance of the year.

An addition to the Alaska fisheries patrol fleet was the *Blue Wing*, which was acquired early in the fiscal year, and after a brief period in southeastern Alaska was assigned to the Kodiak district with headquarters at the Afognak hatchery. This vessel is 55 feet in length and is of the sturdy and seaworthy purse-seine boat type.

The 11 vessels together cruised approximately 68,000 miles during the fiscal year 1925.

RECLASSIFICATION

The reclassification of employees in the District of Columbia, with consequent readjustment of salaries, has now been in operation for a year with results which on the whole are satisfactory. The effects on the scientific personnel have been especially beneficial, reducing the turnover and enabling the bureau to fill vacancies with properly qualified persons and to build up a more efficient and contented organization. The clerical force has benefited less. While inequalities still exist and some allocations of positions need revision, in most cases employees receive salaries more nearly commensurate with the duties and responsibilities of their positions and the morale of the service in general is improved. However, the present force is wholly inadequate to carry on the work, and a larger appropriation for salaries with which to provide for promotions and for the employment of additional clerks is urgently needed.

APPROPRIATIONS

The regular appropriations for the support of the bureau for the fiscal year 1925 aggregated $1,508,645, as follows:

Salaries, office of the commissioner and field	$498,640
Pay, officers and crews of vessels, Alaska fisheries service	31,630
Adjustment of salaries in the field	142,680
Miscellaneous expenses:	
Administration	3,900
Propagation of food fishes	386,250
Maintenance of vessels	107,175
Inquiry respecting food fishes	38,170
Fishery industries	26,200
Protecting sponge fisheries	2,000
Protecting seal and salmon fisheries of Alaska	217,000
Fisheries of Alaska, 1924 and 1925	55,000
Total	1,508,645

Respectfully submitted.

HENRY O'MALLEY,
Commissioner of Fisheries.

To Hon. HERBERT HOOVER,
Secretary of Commerce.

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MILD CURING OF SALMON IN CALIFORNIA [1]

By W. L. Scofield

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Fish and Game Commission of California

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PROCESS IN BRIEF [2]

Only one species of salmon, variously known as king, chinook, quinnat, Sacramento, and spring (*Oncorhynchus tschawytscha*), is mild cured. This type of curing is distinctly a west-coast process, being practiced from Monterey to Alaska.

The salmon are gutted, headed, and the sides split from the backbone. The "sides" are then scraped or "slimed" and placed in a chilling bath of salted and iced water. They are then drained, given a coating of dry salt, packed in barrels or "tierces," mild brine is added, and the tierce is kept in cold storage for a few weeks. The sides are then taken out, graded, and "repacked" in tierces, brine added, and the tierces shipped in refrigerator cars. They may then be removed, washed, given a light smoking, and sold to the retail trade. The "curing" is accomplished in the first brine (before the repack), the mild cure in brine giving the name to the process in distinction to "hard" or "dry" salting, smoking, or kippering.

OTHER METHODS

A variety of curing methods have been used, smoking and sun-drying having been practiced by the Indians before white men came to California. Small quantities of salmon are salted down in barrels,

[1] Appendix I to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 983.

[2] Unless otherwise stated, all descriptions of methods refer to mild cure practice in 1920.

dry or hard salt being used in such quantities that much free, undissolved salt surrounds the flesh in the brine that is formed by the moisture in the fish. The products of various combinations of drying, salting, and smoking are often confused with mild-cured salmon when sold in local markets.

Kippered salmon is the chief rival of the mild-cured product as a delicacy. In kippering, the meat is cooked rather than cured, and is more appropriately called "barbecued" salmon. In this process the fish is cut into 1-pound chunks and cured for only about three hours in an 80 per cent brine. It is then washed and dried, either by air blast or over a small fire, after being strung on wires or placed, skin down, on wire netting of about one-half-inch mesh. It is then ready for the principal step in its preparation—the broiling or barbecuing over a hot fire or bed of coals until thoroughly cooked. It is best when served warm from the barbecue, but is good the next day. Three days after the cooking it is not usable. Salmon prepared in this way is sometimes served in local restaurants after reheating in the oven.

HISTORY OF MILD CURE

The process of mild curing salmon is of comparatively recent origin. A number of years ago, particularly at Halifax, the Atlantic salmon, which is a small fish usually not over 12 or 15 pounds in weight, was given a brine cure preparatory to smoking, but the process was crude and far inferior to the present method. The fine quality curing was developed on the Pacific coast.

The first mild cure of king salmon was tried on the Columbia River about 1889, the curing being done in whisky casks. The product was shipped to Germany, but as there were no cold-storage facilities about half the fish soured during the voyage. About five years later another attempt was more successful, but extensive curing on the Columbia River was not practiced until 1896. Salmon were cured in 400-pound barrels, but this method was not satisfactory, as large fish often were broken by being crowded into the barrels. Finke Bros., a cooperage firm in Portland, Oreg., is credited with making the first salmon tierces, or large-diameter, 800-pound barrels, that have become the standard container. About 1897 or 1898 mild curing started on Puget Sound, but it was not well established until 1901. The abundance of salmon in Alaska attracted packers, and in 1902 the curing began, starting at Taku Inlet. By 1904 several stations in Alaska were mild curing, the price to fishermen that year being $1 for three large fish. Salmon under 22 pounds in weight were counted two for one, but the fish are said to have averaged 30 to 35 pounds, with very few small fish. The cured fish sold at 7½ cents per pound.

In California mild curing was developed later than in the north, the start being made in about 1900 on the Sacramento River, which is also accredited with the first salmon cannery in the United States. About 1901 mild curing started at Monterey and became the chief fishery industry of that bay, but recently the sardine-canning business has left it far behind. For several years Monterey was the only place in California where ocean-caught salmon were cured, the fish being taken by trolling.

CLEANING LOSS

The loss in weight in preparing the round fish for curing is from 30 to 35 per cent. Roughly, 1,130 pounds of round salmon will make an 800-pound tierce of sides, a loss of 330 pounds.

There are three steps in the preparation of the fish: (1) Heading (removing head and gills), (2) cleaning or gutting (removing entrails), and (3) splitting (removing backbone). For a given size of fish the loss from heading and splitting is fairly constant, but in cleaning (removing entrails) the loss varies in different localities and at different times of the year because of variation in size of the eggs or milt and in stomach contents. There is also variation in the percentage of loss due to size of fish, large fish suffering relatively smaller loss than small fish.

Fish under 16 pounds in the round, or about 32 inches in length, seldom are split, as that size is necessary to make the smallest side accepted—6 pounds. Fish under 16 pounds are either sold to fresh markets or canned.

HEADING AND CLEANING

The fish in the round are thrown onto the long table (serving for heading, cleaning, splitting, and sliming) and are headed before cleaning, the gills being removed with the head. A diagonal cut is made through the head, beginning at a point on the top of the head 1 or 2 inches from the back and slanting backward through the cartilage of the head but only partially through the "cheek plates" (opercle). Two flips of the knife cut the cheek plates free from the head, and a semicircular stroke of the knife frees the gills and the tip of flesh on the lower side. Part of the cartilage of the back of the head thus remains on the fish for the purpose of holding the flesh of the "side" together more firmly.

The headed fish is opened with one knife stroke, beginning at the anal opening. Entrails are then removed and two cuts made in the kidney, which lies at the top of the body cavity next to the backbone. The knife point is then used to scrape out the kidney.

SCORING

When the round fish go onto the cleaning table, either just before or just after being headed, the sides are "scored;" that is, gashes are cut in the skin to allow a more ready penetration of the salt. The fat or oil of the fish tends to exclude the brine, and it is therefore more difficult to cure the fat oily regions of the side. The base of the dorsal fin and just back of the "collar" are particularly oily spots, and are frequently the first to show taint in curing. Down the top of the back is another oily region, but splitting exposes this so that it cures readily. There is a fat layer under the skin, especially along the lateral line. Under this line there is a triangular strip of dark meat that is apt to sour in curing, and for this reason the scoring should be along the lateral line. If done with an ordinary knife, the gashes are apt to be too deep and may cut through the fat into the red meat. A notch is usually filed in the knife or, better still, a sharpened point of steel is used with a gauge to prevent the point entering more than a quarter of an inch. The universal practice in California is to cut four or five gashes along the lateral line and two or three above the line in the thick portion of the side. It is questionable whether or not this gives the best results, as shorter and more numerous gashes along the lateral line would probably serve better, and in most cases the gashes above the line disfigure the fish rather than improve the curing. Large sides may require scoring above the line, but small sides do not. In Alaska and on the Columbia River a scoring wheel with sharpened points that cut regular and numerous slits about three-quarters of an inch long is used. The wheel is usually run once along the lateral line, seldom above it.

SPLITTING

To prevent slipping, the fish is first hooked by the "collar" over a sharpened nail in the table, the belly toward the splitter and head to the right for a right-handed man. Four knife strokes split the fish into two "sides," removing the backbone with the tail fin attached. Two preliminary cuts are made posterior of the body cavity to free the flesh there from the backbone; then one stroke of the knife removes the right "side," leaving the dorsal fin attached to the left "side," while the next stroke frees the backbone and tail. Splitters are well-paid, skilled workmen and take pride in speed and cutting "clean," that is, leaving very little meat attached to the backbone.

SLIMING

After splitting, the sides are slid onto the sliming table, which is provided with overhead water pipes and short sections of rubber hose dropping to within a foot or so of the table to provide a stream of water at each slimer's place around the edge of the table. In Alaska a tank is used instead of the table, the fish being slimed on board shelves at the tank's edge, and usually a knife only is used in the process.

Loose ends of membrane are trimmed from the side and the body cavity portion thoroughly scraped (skin side down) to remove the blood from the veins. The chilling tank should then prevent the surface veins from refilling with blood while curing. After scraping, the sides are turned skin up and washed off with a brush to remove any slime that may remain.

CHILLING TANK

The chilling tank contains iced brine and receives the sides from the scraping or sliming table. It is generally miscalled "sliming tank," the name probably coming from Alaska, where a tank is used instead of the scraping table. All slime should be removed in the scraping and washing before the sides enter the chilling tank.

The chilling tank is an important step in the curing and is the one most frequently slighted. The chief object of chilling is to prepare the sides for curing, the cold brine serving to partially impregnate the outer layers of flesh—what might be called "casehardening." Unchilled sides absorb too much of the curing brine and the salt penetrates too deeply at first, so that the flesh is over-salty and improperly cured.

By chilling or casehardening, the inner flesh is cured more slowly and remains more moist. Another object in chilling is to hold the fish oil in the sides. Fish a day out of water or exposed to warm air start to ooze oil, but proper chilling will stop this. If not properly chilled the oil continues to exude from the fish in the curing process, so that when the tierce is opened for repacking an eighth of an inch of oil floats on the brine. Naturally the buyer wants this oil in the fish, not in the brine. The chilling tank also serves to "draw the blood" from the veins of the sides, so that they do not show as dark markings. When insufficiently chilled, the blood refills the surface veins while the sides are curing in the barrel.

For proper chilling the sides should remain in the tank from 2 to 4 hours, but frequently they are not given over a half hour, which is not long enough for the best results. The brine of the tank should be iced to 30 or 40° F. The iced brine should have a salinity of 60 to 70 per cent (tested with a salinometer) in order to caseharden the sides, but the percentage is often far below 60, 40 per cent frequently being used, and much of the benefit of the process is thereby lost. A mistaken standard for judging the salinity is to dissolve enough salt so that the sides will float well, but 40 per cent is sufficient for good floating. The brine in the tank is changed every day or two (or every 10 to 15 tierces) as it becomes fouled with oil. If fresh fish is used and properly chilled, the amount of oil lost in the tank is greatly reduced. Ocean water is often used in making up the tank brine when clean salt water can be had, but fresh water is used in the curing brine or "pickle."

DRAINING

As the sides are taken from the chilling tank they are temporarily stacked, skin down, on a long two-wheeled cart or portable table that serves the double purpose of easily transporting the fish to any desired place in the room and draining off the excess water, as the boards are spaced to leave large cracks. No extra time is required for draining, the few minutes while loading, moving, and unloading being sufficient.

Columbia River packers use a smaller cart holding just a tierce of sides piled 7 along the cart and 3 across one end, so that there are 10 sides to a layer. This is a great convenience in keeping the count straight either at salting or repacking time, for counting the sides singly as they go into the barrel leads to many mistakes, with extra work and confusion. In California the count of sides is nearly always made only at the repack.

SALTING

In the customary California method sides are taken, one at a time, from the long drain cart and dropped, skin down, in a large portable box full of dry salt. Handfuls of salt are then thrown over the exposed flesh and the side removed for packing in the tierce.

Thus, only the thin coating of salt adhering to the moist surface goes into the barrel, with the exception of an occasional light sprinkling of salt thrown in on the layer of sides in the tierce. The sides are closely packed, without counting, in the barrel with the skin side down, except the top layer, which is flesh down. Sides are salted and packed as they come, with mixed sizes and grades. Usually three men work together; the first lifts the sides from the cart and drops them into the salt box, the second covers the flesh with salt, and the third packs the sides in the barrel.

Good judgment should be used in packing mixed sides in the barrel, as they cure unevenly. The packer may improve the curing, however, by the proper addition of loose salt where needed. For instance, when two thick sides fall together there should be an extra amount of salt, as each side requires more than the normal amount. Small and thin sides take the salt more quickly and are apt to become too hard, so they should have less free salt, the brine being almost sufficient. For these reasons a preliminary grading at the chilling tank would insure more uniform curing with less difficulty and labor in grading the repack, and therefore better grading. If sides have been on the drain cart more than a few minutes they become dry on the surface, less free salt adheres, and extra salt should be sprinkled over the layers in the barrel.

Some California packers require the sides to be dropped, flesh side down (instead of skin down), in the salt box, and free salt is then rubbed over the skin and into the scored gashes, as it would otherwise fail to enter the cuts in the skin in salting. This is generally considered a slightly better method, as the brine alone entering the scorings is scarcely sufficient for thick sides. This method is not in general use, although the extra time required is negligible.

The dry salt used is usually a mixture of two parts of Packers' Fine to one part of Threequarters Ground. For the chilling tank brine half ground salt is used, which is coarser in grain and dirty looking, being less refined. English salt was used almost exclusively in the past, but is little used now.

SIZE OF CREW

There is little uniformity in the size of mild-cure crews, from 4 to 20 men being employed, depending on the quantity of fish ordinarily received. One splitter will keep from 6 to 12 men busy sliming. When rushed, 3 men are used in preparing the fish for the splitter. One fills the cleaning table with fish and assists in scoring or heading, a second heads and scores, while the third cleans (removes entrails). In slack times 2 or even 1 man performs the 3 operations of heading, scoring, and cleaning. It is claimed that 1 experienced man, who can split, ought to put up three tierces of mild cure alone in one day, performing all the steps from heading the fish to coopering the barrels after packing. A proper labor charge is variously estimated at from $7 to $12 per tierce, but this charge necessarily varies greatly, because a full crew is often held idle on the prospect of a heavy run of fish being received at any time.

TIERCES

The barrels or tierces used in curing, storage, and shipment are a standard size, holding from 775 to 850 pounds of sides, the normal amount being 800 pounds. The barrel has 6 hoops, 28 to 30 staves $1\frac{1}{4}$ inches thick and 34 inches long, and $1\frac{1}{2}$-inch heads 32 inches in diameter. In Alaska the barrels are made from spruce, but this is not as good as Douglas fir, which is the wood used in about 95 per cent of the California tierces. The barrels usually are shipped knocked down to the curing shed, where they are set up as needed.

CURING

After the tierce has been filled with the salted sides it is in most cases headed up at once, brine is run in at a small bung until full, and a wooden stopper ("cork") is driven home. This is not always the procedure, as there are other methods explained elsewhere. The tierce is then ready for curing in cold storage.

The brine, or "pickle," for curing is made by mixing salt of the Packers' Fine grade with fresh water. The solution varies in salinity from 90 to 95 per cent. In the past when the pack was put up for shipment to Germany the solution was usually 85 per cent. This is too weak for the best curing, as the flesh sours somewhat just under the skin, enough to smell a little; but this odor can be removed in the smoking. The German buyers prefer this slight souring to having the fish too salty. At present brine under 90 per cent is seldom if ever used, 92 to 94 per cent is often used, but 90 per cent is most frequently used. When fish are allowed to make their own brine, a 92 per cent solution usually results. When the sides are cured (after repacking) a 90 per cent brine is the standard solution used for storage and shipment.

The time required for curing varies, the size of the fish being the chief factor. Twelve days are often sufficient, but 18 days usually are considered the safe period, and the time may be extended indefinitely. The curing should not extend over four or five months, however, because the brine is weakened by the curing process, the salt settles to the bottom of the barrel, and the "sides" begin to get soft. Because of storage expense and a desire to realize on the fish, it is seldom cured more than one month before repacking. In extreme cases of rush orders the time for curing is sometimes reduced to six or eight days by using stronger brine and curing at a higher temperature. In such cases a little salt is often sprinkled on the sides when repacking, as the cure is not completed and will continue in transit.

Curing may be done without a regular cold-storage plant by icing alone. The temperature of a closed room may be reduced to 42 or 44° by ice, sufficient to cure the sides. This method is even desirable when the cured fish have to be shipped without cold storage, in which case the tierces may be three or four days in transit if kept cool (as on a boat trip) and immediately placed in cold storage at destination. A train trip of three days through the hot interior valleys without refrigeration would sour the fish.

VARIATION IN CURING METHOD

There are several variations in the method of curing. One, the so-called Scotch method, is sometimes followed in California. The sides are pressed into the barrel and never repacked. About 850 pounds of sides per tierce result. The appearance of this fish is not so good and there is less moisture in the flesh.

Another variation is to fill the barrel and let it stand a day. By this time the sides have settled and a few more may be added and the head pressed down without adding any brine. The water from the fish forms sufficient brine, and when the proper amount of dry salt is used the brine will have a salinity of about 92 per cent and is sufficiently abundant. More fish per barrel may be packed in this way, usually 825 to 850 pounds per tierce.

After curing, when the sides have gained in weight, the barrels hold from 850 to 875 pounds. This method allows the fat sides to gain weight until the cured sides weigh more than when fresh.

TEMPERATURE FOR CURING

The barrels are kept in cold storage while the fish are being cured, 39° being the best temperature. Lower temperatures are often used, however, but with 32 to 35° the sides do not take the salt so well and the fish is likely to be softer than it should be. If low temperature is to be used, it is better to let the barrels stand in a cool place 24 to 48 hours before entering cold storage to allow the cure to get a good start. After the sides have been cured 32° is a good temperature for keeping the fish.

While curing, it is important that an even temperature be maintained. If the temperature of the cold-storage room is allowed to creep up and is then suddenly forced down again, and this process repeated, a poor product will result. After the fish is cured it is not so important to keep an even temperature; in fact, there is usually considerable variation in the refrigerator car as the ice melts out and the car is reiced.

The temperature to be used in curing depends somewhat on how much time is available. Although 38 to 40° give the best cure, it is sometimes desirable to hasten the process for quick delivery. As the salt penetrates more rapidly at a high temperature, 40 to 44° are used, but a temperature above 44° is not safe for curing. In rush orders the cure can be speeded by using more dry salt, stronger brine, keeping the barrel in a higher temperature, and even by adding a little salt in the repack so that curing may be completed in transit.

WEIGHT CHANGES WHILE CURING

During the first two weeks of the curing process there is usually a decided shrinkage in the weight of the sides, the amount depending more on the fatness of the fish than on the method of curing. Lean fish will shrink much more (even 50 per cent more) than fat fish. The shrinkage in fat fish is from 8 to 20 per cent of the fresh weight of the sides. After two or three weeks there is a slow gain in weight, so that most cured fish weighed three or four months after repacking will be found to equal or exceed the fresh weight.

Fat sides gain to exceed the fresh weight, but lean sides gain little. This gain is from 15 to 50 pounds per tierce over the weight at repacking time if the fish have been thoroughly cured. Hard-salted salmon is so thoroughly salted that there is not this gain in weight.

SUNBURN

Fish caught by the trollers are too often left on deck or in a box exposed to the sun. The salmon should be covered at once with something to shade them, wet salt sacking being the most convenient thing to use. The sacking should be kept wet to prevent the skin from drying and burning. Cooling from evaporation also retards belly burning. After the skin dries it begins to wrinkle, and if exposure is continued the flesh will break away from the skin. Even before the wrinkling of the skin is very noticeable the flesh underneath "cooks," becomes soft, tainted, and may drop from the skin when smoked. It is claimed that a fat salmon exposed to the sun for 10 minutes on a hot day will become sufficiently tainted so that the sour smell will be evident in the flesh of the cured side.

Sunburning is often called "shoulder burning" because it is first evident on the "shoulders," the thickest part a few inches back of the head just above the lateral line. The shoulder burn may be the size of a man's hand or cover half the side. Often the fish is burned over the whole side.

Sunburning so injures the flesh that it smells under the skin even after curing, and buyers test suspicious-looking sides by inserting a knife or sacking needle under the skin. The oder is distinct on the knife if the side has been burned, and such fish are graded out from the prime sides. Such sides are called "stinkers" at smoking, as the odor is pronounced in the smokehouse.

BELLY BURN

Deterioration of the fish, due to visceral decay after death, is called "belly burn," because the flesh next the body cavity is darkened and made soft and evil smelling. In more advanced stages the fish becomes so soft that the ribs break through the flesh. The tissue between the flesh flakes breaks down and the fish is unfit for mild curing. The softening of the whole fish, when held for a day or so without cleaning, is only indirectly due to belly burning, but it goes under that name or is called "mush fish."

Ocean fish having food in their stomachs will begin to taint in a very short time if not kept cool and moist. An hour is often sufficient to give the flesh an odor. Ocean fish held 30 hours before cleaning are sometimes so soft that the flesh about the body cavity falls to pieces in cleaning. Fish held too long before cleaning may not be unfit for mild curing and may show only slightly the breaking apart of the flesh flakes, but such fish will not caseharden in the chilling tank, continue to exude oil, cure badly, and are inferior when smoked. All ocean fish are best when split as soon after catching as possible. A much-needed improvement in caring for fish is the cleaning of all ocean salmon by the fisherman on his boat as soon as caught, merely opening and removing the entrails. River fish, whose stomachs are empty, are much less apt to belly burn and may be kept longer without the flesh "mushing."

BROKEN FISH

Fish may be "broken" from rough handling at any stage from the time they are caught until the cured sides are shipped. Fish in the round are not so easily broken as after being split, yet many of the injuries are received while still in the round. Bruising, bending, dropping, and piling too deep in the boats are the causes of injury in the round. A fish dropped tail first will in most cases be so broken that the cured side will have to go as a "B" or cull when graded. Bending when dumping in a pile often makes a "B" grade, especially when there is the weight of other fish above.

The breaking is due to the tearing apart of the flakes of the flesh. This injury becomes more noticeable during smoking, and when ready for the retail trade the fish is difficult or impossible to slice and has to be sold as inferior fish at a reduced price. The loss to the packer is considerable, as the "B" grade sells at 5 cents less per pound. Most of the breakage is due to rough or unskilled handling after splitting. Often the splitter, when he is ahead of the slimers in his work, will pile the sides up on the table, newly split sides being slid or thrown onto the pile. When the side bends over a pile more or less breakage is sure to occur, and for this reason sides should be only one deep on the table. Picking up the side requires care. When picked up by the "collar" and bent over the hand the flakes are broken apart. Rough handling on the sliming table and throwing into the chilling tank causes a portion of the "B" grades. Bending in the salt box and while packing in the tierce is responsible for some of the breaking.

Gaffed fish are far too frequently found in the catch. If deeply gaffed, the fish is not mild cured. If the hole is shallow and small the fish is split in order to secure the one good side, the gaffed side going as a "B" or cull. It is significant that the gaff has been practically discarded in the north and a landing net used instead.

REMOVAL OF FINS

As usually practiced in California, no fins are removed except the tail fin (caudal), which comes out with the backbone in splitting. With a right-handed splitter the dorsal and adipose fins remain on the left "side." Removing the fins takes extra time, but the appearance of the cured side is improved. The dorsal fin becomes a leathery sharp projection in smoking, and is a disadvantage in packing the smoked side, as it cuts through the waxed paper when wrapped for shipping. Removing the dorsal fin would also expose the oily region at its base to more ready curing. The pectoral fins fold tightly against the body, fitting into depressions in the flesh. When the cured side is washed and hung for drying and smoking, moisture is apt to hold under the pectoral fins and prevent proper treating, with the result that the spots under these fins are apt to spoil and mold. The removal of other than the dorsal and pectoral fins is not so important except to improve the appearance, thereby aiding the sale when the demand is not strong. A few California packers remove the fins, and the practice is general on the Columbia River.

GRADING ON THE COLUMBIA

Columbia River mild-cured salmon is most highly regarded by the trade and sells for more than the Puget Sound and most California cured salmon. This difference is not in the quality of the fresh salmon so much as in the curing methods and careful grading. Discovering that a tierce of salmon sold for a price determined by its poorest "sides," on the principle of a chain being as strong as its weakest link, the Columbia River packers have found that carefully grading out the best sides brings an added fancy price, and a poor side slipped into a grade above its proper place works injury to their trade.

Unlike the California method, the Columbia River packers grade twice. Usually three chilling tanks are used, being placed end on to the sliming tank (or table) for economy in space. The sides are thus given their first rough grading into large, medium, and small in the three chilling tanks, which is an advantage in salting and curing (since different sizes cure unequally) and also saves much labor in repacking. At the repack there is a careful second grading into from 6 to 10 grades, the chief grades being determined by the number of sides necessary to fill the standard 800-pound tierce, and are expressed as grades 50, 60, 70, 80, or 90 (sides per tierce). As most of the fish are large (seldom less than 10 pounds to a side) there are few medium or small sides, but mostly large and extra large. Slightly broken sides are graded as "B" of that size and are not thrown into one grade or included with the culls. The resulting pack is uniform, the sides of one grade varying in weight but little, and no prime fish are pulled down by being classed with inferior sides.

GRADING IN CALIFORNIA

California packers usually recognize but three or four grades, with a catchall grade of "B" and culls. The "B" grades of each size class are frequently thrown together and separated from the culls or worst sides. The cull grade is loosely defined and may include pale, gaffed, burned, broken, small, thin, and poor quality. More frequently the slightly injured sides are called "B" grade or No. 2 and are distinguished from the badly injured sides or culls. The result of lumping the "B's" or No. 2's together is that some good sides go for a poorer price than they deserve and many sides that should be graded "B" go as "A" and thus lower the standard of the prime sides. For instance, a collar-broken large side may be only slightly injured. If called "B" it goes in with a barrel of small, thin-bellied, gaffed, and inferior fish. It is therefore often squeezed in with the prime grade. It would improve the pack to grade more closely and with more primary grades and an "A" and "B" grade of each size class where the pack is large enough to have a tierce of "B's" of each size. However, improvements in the pack are not likely to be developed while the demand for mild cure is as strong as at present.

In California there is seldom a preliminary grading, the sides being cured as they come without regard to size, so that a tierce may contain all grades and culls mixed together. The grading and counting are done at repacking time. Smaller sides are now accepted than in the past, as the European shipments could not include sides under 8 pounds but now the New York market takes 6-pound sides.

The customary four grades, expressed in weight of a single side, are 6 to 7, 7 to 8, 8 to 11, and 11 pounds and up. Many sales are made throwing the last two large sizes together, thus making three grades—small (6 to 7), medium (7 to 8), and large (8 pounds and over). Two separate grades may be made for "B" and cull, or they may be thrown together as one. "B" or No. 2 usually sell at 5 cents less per pound. In spite of the loose grading of the "A" or prime sides, California has the reputation of a large percentage of "B" and cull in the pack. This is said to be due not so much to pale fish in the catch as to sunburn, breaking, and poor curing by inexperienced or careless crews. Frequently a pack is from 15 to 25 per cent "B" and cull instead of the 8 to 10 per cent "B" with practically no culls, as it should be.

SALE OF CURED FISH

Most of the California pack is sold and paid for in the State, and usually is inspected at the repack by a broker or representative of an eastern buyer. In most cases the packer contracts for his season's pack before the season opens. In fixing the price paid the packer it is customary to recognize three chief grades (exclusive of culls), with a different price for each. For example, a fair price for 1920 was 25 cents per pound for large (8-pound sides and over), 23 cents for medium (7 to 8 pound sides) and 20 cents for small (6 to 7 pounds). "B's" or No. 2's go at a reduced price, usually 5 cents less per pound. Culls are either classed with the "B" grades, taken at a further reduced price, or not accepted at all. The 1920 prices were an advance of 2 cents per pound, on the average, over 1919. In the past it was customary to contract the pack at a flat rate. For example, a large Monterey pack was sold in 1919 at 20 cents. Shipment east, after the repack, is in refrigerator cars, 32 tierces to the standard-sized car and reiced in transit.

The cured fish are ready for smoking any time after the repack but may be held indefinitely in cold storage. Fish held three years before smoking have met with ready sale.

SMOKING

Practically all smoking is done in the large eastern cities. The cured sides are taken from the barrel in the morning and washed in a tank of fresh running water all day, in addition to being washed off with a soft brush. They are then hung in a drying room, provided with a hot-air blast, for an hour or so until the surface and excess moisture is dried off. Sides are then smoked all night and are ready for early morning delivery the next day. Washing and smoking, therefore, occupy about 24 hours. Olive oil is rubbed on the smoked fish, especially on the lean sides. In the usual method of smoking the fire is furnished by gas pipes in the floor perforated for small flame jets on each side of the pipe. Mahogany sawdust is placed in small piles along the pipe so that the gas flame slowly eats into the piles.

SALE AFTER SMOKING

In the cities the smoked sides are delivered in the morning by peddlers to shops retailing the product. The amount smoked is just enough for the day's trade, so the smoke is repeated each day. The smoked sides lose color rapidly and therefore they are better used as fresh as possible, but they can be kept over two weeks if held in cold storage after smoking. In the stores the sides are sliced on the bias, diagonally through the flakes or grain, in very thin slices. When the flakes are not solid, as in broken fish, the slicing is difficult and thin slicing impossible. Broken, thin, "B's" or No. 2's, and culls are sliced thick and put up in olive oil in 1-gallon sealed tins. Slightly broken fish is sometimes sliced as thin as possible and put up with oil in flat or half-pound cans. In shipping the smoked sides to out-of-town trade they are packed in a shallow box, two sides to the box, or four if the sides are small, the smoked fish being first wrapped in waxed paper. The smoked mild cure is sold readily in German communities of the eastern United States, but more is sold to the Jewish trade, especially in New York. It is used instead of meat, taking the place of bacon, as the thin slices are delicious heated in a pan and served with eggs. The slices are largely used as meat in sandwiches. Although a high-class trade takes the better grades, great quantities are used in the sweatshops in lunches for the laborers. Before the war more mild cure went to Germany than was used in the United States. Now practically all of the California pack is consumed in the eastern cities of this country and very little is sold locally on the Pacific coast.

OCEAN AND RIVER FISH

Open-sea salmon caught by trolling are tender fleshed and fat, and as they are feeding they soon taint from belly burn and have to be handled more carefully and packed as soon as possible the same day as caught. If held over until the next day they are almost sure to be soft. Salmon on the journey up river to spawn are harder fleshed, with empty stomachs, and will keep longer. On the Sacramento River a common practice is to clean the fish and ice them down on the floor overnight to draw out the "muddy" or "tule" taste, and it is also claimed that they will split more easily if so held until the following day. The fall-run Sacramento fish from warm and muddy water have a more decided "river" taste and "muddy smell" than the spring run.

COLOR AND FAT VARIATION

There is much variation in the salmon caught at various localities along the Pacific coast. Broadly speaking, the southern catch (Monterey, especially) has a high percentage of pale, but few, if any, white fish. In northern California and Oregon nearly all of the salmon are red, and further north they are red but with a higher percentage of white salmon. Puget Sound chinooks are said to be 15 to 20 per cent white, and in Alaska about 20 per cent white.

The oil content seems to be more variable than color, and also less consistent as to locality. The fall runs in both the Columbia and

Sacramento Rivers are too thin for good mild curing, few being packed on the Columbia in the fall for fear of injuring the high standard set by the spring-run product. The Yukon River fish are credited with being the fattest of all the king salmon. The spring runs of the Columbia and Sacramento are the choice fish for mild cure in both color and fat, being second only to the Yukon in fat. The Oregon coast streams are said to have long-shaped fish with not much fat. Cook Inlet fish are of low fat content, and Grays Harbor fish, though large, have so little oil that they are no longer mild cured but are sent to the fresh markets. Copper River fish have more oil, and farther north there is plenty of oil in the fish.

A high oil content is desirable for richness, a thick large fish is preferred, and the redder the flesh the better the sale. Pale-colored salmon are salable as mild cure, but the "white" salmon are of little value when cured, not because of inferior quality but on account of their appearance.

Although of good color, the lack of oil in the fall run of the Sacramento fish prevents a fine quality mild cure, but they have one peculiar advantage. The cured sides are hard and leathery from lack of oil, but they will smoke better than the fat sides in extremely hot weather. Ocean fish and oily, spring-run, river fish can not be smoked during the eastern midsummer heat because the sides begin to spoil and taint in the drying house and smokehouse.

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PEARL ESSENCE: ITS HISTORY, CHEMISTRY, AND TECHNOLOGY [1]

By Harden F. Taylor

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INTRODUCTION

The value of a pearl resides not in the material of which it is composed but in the manner in which nature arranges this material. Except in shape, the genuine pearl is identical with the shell or mother-of-pearl of the mollusk that produces it. Both consist of layers of crystalline calcium carbonate alternating with layers of conchiolin, a horny, organic substance that binds together the layers of calcium carbonate. These otherwise worthless materials are so disposed in a pearl as to give an optical effect that makes it one of the most valuable of all articles of commerce.

To imitate pearls man must make use of some substance that, when put into the shape of a pearl, exhibits a pearly luster.[2] The only substance that has ever answered this requirement satisfactorily is the silvery substance deposited in the skin of many species of fish. This substance, when rubbed off the scales, freed from foreign matter, and suspended in water or other suitable liquid, is pearl essence. When applied on the inside of hollow beads or on the outside of solid ones it imitates the genuine pearl quite satisfactorily and makes the ordinary imitation pearl of commerce. When incorporated properly in celluloid plastics, it makes the imitation mother-of-pearl now

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[1] Appendix II to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 989. Technological contribution No. 22.

[2] For data on and discussion of the nature of pearly luster, see Liesegang (1915), Pfund (1917), and Bancroft (1919).

rapidly coming into use for the manufacture of backs for hand mirrors, manicure and toilet sets, and for other purposes.

It is the purpose of this paper to give an account of the history, chemistry, and preparation of this beautiful pearly liquid. There will also be included some, though not exhaustive, information regarding the manufacture of imitation pearls and pearly articles.

TERMS USED

In this paper, the term "imitation" pearls will be used to denote those products made of glass, wax, lacquers, pearl essence, etc., which resemble pearls more or less closely but have nothing in common with them in composition or structure. The term "artificial" pearls, often used for such products, should be reserved for "culture" pearls—that is, those produced by mollusks as a result of artificial stimulation by man, such as inserting foreign objects into the mantle of the mollusk. The genuine pearl is, of course, produced spontaneously by the mollusk.

HISTORICAL

EARLY HISTORY

It is not surprising that efforts were made early in the history of mankind to imitate such valuable gems as pearls,[3] and history contains many references to this subject. It appears that the discovery that first led to real success was made by Jaquin, a French rosary maker, who, on the banks of a stream near his home at Passy, noticed that the water in which a small fish (the *able* or *ablette*, *Alburnus lucidus*) had been washed contained a highly lustrous substance, which, when concentrated by sedimentation, suggested in a remarkable degree pearl, and application of it to small globes of alabaster, wax, etc., produced for the first time remarkably good imitations of pearls.

Some references credit the Chinese with this discovery. Close scrutiny appears to indicate, however, that they arise from a confusion of the Chinese art of inserting small carved images and other objects into the mussel, to be coated with the secretions, with the manufacture of imitation pearls undoubtedly first invented by Jaquin.

Jaquin's discovery was made in about 1656. Réaumur (1716) refers to it as having been "sixty years ago," though it may have been in 1680, since the references are in disagreement. Jaquin experimented with various materials to be treated with his pearly coating, and the application of the luster in various ways, but meanwhile his pearls gained a reputation and apparently extensive distribution. Beckmann (1786) relates a story, quoted from the Mercure Galant of 1686, of a penniless marquis who, at the suggestion of a servant, fooled his fiancée with a string of Jaquin's imitation pearls which cost him 3 louis, the price for which if they had been genuine would have been about 2,000 francs.

Following Jaquin's time the industry remained for many years entirely Parisian, though in time pearls were made in Holland, Germany, Bohemia, and Japan. In 1806 a plant was established by one

[3] See Beckmann (1786) for the early history of the subject.

Bourguignon in France, and the term *bourguignon* came to be used to denote imitation pearls. By the time of the American Revolution a factory at St. Jean de Maizel was producing 10,000 pearls a day.

The first extensive account of the use of *essence d'Orient* (the French term for pearl essence) was that of Réaumur (1716), already referred to. This writer seems to have been the first to discover, or at least to record, that the essence is not a homogeneous liquid but a suspension of a vast number of minute particles shaped like blades. Réaumur evidently did much work on the subject. He describes at length the distribution of the lustrous substance among the tissues of fishes—peritoneum, stomach, scales, iris, etc.—and constructs an elaborate though wholly erroneous theory to explain how it may be produced in the stomach and intestines and transported through minute canals to the surface, where it is distributed and deposited in the scales. He also describes the process of making the essence and applying it to beads. The scales of the ablette were agitated with water in a bowl, the water being poured off and renewed, again agitated, and so on until the scales were clean. The wash waters were mixed, the suspended particles allowed to settle for 10 to 12 hours, and the clear excess of water was decanted. The concentrated suspension left was *essence d'Orient*. No mention is made of the use of ammonia. The essence was quite unstable, especially in warm weather, when it decomposed and lost its luster. He says that during a storm it will decompose from one hour to the next.

The essence was applied by means of fish glue to beads of wax, alabaster, or glass. Since these were sensitive to moisture, the next improvement was to blow hollow spheres of glass—blue, greenish, or "gyrasole" (opal)—and coat them inside with the fish glue and pearl essence mixture.

Referring to the beautiful but indescribable whirling effects seen in the liquid pearl essence, Réaumur says of the tiny blades:

> They yield so easily to such slight movements that I do not doubt that they have been taken for insects by those who are disposed to give that name to everything which moves continually in liquids.

If we judge from the numerous references in the literature about Réaumur's time we will readily conclude that pearls were very much in fashion, and that there was a lively interest in the nature of pearls and the possibility of producing them artificially. It was only a few years later that the great Swedish botanist, Linnæus, announced the discovery of an artificial method of inducing pearl formation in mollusks. The method remained a secret and was lost.

Beckmann (1786) described the process of making the essence very much as Réaumur did, only by this time it had been discovered that "volatile alcali" (ammonia) helps to dissolve the epidermal tissue and also preserves the essence. He described also the introduction of the mixture into the beads with a fine pipette, and how the beads were kept in motion on a swinging cradle to obtain uniform distribution of the coating. After the coating was dry, the bulb was filled with wax and strung. Colors were used. Small paper tubes were inserted through the better grades to prevent the thread from becoming waxed.

HISTORY OF CHEMICAL RESEARCH ON PEARL ESSENCE

The next paper of importance was by Ehrenberg (1833), on the formation of crystals in the tissues of living animals. In this paper

Heinrich Rose, who worked at the instance of Ehrenberg, reports his findings, the conclusion from which is that the lustrous crystals consist of a volatile organic substance.

Goebel (1836) introduced a short paper with a reference to news items published in European newspapers (Froriep's Notizen, December, 1835, and Hanovrische Zeitung and Berliner Staatszeitung of about the same time) reporting the sensational discovery by "the well-known chemist, Doctor Du Mesnil, of Wunstorf," that the metallic luster found on the scales of certain fishes—for example, the carp—is silver. This remarkable conclusion is supported by what purports to be chemical proof (precipitation with ammonium sulphide). He went so far as to calculate that an ordinary carp will yield about 0.12 gram of silver. Goebel, who reports this interesting but mistaken finding, himself tested Du Mesnil's conclusion and found no trace of silver, and pointed out that a mere precipitate with ammonium sulphide is not necessarily silver.

In 1836 appeared a paper by Schnitzlein, who also refers to the work of Du Mesnil and undertakes to test his conclusion. He found, like Goebel, that no silver or other metal was present. He found the crystals to be soluble in dilute acids and alkalies, they burned with a smell of burning horn, were not precipitated with hydrogen or ammonium sulphide, and before the blowpipe yielded no metal. He concluded that the source of the luster was an organic compound of albumen with phosphate of lime. Mathias (1843)[4] concluded that the sparkling particles were phosphate of magnesia.

Von Wittich (1854) was first to prepare the substance in large quantity for chemical examination. He scrubbed the scales in alcohol and separated the sparkling particles, which were disengaged from the membranes and passed into the alcohol. He observed that on igniting the substance a smell of burning horn was given off, and in the ash were found calcium phosphate, ordinary salt, and small quantities of other mineral matters. He concluded that he was dealing with a nitrogenous compound of the inorganic salts that remain on ignition.

Up to this time it will be seen that even though numerous investigators had attacked the problem, no substantial progress had been made in identifying the substance in hand. This does not speak so badly for the chemistry of the time as might at first appear. The real difficulty then, as later, was in getting the substance in pure form for analysis. While the particles make a great showing by virtue of their great luster, they are really so thin as to amount to exceedingly little substance. In proportion to volume, they are possessed of great surface on which impurities can accumulate, and it has always been difficult to free them from the large quantities of slime, blood, etc., with which they are from the first associated. The mineral matters of various composition reported remain from the burnt slime, blood, etc.

Barreswil (1861) was first to arrive at the correct identification of the lustrous substance as guanin. This compound had been discovered in bird guano by Unger in 1845. Barreswil enumerated the properties which led him to that conclusion—its insolubility in water, ammonia, and acetic acid, its behavior on ignition, its solu-

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[4] Tromsdorff's Journal, Band X, Stück 2, 1843, p. 3. Paper not seen by the writer and therefore not included in the bibliography.

bility in mineral acids, and its characteristic crystallization. These and its other properties led him to refer it to the guanin of Unger.

Voit (1863 and 1865), at the instance of Professor Siebold, investigated this substance and agreed with Barreswil as to its identity, though his conclusion was reached independently, and he gives numerous other properties and reactions to support that conclusion. Referring also to the production of a compound of barium and guanin by Strecker (Annalen der Chemie und Phaımacie, Band CVIII, 1861, p. 154), Voit cites properties that led him to believe the lustrous particles are a compound of guanin and lime. This idea persists in the reference books to-day in spite of Bethe's (1895) definite finding that it is pure guanin. Voit's experience with the synthetic production of "guanin-lime" led him to speculate that some day the artificial preparation of pearl essence might be realized.

It will be noticed that up to this time the analytical procedure consisted of trying various reactions for guanin and in making various qualitative tests for calcium and other mineral substances. Bethe (1895) was first to undertake the solution of the problem quantitatively. He carefully prepared and purified the crystals, dissolved them in hydrochloric acid, filtered the solution, and precipitated a highly purified guanin with ammonia that had a percentage composition agreeing very closely with the theoretical. The amount of calcium and other mineral impurities was found to vary with the method of preparation, a fact that led him to conclude that they were not an essential part of the compound. His work bears all the marks of accuracy and finality, and the lustrous particles must now be regarded as pure crystalline guanin.

RECENT HISTORY

With the outbreak of the World War in 1914, the European supply of pearl essence was cut off, and attention was directed from all sides to the possibility of obtaining a supply of it in the United States. While the ablette or bleak does not occur in this country, other fishes were found that yielded a satisfactory product, and an industry grew rapidly and has now reached large proportions. Improved methods, aided by machinery, are followed, and the recent application of pearl essence in the manufacture of imitation mother-of-pearl celluloid products has greatly increased the demand and consequent supply.

SOURCES AND DISTRIBUTION OF GUANIN AMONG ANIMALS

PRODUCTION OF GUANIN BY ANIMALS

Mention has already been made of the work of Bethe in demonstrating that pearl essence is pure crystalline guanin. Guanin is one of the end products of protein metabolism in the animal body. It is a derivative of nucleic acid and occurs in all nucleated cell tissues. The biological significance of its occurrence in the form of deposits in animals is interesting and important. Occurrences in the higher animals of more than very small amounts of such end products of metabolism as urea, uric acid, creatin, xanthin, taurin, and guanin are unusual and these substances are indicative of pathological conditions when present in any considerable quantity; but, perhaps because of less efficient organs of elimination, these and similar chemical substances are often found in surprisingly large quantities under normal conditions in many of the lower orders of animals. Not being eliminated, they are disposed of as deposits in out-of-the-way places among the tissues. Urea accumulates in sharks and rays, uric acid and urates are in certain snakes and butterflies, and among invertebrates generally extensive accumulations of this kind are of frequent or regular occurrence.

Ewald and Krukenberg (1882 and 1883) found guanin in the skin of chameleons and lizards, in alligators, snakes, frogs, snails, fishes, and many other animals. The tissues containing it are the skin, connective tissue, retina, iris, peritoneum, air bladder, liver, pancreas, etc. It is found in the excrement of spiders and certain snakes, and is abundant in the bird guano deposits of Peru and elsewhere. With the possible exception of those in the iris of frogs' eyes, these deposits are all amorphous, and it is only in the fishes that crystalline deposits are found to any considerable extent. Of course, the crystalline state is absolutely essential for purposes of making pearl essence.

GUANIN IN FISHES

In the fishes guanin is put to the useful purpose of camouflage. Most of it is deposited on the belly side of the fish and makes a bright silvery appearance to blend with the bright sky as seen from below by enemies of the fish. Similarly, when seen from above the fish is a greenish gray to blend with the color of the water.

This guanin deposit is present in abundance in a vast number of species of fish; in fact, the exceptions are those without visible deposits of guanin. Our familiar herrings, sardines, whitefishes, menhaden, mackerel, salmons, butterfish, carp, sunfishes, tarpon, scup, squeteague, ladyfishes, spot, croakers, hogfish, barracuda, bonito, shad, gizzard shad, mullet, and many others exhibit the silvery luster. It is even doubtful that any fish exist which are free from guanin deposits. Such fishes as haddock, cod, and flounders have subdermal connective tissues heavily charged with *amorphous* guanin, which is chalky white. It is of zoological interest to note that these species that live on the bottom and have amorphous guanin do not need the lustrous camouflage that would be provided by the crystal variety. It is not sufficient to say that pearl essence is a suspension of guanin—it must be in a definite crystalline form.

EUROPEAN SOURCES OF PEARL ESSENCE

The European fish from which pearl essence has been made from the seventeenth century is the bleak (German, *Ukelei, Laube;* French, *ablette*), *Alburnus lucidus*, a small fish of the carp or minnow family (Cyprinidæ), widely distributed in the fresh-water streams of Europe. The fish is of no value as food and serves only the one purpose of producing pearl essence. This fish serves particularly well as a source of pearl essence because it is small and comparatively poor in dark skin pigments that would discolor the essence. In England essence is made from the herring (*Clupea harengus*). It is understood that there is a plant manufacturing it at Peterborough.

In Europe there is a commerce of some importance in the scales of the *ablette*, carried on by producers who sell the mildly preserved scales to the manufacturers. The *ablette* are scaled by hand by low-priced labor. The scales are then put in a large container of salt brine of about 10 to 15 per cent concentration and moved about in such a way as to wet all the scales. The brine is then drained off and the scales are put into muslin bags and squeezed to free them as far as possible of the brine. They are then compressed tightly in barrels, kegs, or metal cans. In this condition they will keep for some time, or for several weeks in storage at about 32° F. Several shipments of Eastport herring scales have gone to Europe in cool storage. The scales are not allowed to dry but are kept moist with the brine in the sealed containers.

AMERICAN SOURCES OF PEARL ESSENCE

The principal sources of American pearl essence at present are the sardine herring (*Clupea harengus*) at Eastport, Me., where there are two factories operating on herring scales obtained from the sardine canneries and boats. Scales accumulate in the bottom of the boats and are collected and sent to the factories; also, the water used to flume the fish into the canneries, containing much of the lustrous guanin, is caused to run into settling tanks. The sediment is collected and transported to the essence factory, where it is manufactured into finished essence. The price has ranged from 4 to 14 cents per pound for the scales. A considerable quantity is manufactured at Hyannis, Mass., from the scales of the glut herring or alewife (*Pomolobus pseudoharengus*), and there is some manufacture in New York from materials shipped in from various points.

At Reedville, Va., there is a manufacture in the short spring season from the scales of the glut herring (*Pomolobus æstivalis*), and also the branch herring (*P. pseudoharengus*), as well as from the shad (*Alosa sapidissima*) and hickory shad (*P. mediocris*). The scales are understood to bring 10 cents per pound, 20 pounds of scales being produced by 1,000 alewives. As 1,000 alewives average 633 pounds in weight, about 3 per cent of the weight of the fish is in available scales.

The California sardine or pilchard (*Sardina cærulea*) is a potential source of supply, though it is impracticable to collect the scales under the present methods of handling the fish there. The silver carp (*Carpiodes velifer*) of the Mississippi Valley has been found by the writer to produce a large quantity of lustrous substance, but it is not a very abundant species. The gizzard shad (*Dorosoma cepedianum*), of fresh-water streams of Florida and elsewhere, is a moderately abundant fish and produces the essence. Among the other American species that might be considered potential sources of the essence are the ladyfish (*Albula vulpes*), whitefish and cisco (Coregonus) of the Great Lakes, the Pacific coast salmons, Alaska herring, southern mullet (*Mugil cephalus*), and perhaps also the shiner (*Abramis crysoleucas*). The writer has made pearl essence of good quality from the menhaden (*Brevoortia tyrannus*), the fish caught in great quantities off the Atlantic coast and used for the manufacture of fish meal, fertilizer, and oil.

PROPERTIES OF PEARL ESSENCE

Pearl essence is a suspension of the natural crystals of guanin in a liquid, ammoniated water, amyl acetate, acetone, or other liquid. One commercial form of it is a highly concentrated suspension of the crystals or particles in a thick lacquer of celluloid in amyl acetate. The properties given are chiefly those of the crystalline guanin.

PHYSICAL PROPERTIES

The natural crystals of guanin obtained from fish scales are usually much broken up in the process of manufacture. While the size of crystals varies somewhat on a single fish, it is in some measure proportional to the size of the fish from which the crystals come, those from the shad and whitefish, for example, being much larger than those from the alewife or sardine herring. While the crystalline form appears to be similar in different American species of fish, one

FIG. 1.—Crystals and fragments of guanin from pearl essence derived from shad. Magnification approximately 100 diameters

specimen of pearl essence of Japanese origin has come to the writer's notice in which the crystals appear to be very thin needles rather than blades. Those from the shad have dimensions of about 0.1 by 0.02 by 0.001 millimeters. Such a crystal would have a volume of 0.000000002 cubic centimeter, a surface of 0.0000424 square centimeter, and a weight of 0.000000032 gram. The specific gravity of the crystals is somewhat in excess of 1.6, since they sink slowly in carbon tetrachloride. One gram of the crystals has an aggregate surface of about 12,575 square centimeters—somewhat more than a square yard—and contains about 312,500,000 individual crystals. The large amount of surface accounts for some of the properties of the essence, for the crystals adsorb substances from solution and hold them on their surfaces. They appear to hold albumen, which fact would account for the difficulty in transferring them from water to nonaqueous liquids that precipitate albumen. Likewise, they adsorb coloring matters from solution and thus become "off color." Suspended in ether or amyl acetate, they adsorb and hold tenaciously to any fat present. When cleaned, they can be suspended in any liquid that does not dissolve them.

The guanin particles, when reduced to a dry powder, have a smooth, soapy feel between the fingers, like that of talcum powder. When properly cleaned they are presumably colorless and transparent, but when viewed by transmitted light under the microscope they are often slightly yellowish, probably because of adsorbed impurities on their surfaces. A drop of the essence dried on white paper is usually brownish yellow.

To understand the beautiful and peculiar appearance of pearl essence, one may visualize very thin light blades, floating in a liquid and turning over and over like narrow strips of paper falling in air, their narrow surfaces throwing brilliant flashes of light in all directions and at the same time giving a play of colors like soap bubbles do. The light coming from them is doubly refracted and polarized, and when it passes successively through two of these crystals it is broken into colors by a twisting of the polarized beam.

The crystals show their maximum luster when they are oriented parallel to each other. This condition occurs when a current is set up in the liquid containing them. If the crystal happens to lie across stream, the velocity gradient perpendicular to the direction of flow causes one end of it to move faster than the other, and it is therefore steered around until its long axis is parallel to the direction of flow of the stream or current. This accounts for the whirly effect in the liquid essence. It also indicates that in applying lacquers the maximum effect will be obtained if the fluid is caused to flow. In imitation pearl, advantage is taken of these facts to brush patterns of various kinds into the film. If the coat is applied as a uniform film with the crystals pointing promiscuously in all directions, the effect will be a metallic or dull pearly luster.

OPTICAL AND CRYSTALLOGRAPHIC PROPERTIES

The writer submitted specimens of pearl essence from shad, suspended in ether and monobromonaphthalene, to Dr. H. E. Merwin of the Geophysical Laboratory of the Carnegie Institution of Washington, to whom he is indebted for the following statement of the optical and crystallographic properties of the guanin crystals:

> The materials most studied had been kept in turpentine and in methylene iodide, but they were found to be closely similar to or identical with samples from ether or bromonaphthalene.
>
> The preparations consisted of minute crystalline blades of rather uniform size of about 0.10 by 0.02 by 0.001 millimeters. Flatwise the blades showed no appreciable double refraction, but when tilted the double refraction was evidently strong; and on blades tilted sufficiently to show definite extinction, angles of extinction were as high as 30°, but practically parallel extinction was observed also. Edgewise, extinction was parallel. Thus the possibility that two substances were present—one orthorhombic and the other monoclinic—had to be considered. No definite interference figures were observable. The indices of refraction were observed by the immersion method, but the blades were so thin that the index β, which had to be measured on flatwise blades, could be found only roughly; γ, vibrating lengthwise, was so high that no known immersion liquid could be found which may not have slightly attacked the crystal;[5] α,

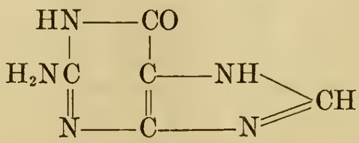
[5] The liquid finally used was arsenic sulphide, dissolved by heating in methylene iodide. In a liquid of the same index, containing methylene iodide, sulphur, and the iodides of tin, arsenic, and antimony, the crystals appeared decidedly higher.

vibrating normal to the blades, was probably accurately measured. These measurements gave no evidence of the presence of more than one substance; $\alpha=1.456$, $\beta=1.8$, $\gamma=1.85$.

The relation of crystal shape to the principal indices of refraction accounts for pearly luster in low refracting media in which the crystals may be suspended. No pearly luster could be seen in a liquid of index 1.85. To give the maximum effect, the blades would be nearly parallel to the surface illuminated. The light entering the surface encounters blades, which, on account of decidedly higher refraction and flatness, reflect more strongly in some directions than in others.

CHEMICAL PROPERTIES

Guanin, 2-amino, 6-oxypurin, has the composition $C_5H_5N_5O$, or



a derivative of purin, and belongs to the group known as the purin bases. In the living animal it occurs combined with other groups in nucleic acids, which in turn are combined in the complex nucleoproteins found in cell nuclei. Guanin is insoluble in water, alcohol, ether, chloroform, ethyl or amyl acetate, acetaldehyde, or any neutral solvent, acetic acid, dilute or glacial, acetic anhydride, formic, lactic, or solutions of salicylic or citric acid. Ammonium hydroxide solutions containing 1, 3, or 5 per cent NH_3 dissolve 9, 15, and 19 milligrams of guanin, respectively. Hot ammonia solutions dissolved relatively more (Wulff, 1893). In supersaturated ammonia, especially if hot, it is still more soluble, and from this solution, on spontaneous evaporation, crystallizes out in needles or plates (Drechsel, 1881). It is soluble in dilute mineral acids and in solutions of sodium or potassium hydroxide. On neutralization of the acid solutions with ammonia, amorphous guanin is precipitated. It is decomposed by strong oxidizing agents, potassium permanganate or chlorate, or chlorine, and is converted into xanthine by nitrous acid. It forms compounds with many acids, acid radicals, organic groups, and inorganic salts (see Wulff, 1893). When pure, guanin or pearl essence should leave no residue if ignited on platinum foil. It is not changed by heating in water to 250° C.

Guanin was synthesized by Emil Fischer (1897) from trichloropurin. The purin was prepared from ammonium urate. It has been suggested that pearl essence may be made synthetically. Perhaps it may be, but preparation of guanin of the delicate crystalline form necessary for pearl essence appears to present such difficulties as to indicate continued dependence on the natural supply from fish scales, especially since there appears to be no real scarcity of the latter, once the collection of it is organized.

When guanin crystals are suspended in a nonaqueous liquid like ether, that itself is not miscible in all proportions with water, the liquid must be strictly anhydrous. If a trace of water is dissolved in the ether, the crystals refuse to subside into a compact silvery mass, but hold apart from each other in a feathery aggregation. If more water is present they will flocculate in large masses which become impossible again to break up. Perhaps under these conditions they acquire an electrical charge, but this has not been investigated. In any event, the ether or amyl acetate must be kept strictly anhydrous.

If the crystals of guanin are boiled in amyl acetate they lose their crystalline form and become amorphous. This may be caused by loss of water of crystallization, though no mention is made in the literature of combined water and the writer has not gone into this subject.

Certain other chemical properties of guanin will be referred to in connection with methods of assaying and analysis of pearl essence.

PROCESSES OF MAKING PEARL ESSENCE

In the literature many vague references are made to the origin of pearl essence. Many books on pearls, in sections on imitations, mention the use of "ground-up fish scales." As a matter of fact, fish scales themselves do not enter directly in any way into the manufacture of pearl essence. The luster is guanin crystals, which are not found in the scales but are deposited in the epidermis of the fish, parts of which adhere to the scales when they are removed from the fish. It is this epidermis that is the source of the shiny crystals, removal of which from the scales is the first operation in the manufacture of the essence. By far the greater amount of the lustrous substance remains on the fish and is never recovered. The scales are usually collected from the fisheries and washed while still fresh. The first step is to scrub off the lustrous material from the scales. This is done in a large agitator made with a revolving member, like the old-fashioned ice cream freezer. Domestic washing machines may be used for smaller scale operations. As little water as possible is used.

The next step is to separate the lustrous sediment from the wash water. For this purpose large revolving drum centrifugals are used, in which the sediment is thrown against the inside surface of the drum. This sediment is scraped out and is ready for the manufacturing process. Here procedures begin to differ among themselves. Generally they are directed to making (a) aqueous or (b) nonaqueous pearl essence.

AQUEOUS SUSPENSIONS

The process of making pearl essence of the aqueous kind that has been in use for many years is not very complicated. The scales are obtained in as clean condition as possible and preferably from the belly side of the fish. They are then agitated or scrubbed with water, with or without ammonia, and the epidermis (a very thin membrane) is washed off and becomes suspended in the water. The ammoniated suspension is put through a strainer (not copper or brass) to remove scales and trash. The pearly and proteinaceous matter subsides when the liquid is allowed to stand in a cool place, and the supernatant water is then decanted and replaced with fresh ammoniated water. This process is repeated several times, the ammonia gradually dissolving the epidermis and leaving the crystals sufficiently clean for use. Long standing with fairly strong ammonia has a decided purifying effect.

Pearl essence prepared in this way will keep indefinitely if sufficient ammonia is present. It should be kept in bottles having glass or rubber stoppers. It contains some colloidal matter, presumably protein, and is therefore incompatible with protein coagulants, alcohol, heat, etc. Gelatin, fish glue, isinglass, etc., may be dissolved in it directly. Another preservative for the aqueous suspension is 0.3 per cent salicylic acid dissolved in the water. If traces of iron are present (as they often are) the suspension will be pinkish.

NONAQUEOUS SUSPENSIONS AND LACQUERS

Pearl essence may be found on the market in the form of suspensions in acetone and amyl acetate. It is also sold in the form of a thick paste as crystals suspended in a viscous lacquer of celluloid in amyl acetate. Other liquid vehicles may be used. The writer has made suspensions in ethyl acetate (which evaporates more rapidly than amyl acetate), acetic aldehyde, glacial acetic acid, acetic anhydride, chloroform, carbon tetrachlorides, etc.

Methods of manufacture of these preparations are mostly trade secrets, and some steps in them are covered by patents.[6] One such patent (Paisseau, No. 978394) covers the progressive dehydration of the aqueous suspension by replacement with a nonaqueous liquid that is miscible in all proportions with water, such as alcohol or acetone, or in limited proportions, such as ether. The same patent also claims the transfer of the particles to amyl acetate by addition of the latter liquid to the aqueous suspension and boiling off the water, which has a lower boiling point than that of amyl acetate. Once the particles are in amyl acetate, they may be concentrated by sedimentation or centrifugation and celluloid added to produce the viscous paste preparation. One such preparation examined by the writer contained about 13.5 per cent each, by weight, of celluloid and guanin particles, and 73 per cent amyl acetate. Pearl essence suspensions intended to be used for celluloid lacquers or celluloid plastics should be free from all traces of ammonia, which, if present, will cause the celluloid to turn yellow.

A method of preparing pearl essence in nonaqueous suspension, devised by the author of this paper, depends on the property of guanin particles of being wetted by certain liquids, like ether, more readily than by water. If ether is emulsified with a suspension of pure guanin particles in water, and the two liquids are allowed to separate, the guanin particles will be found in the ether layer above the water. Other matter present will remain in the water layer. Not only ether, but other liquids of the fat-solvent class, such as chloroform, benzol, carbon tetrachloride, toluene, etc., have this same property of driving water from the surfaces of the crystals, thus separating them by a kind of flotation from the impurities with which they are associated in the crude washings from the scales.

The principle involved in this flotation is an interesting and important one in both physical and industrial chemistry. Metallic

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[6] J. Paisseau. Composition for use in the manufacture of artificial pearls. United States patent No. 978394, Dec. 13, 1910.
J. Paisseau. Manufacturing of artificial pearls and other nacreous objects. United States patent No. 1438395.
G. Keil and K. Plischke. Verfahren zur Herstellung von Silbertinktur. German patent No. 215672, Oct. 30, 1909.
G. Leroy and Cie. Perfectionnement à la fabrication des perles fausses. French patent No. 473662, Oct. 8, 1914; also additions Nos. 19477, 19522, and 20258.
For a list of German patents see Von Unruh, 1918.

compounds are now separated with great efficiency from low-grade ores by flotation with oil. Examples of this selective wetting are given by Bancroft (1921), who discusses this subject briefly as a case of selective adsorption of liquids by solids, citing several references. For example, kerosene will displace water in contact with metals, but water will displace kerosene from quartz. Alcohol will displace oil in contact with metal, but linseed oil will displace water from white lead. Chloroform appears to be more efficient than ether in removing the crystals, but it and carbon tetrachloride are of such high density that the later separation of the crystals by sedimentation or centrifugation is slow.

Before this flotation will take place, however, all the protein must be removed from the surfaces of the crystals. This is accomplished as follows: The crude sediment from the scales is washed thoroughly with several changes of fresh water, which is decanted off after sedimentation each time, to remove blood and other matter. To each liter of the concentrated sediment from the scale washings are added 30 cubic centimeters glacial acetic acid, or its equivalent, and 2.5 grams scale pepsin dissolved in water. The mixture is allowed to stand 48 hours or more at room temperature, or a shorter time at a higher temperature, not exceeding 40° C. When digestion is complete, ether is added to the digestion mixture, emulsified, and then caused to separate by a gentle rocking of the container. The crystals of guanin pass into the ether, leaving foreign matter in the water. As much water as possible is removed by sedimentation in the different steps of the process. The ether causes all the undissolved organic matter to rise in the water and collect immediately under the ether layer. The water should be drawn off from below—in fact, it is important to eliminate as much water as possible at every stage.

The ether also dissolves a considerable quantity of fat from the mass. The supernatant ether layer, containing the guanin particles, is decanted. It is allowed to stand until the particles settle out, is poured off and replaced by fresh, fat-free, anhydrous ether, again allowed to settle, and the process repeated until the particles are free from fat and water. They are now bright and lustrous and may be transferred by sedimentation or centrifugation to acetone or amyl acetate, concentrated, and the celluloid added to produce the viscous paste. Some dark-colored matter usually floats out with the guanin particles. If suspended in acetone, after complete dehydration with ether, the essence may be freed of this impurity by a brief sedimentation in which the dark substance settles first. The supernatant acetone, containing the clean particles, is decanted off. The ether is recovered as far as possible. Used ether, containing water and fat, is dehydrated by lumps of calcium carbide, on which the ether stands for a few hours and from which it is distilled. The thick residue remaining from the crude essence liquor also contains a considerable quantity of emulsified or dissolved ether which should be distilled and dehydrated.[7]

The particles of guanin should be neither too coarse nor too fine. The finest particles, consisting of minute fragments of crystals, appear, when separated from the coarser ones, chalky white or yellowish, while the larger crystals, such as those from the larger species of fish,

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[7] For data on the solubility of water in ether, and ether in water, see A. E. Hill, Journal of the American Chemical Society, Vol. XLV (1923), pp. 1143-1155.

give a grainy coating. For bead pearls the larger particles give too great a brilliancy, approaching metallic luster, while those too small make dull pearls. Intermediate sizes produce the more desirable soft pearly luster. Large crystals can be broken in a pebble mill with 5-millimeter glass beads. The grinding is best done in very concentrated suspension in amyl acetate, and its progress should be closely watched so as not to grind the particles too fine.

CHEMICAL EXAMINATION AND ASSAYING OF PEARL ESSENCE

There is no standardized procedure for the examination of pearl essence, nor is there any standard of concentration, covering power, or value. An experienced eye is now indispensible in judging this product. Fineness of grain, tint, luster, concentration, and, in the lacquers, viscosity must be taken into consideration. The writer has consulted the literature touching on the estimation of guanin and further, as a result of laboratory examination of numerous specimens, has arrived at certain tentative methods that are proposed for evaluating pearl essence.

QUANTITATIVE ESTIMATION OF GUANIN

Balke (1893) devised a volumetric method of estimating guanin by titrating with Fehling's solution in the presence of hydroxylamine hydrochloride. The copper compound $C_5H_5N_5OCu_2O$ is formed and the end-point is the yellow-red precipitate of hydrated copper oxide. The guanin is dissolved in alkali solution, and 1 cubic centimeter of medium concentration of hydroxylamine hydrochloride is added. The Fehling's solution is admitted slowly from a burette. The quantities found by this method were in every case too low. In a series of five determinations the average deficiency was 9.14 per cent. In 1 per cent solutions of guanin the results were only 1 per cent too low, but in more dilute solutions the results were as much as 14 per cent too low. In the case of concentrated solutions he found that the addition of sodium acetate reduces the error.

Wulff (1893) describes a method of determining guanin as a picrate. He reported that cold saturated picric-acid solution will precipitate guanin from acid or alkaline solutions as dilute as 1 : 30,000. To the neutral or alkaline solution in which the guanin is to be determined is added a cold saturated solution of picric acid. An excess of picric acid is not objectionable, provided the guanin solution does not contain too much acid, in which case some picric acid might be precipitated. The precipitation is best carried out warm, and the reaction mixture should stand 24 hours, since the precipitation proceeds slowly. The precipitate is collected on a hard, dense filter paper, thoroughly washed with a 1 per cent picric-acid solution, and drained thoroughly. The felty picrate is placed between watch glasses and dried out gradually with increasing temperature. Finally the one molecule of water of crystallization is expelled by one and one-half hours exposure in the oven at a temperature of 110° C. It now has the formula $C_5H_5N_5O.C_6H_2(NO_2)_3OH$, and is weighed and calculated as guanin.

Even though a small amount of picric acid adheres to the crystals the results are still slightly too low, perhaps because of the incomplete precipitation that Wulff ascribes to the tendency of the picrate to dissociate.

The writer tried solutions of the guanin from pearl essence in hydrochloric acid, followed by precipitation with an excess of ammonia, but the results were far too low. It may be significant that all these methods give too low results. It has already been mentioned that guanin particles adsorb foreign substances strongly. Perhaps the specimens assumed to be pure contained more impurity than was supposed, and that the real quantities of guanin were approached by the analytical methods used.

Bethe (1895) dried a drop of pearl essence on a microscope slide and stained it with a warm solution of methylene blue. The membranous and other organic tissue impurities are stained, while the crystals are not. Upon microscopic examination an estimate can be made of the degree of freedom from this class of impurity.

For practical examination of pearl essence the writer has been using the following methods:

MICROSCOPIC EXAMINATION

The information to be gained by microscopic examination of pearl essence relates to (*a*) shape and size of particles, (*b*) color of crystals, and (*c*) presence or absence of foreign matter.

If the essence is an aqueous suspension, put a small dot of it on a microscope slide with a glass rod, mix thoroughly with a drop of glycerin, and cover. If it is in an acetone or amyl acetate suspension, use tricresyl phosphate or other nonvolatile, transparent liquid of low index of refraction, miscible with the suspension liquid. Cover with cover glass.

Examine first by transmitted light with 16 and 4 millimeter objectives, with the diaphragm almost closed. Note color, if any, of the particles. Then examine by reflected light or dark field illumination. For this purpose artificial light is better than diffused daylight. Tilt the stage and arrange a desk light to illuminate the slide obliquely. Note (*a*) shape and size of crystals, (*b*) whether they are entire or fragments, and (*c*) uniformity of size of particles. A rough estimate may be made of the concentration of the essence by preparing a definite dilution (1 : 100 or 1 : 1,000) and counting the particles in the Fuchs-Rosenthal counting chamber, though the writer has found it difficult to get consistent results by this method.

Make a thin smear of the specimen on a slide and dry. Stain five minutes with an aqueous solution of methylene blue, rinse, dry, and examine. Note any stained particles of epidermis or other foreign matter, being careful to distinguish between these and spots of dye that may be occluded between the crystals. Make another stain with Sudan III, which stains fat a reddish-yellow.

PHYSICAL ANALYSIS OF THE SPECIMEN

Weigh out about 10 grams of the sample (acetone, amyl acetate, or lacquer vehicle) in a tared weighing bottle. Dry to constant weight at moderate temperature (50° for acetone, 70° C. for amyl acetate). Weigh again and record the loss of weight as volatile solvent. Dissolve in about 100 cubic centimeters of acetone and filter by suction through a tared Gooch crucible densely packed with fine asbestos (or other suction filter), repeating the filtration until the filtrate is as clear as possible. Wash the filter with more acetone. Transfer the acetone filtrate to a tared evaporating dish and evaporate at moderate temperature to constant weight. Excessive temperature must be avoided to prevent loss of any camphor from the celluloid. Weigh the celluloid and record. Ignite the crucible and weigh the ash. A further separation of the constituents of the ash may be made, if necessary, by the usual methods.

COVERING POWER

A practical test used by manufacturers is to mix the specimen under consideration with the lacquer or plastic and apply in the customary way in making pearls or nacreous celluloid sheets, and compare the results with their own standards. Since practices differ so widely, it is impossible to give any details of the methods used for these tests.

MANUFACTURE OF IMITATION PEARLS

From the historical account it was seen that the beginning of imitation pearl manufacture was made by Jaquin with solid beads coated on the exterior with pearl essence and glue (the bead itself was wax, alabaster, or glass), but because of the lack of resistance of the gluey coat of pearl essence the beads were not satisfactory. To overcome this difficulty, the early bead makers (Jaquin or his immediate successors) had recourse to hollow glass bulbs coated on the inside, as described by Beckmann. It was something like 250 years later that, on the invention of waterproof lacquers, the art returned to Jaquin's original idea of coating a solid bead on the outside in the manufacture of so-called "indestructible pearls" of the present day. However, both the hollow and solid pearls are now on the market.

HOLLOW GLASS IMITATION PEARLS

THE GLASS BULBS

The hollow glass beads for this type of pearl are of two general classes. The very cheap imitation pearls, such as those used for necklaces, usually sold in 5 and 10 cent stores, are made of molded beads. A glass tube is blown in a mold making a number of connected bulbs, which are cut apart after the glass cools. These beads on examination show mold marks and ridges on opposite sides of the bead, extending from one hole to the other. They also have extensions around the holes where they have been cut apart from their neighbors on the original molded piece. The cut edges are sharp, and the spherical parts of the beads are not close together as they are in the case of beads of better quality.

These beads are coated inside first with pearl essence and gelatin. When this coat is dry, the bead is filled with paraffin or other suitable wax. Such beads are very light and will usually float on water. They are of good but artificial-looking luster. Other ornamental objects such as pear-shaped beads for stickpins, lion's heads, and the like, blown in glass, are made by the same general method.

The better grade of hollow necklace beads are made of a specially selected soft but colorless glass tubing. The ordinary laboratory glass tubing is not satisfactory. One method of making these bulbs is to flame-seal the tube at one end and blow a bulb of the desired size and shape. A sheet metal mask is made with a hole somewhat larger than the hole desired to be made in the bead. The bead is pressed against this mask and a small pointed blast flame is directed against this hole. This will soften the glass at a very small point. A hole is blown through, and an instant in the flame is allowed for the edges of the hole to retract and become smooth. The bead is then cut away from the glass tube. The hole at the cut end may also be smoothed in the flame with the aid of the mask. Usually in beads of this class the two holes are unlike, the wall being thinner around the hole that was blown than around the other. Such beads, when strung into necklaces, come close together and have a good appearance.

These beads, after having been coated inside with the pearl essence mixture, are filled with wax, equal parts of paraffin and Japanese white wax being suitable. Sometimes barium sulphate is added to the wax to give more weight and whiteness, but this can be overdone.

PRODUCTION OF IRIDESCENT EFFECT

Iridescence is usually absent from imitation pearls. However, in the case of the hollow-bulb type an iridescence is sometimes imparted by a judicious treatment of the bead with hydrofluoric acid or by coating the bulb with a solution of titanium chloride and heating in the Bunsen flame. These effects are such an exaggerated and shiny iridescence that they rather impair than improve their resemblance to genuine pearls.

COATING THE HOLLOW BEADS INSIDE

The method of coating these hollow beads inside varies greatly. The classic method is to revolve the bead on a toothpick, either by hand or machine while the essence mixture is introduced through the open hole by means of a fine pipette. The bulb is revolved until the coating is uniform. The writer has made this inside coating with a gelatin solution so concentrated that it readily sets on cooling. It may be preserved with 0.3 per cent salicylic acid to prevent decomposition during the slow drying that follows. When the hot liquid is introduced into the bead the latter is revolved until a uniform coat is obtained. A small camel's-hair brush, wet with ether, is touched to the outside while the bead is still revolving. Rapid evaporation of the ether cools the bead until the gelatin sets.

Parkert (1919) describes a method of coating these beads in large quantities. He makes a quick-drying lacquer of copal lac, mastic, and acetone, into which the dried lustrous material is incorporated. The lacquer is put in a bowl that can be heated and revolved at the same time. The bulbs are placed in the vessel with the lacquer and the vessel is sealed and revolved until the lacquer has found its way into all the bulbs and little is left outside. The vessel is then opened, the speed of revolution doubled, and a small gas flame placed under it until the solvent is evaporated. The coating that adheres to the outside also is removed by working the beads around in a leather bag until they are clean.

These hollow beads have certain advantages over the "indestructible" solid ones. The outer surface is of glass and is not subject to the effects of moisture and discoloration. On the other hand, they are usually light in weight and are more readily broken then the solid ones.

SOLID OR "INDESTRUCTIBLE" IMITATION PEARLS

These beads are solid glass with the necessary holes through them and coated on the outside with a waterproof lacquer containing the lustrous material.

GLASS BEADS

The glass beads from which solid imitation pearls are made are opal—neither milk-white nor clear. The exact degree of opalescence has much to do with the appearance of the finished bead, and is varied in practice to give the desired tint, some being almost white, others being almost transparent. The material is usually glass tubing of the required degree of opalescence and of capillary bore, the size necessary for stringing.

The beads may be made in several ways. The tube is cut into lengths to give pearls the desired shape when finished. These pieces of tube are strung on small iron or copper wire (the writer has used strands of asbestos thread), and they are then held in a gas flame and rotated as they soften, until they assume the desired globular shape. They are removed from the flame and rotated until cool. If wire was used as a support, the beads are put in a bath of dilute nitric acid to dissolve out the wire. If asbestos was used, it may be punched out with a bodkin. Bonnet [8] coats a revolving metallic shaft with a refractory kaolin mixture, which is pulverulent when dry. The molten glass is applied to the revolving shaft in drops and the shaft revolved until the beads are shaped. When they are cool, the shaft is pulled out of the beads.

A more rapid method of making the beads is as follows: The glass tube of chosen caliber is cut into suitable lengths to make the beads. These pieces are tumbled in a mixture of fire clay and graphite until the holes are plugged with the mixture. They are then introduced into an iron drum containing powdered talc. This drum is slowly revolved while it is heated until the glass is soft. The pieces assume the desired globular shape during the revolving and the talc prevents them from sticking together. They are cooled while still being revolved. They are then taken out and are ready for the coating, when the refractory material is removed from the holes.

PEARL COATING

There are many variations in the coating process which this paper will not attempt to describe exhaustively. Most of them are trade secrets, and some are covered by patents.

[8] L. Bonnet, United States patent 1466575, Aug. 28, 1923.

The coating lacquers may be either aqueous or nonaqueous. The ordinary water suspension preserved with ammonia or salicylic acid and thickened with gelatin or glue may be applied to the bead, and when this coat is dry a waterproof coat of collodion or other lacquer is applied to protect it from moisture. Another aqueous lacquer consists of a cupra-ammonium solution of cellulose (cotton), into which the lustrous essence is mixed. This is applied to the bead and the ammonia removed by evaporation and the copper by dilute hydrochloric acid, whereupon the coat is dried to finish the pearl.[9]

The process now in general use employs a direct incorporation of the lustrous guanin particles in collodion or cellulose nitrate or celluloid solution in amyl acetate. This is applied to the bead in from one to six or more coats, each of which is dried before the application of the next. The preparation of the amyl acetate suspension of the guanin particles was treated in the section of this paper dealing with processes of manufacture of the essence. It is necessary only to dissolve celluloid in such a suspension to make the lacquer. Where the concentrated pasty lacquer is employed, 1 pound is mixed with from 4 to 4½ gallons of a clear celluloid lacquer containing about 20 per cent celluloid. The beads receive from four to six coats of this. Cellulose acetate may have possibilities as a lacquer. It is not affected by a strong light, which turns celluloid yellowish, it is not inflammable, and is generally quite resistent to external influences. Glacial acetic acid is a good solvent for it, but this solvent is too irritating to the operator and evaporates too slowly for convenient use.

The selection of the right size grain of guanin particles is a choice of much nicety. Too coarse particles are grainy; slightly finer particles produce too much brilliancy, approaching metallic luster; too fine particles are dull or chalky. The finest orient is given by a moderately fine grain, but since the purchasers' choice varies, all degrees of brilliancy are to be found on the market.

Various dyes are also used to tint the lacquers. Safranin or eosin produce a pink, Sudan III in very great dilution gives a cream or oriental hue, while Victoria blue will neutralize any yellow present or give a blue tint.

The simplest dipping process is to put the bead on a toothpick and dip, revolving until the coat fails to run, and then dry. This method is expedited by fixing many toothpicks in a block with fine holes to receive them, and dipping many at a time. Mechanical devices are also in use for dipping automatically. The room in which the dipping is done should be free from dust, and in the larger factories air conditions are controlled to reduce humidity and remove dust.

ROMAN PEARLS

Another class of imitation pearl is made by covering the glass bead with the air-bladder membrane from certain fishes. This membrane or bladder is a colorless tissue composed of a gelatinlike substance, and in many species of fish contains a brilliant natural deposit of the guanin crystals. The air bladder of *Argentina sphyræna* is used in the manufacture of "Roman" pearls.

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[9] G. Leroy et Cie. French patent 473662, Oct. 8, 1914, additions 19477, 19522, and 20258; also Paisseau, French patent 420885, Dec. 6, 1909.

Pearls are made in a similar manner by the Chinese, who use a wax bead instead of a glass bead.

A story is related of a Roman lady who felt highly complimented when an Italian nobleman referred to her as a Roman pearl. Her appreciation of this term gave way to indignation when she learned that the Roman pearl was an out-and-out imitation.

IMITATION MOTHER-OF PEARL CELLULOID PLASTICS

Sheet celluloid containing guanin particles to imitate mother-of-pearl for the manufacture of mirror backs, manicure and toilet sets, ladies' fancy canes, opera-glass handles, etc., is now coming into prominence.

The amyl acetate-celluloid lacquer is brushed or sprayed on glass or polished metallic surface and a grain is worked into it by means of a straightedge, painter's graining tool, or other instrument. Thick sheets so made are split with cutting machines. Thin sheets are made directly on the glass without splitting. The finished sheets are polished under pressure against polished nickel sheets. The pearly celluloid sheets are cemented to a white backing sheet, and this in turn to amber, or not, as desired.[10]

DETECTION OF IMITATION PEARLS

Recognition of a genuine or imitation pearl is somewhat like recognition of a person—a matter of familiarity. Those who are at all familiar with pearls can detect imitations at a glance. Yet there are definable differences. The genuine pearl has a specific gravity of about 2.6; its surface is usually somewhat iridescent, giving a faint play of colors; its surface does not give a sharp and well-defined reflection of such things as window bars; the hole is obviously drilled; the genuine pearl can be scratched by a sharp knife; it is opaque. It is not affected by acetone or amyl acetate but is readily attacked by acids.

The hollow glass bulb imitations are glass outside; they give a sharp reflected image of window bars; they can not be scratched except with things that will cut glass; the holes are plainly holes in glass with smooth edges, and usually one is larger than the other. They are usually light and often float on water; they have no iridescence, or else have too much; and the surface is not attacked by any acid but hydrofluoric.

The solid or "indestructible" pearl is made of opalescent glass; it is usually translucent and looks yellowish when held up to the light; it may even give an image of objects like a lens. The coating is outside and does not extend smoothly up to the very edge of the hole. Air bubbles may often be detected in the glass. The coating is celluloid and can be cut or peeled off, and is inflammable; it can be dissolved off with amyl acetate or acetone. If a pearl suspected to be this type of imitation, but claimed to be genuine, is immersed for a minute or two in acetone, the genuine will not be damaged but the coating will dissolve off from the imitation.

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[10] For review of literature and bibliography of imitation mother-of-pearl, see Von Unruh, 1918a.

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PROGRESS IN BIOLOGICAL INQUIRIES, JULY 1 TO DECEMBER 31, 1924[1]

By Willis H. Rich, *Assistant in Charge of Scientific Inquiry*

CONTENTS

INTRODUCTION

Because of the fact that almost all of the scientific investigations undertaken by the Bureau of Fisheries are conducted during the summer months, so that th y are begun before the end of one fiscal year and are concluded some time during the next succeeding fiscal year, it has been decided to change the plan of issuing annual reports on such investigations so that an entire season's work may be

[1] Appendix III to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. No. 990.

covered in a single report. This new plan has been followed in the present document, which covers investigational work in progress from July 1 to December 31, 1924.

Organization of the division's work along the lines suggested in the report for the fiscal year 1924 has been continued and may now be considered as fairly complete. Emphasis has been placed upon the development of a system of what may be termed major researches, with a thoroughly competent investigator in direct charge of each investigation and assisted by one or more of the younger and less experienced men on the staff. The men in charge of these units are practically independent of any immediate direction by the administrative head of the division and are held directly responsible for the success of the work with which they are concerned. The results obtained since the establishment of this system have been most encouraging.

In the following report the predominating part taken by studies of the life histories of our important food fishes is apparent. These life-history studies provide such fundamental data as the rate of growth, age at maturity, time and manner of spawning, habits of the young, feeding habits of both young and old, extent and direction of migrations, extent to which various groups of fish mingle particularly with respect to their interbreeding, and the enemies or other elements in their environment which tend to reduce the abundance of those fish and other forms from which we obtain our fishery products.

One of the most important aims of the student of life histories is to determine the relative success of each breeding season and the factors that determine success or failure. In order to achieve this it is important to make age determinations for a sufficient number of individuals each year so that reliable figures may be obtained. In forms for which age determinations can not be made the methods used to determine the degree of success in breeding in different years are more difficult and frequently involve extremely complicated procedures. Such researches as these must be conducted over a long series of years if reliable results are to be obtained. In fact, in many cases it may be necessary to continue indefinitely such a yearly census of the age groups represented in a given population.

These life-history studies are not only of prime importance in the conservation of biological resources but also have a real though perhaps not generally recognized place in the biological sciences. We are studying *species* as a unit, with the idea always in mind of determining the factors that adapt the species to its environment and which make for its continued existence. None of the other biological sciences is primarily concerned with this particular problem. Most of them consider the *individual* as the unit and discuss its structure, physiology, development, classification, etc. The geneticist is concerned in part with a consideration of species as a unit, but from the standpoint of its origin rather than of its maintenance. The very broad science of ecology may possibly be considered to treat of species as units, but as at present developed ecology is so loosely organized and so broadly inclusive a branch of biology that it is difficult to set its boundaries. Perhaps these life-history studies may properly be considered as a specialized and fairly closely circumscribed part of ecology which deals primarily with the factors, both inherent and environmental, affecting the abundance of individuals of a given species.

Properly considered, these studies are as purely scientific and bear as directly upon the larger problems of biology as do other biological sciences, even including genetics. Is it not as important to know how a species is maintained as to know how it arises? Is it not as important to know how a species is adjusted to its environment and how it responds and adapts itself to changes in its environment as to know these same things for the individual? The adaptive processes in the individual are, of course, bound up with the adaptation of the species and the survival of the individual with the survival of the species. The two are inevitably closely associated, but there is something more involved in the survival of a species than in the survival of an individual. This may seem paradoxical but it is obviously true, since species are maintained over long periods of time, whereas the individuals composing the species are continually changing—new individuals coming in, existing for a relatively short period of time, and then dying. In a sense, the species is an individual and has an existence of its own, a growth and survival of its own quite apart from the existence, growth, and survival of the individuals which at any time may compose it. It has periods of stress when its survival is precarious and which may end in its extermination. Naturally the same factors which result in the extermination of a species result in the death of the individuals composing the species, but it is with the larger aspects of the problems of adaptation and survival, those dealing with the species as a unit, that life-history studies are concerned.

The condition of a species, whether young and growing healthily, old and characterized by senility, well or poorly adapted to its environment, may be measured by the abundance of individuals; and in any given form the fluctuations in abundance are indicative of the success or failure of the species as a whole to adapt itself to the various changes in its environment. From this point of view life-history studies, which in the end are primarily concerned with discovering the causes of fluctuations in abundance, can be fully justified as essays in pure science and have a distinct place in the biological sciences quite apart from any economic use to which the resultant information may be put. It happens, however, that it is exactly this sort of information that is essential to the scientific conservation and development of biological resources—in this instance our aquatic resources.

The foregoing is not to be interpreted as in any sense an apology for the prominent place taken by life-history studies in the work of the division. It is, rather, an explanation of the nature of the investigations and of the attitude of those directly concerned—an explanation for the benefit of those scientists who incline to the view that no investigation undertaken primarily for economic reasons can possibly be of scientific value.

The following pages contain brief accounts of the accomplishments in the various researches during the half year July 1 to December 31, 1924. In general, the accounts as given were prepared by the investigators in direct charge.

INVESTIGATIONS OF FISH AND FISHERIES

ATLANTIC COAST

LIFE HISTORIES AND MIGRATIONS OF COD, POLLOCK, AND HADDOCK

An investigation of the early development of cod, pollock, and haddock off the New England coast, begun on May 1, 1924, by Dr. Charles J. Fish, was continued throughout the past year. The problem—an exhaustive study of conditions existing during the period of incubation of the eggs, the early larval history, the food during this period, the enemies, and the gradual changes in the feeding habits and migrations during the first year of existence—has been divided into two parts. The first part covers the period of the pelagic existence of the young, and consists of hydrographic and plankton surveys of the breeding grounds. The determination of the exact location of the spawning centers, the period of spawning, and the relative production and distribution of eggs form an essential part of this work. An investigation of the migrations, feeding habits, and enemies of the young fish after they leave the surface waters and enter the shallow shore zone forms the second part and necessitates seining and trawling over extensive areas along the shore.

In order not to delay the work, the second part of the problem was begun first, and throughout the summer of 1924 the steamers *Gannet* and *Phalarope* were utilized in a survey of the coast from Mount Desert, Me., to Woods Hole, Mass. During August and September the *Gannet* covered 1,545 miles and towed the Petersen young-fish trawl over 1,100 miles.

As the lack of an adequate ship prevented a survey of the outer banks, Massachusetts Bay was selected as the most suitable area in which to begin observations on the early life history of the cod. The *Fish Hawk* was assigned to this work in November, when the fall spawing season began. Cruises were made covering the inshore breeding grounds of the bay south of Cape Ann. The Plymouth grounds were found to be by far the most important cod-spawning area in the bay, while pollock eggs were found in the greatest numbers in the region of Stellwagen Bank.

The steamer *Gannet* was occupied in similar observations in the Gulf of Maine, concentrating particularly on the region about Sheepscot Bay, where each year at the height of the spawning season great quantities of fresh water pour out from the rivers over one of the most important spawning areas of the coast. What effect this influx of low-density water has upon the eggs is as yet unknown.

As the work has just begun any conclusions made at this time must necessarily be of a very general nature. However, some very significant and interesting results have been obtained. Upon reaching the post-larval stage the cod and pollock seek shallow water, and in April and May are taken, often in large numbers, along the shores. The smallest specimens of both species taken with the seine were found to be feeding almost entirely on Harpactid copepods, probably most nearly like the free-swimming copepods of the surface waters. Later they were taken filled with mysids, amphipods, and in fact almost all of the small crustaceans living in the littoral zone. As the temperature rises in June they leave the shallow water and seek deeper levels. By August 1 of the past year this zone was entirely vacated as far north as Boothbay, Me. During that month and September more than 50 seine hauls, extending from Mount Desert to Provincetown, yielded but three cod, although scattering pollock were often taken. Just where the young cod go after entering the deep waters has not yet been determined. Hauls made over the whole area with the Petersen trawl at all levels did not yield a single cod, although three small haddock were taken at 30 meters. Haddock apparently never enter the shore zone, remaining always in the deeper waters.

Doctor Fish is being assisted in Massachusetts Bay by Robert A. Goffin and Richard Parmenter, and in the Gulf of Maine by Capt. George Greenleaf, master of the *Gannet*. Marie D. P. Fish also is aiding in the identification of the larval fish.

A report on the plankton taken on a three weeks' cruise off Newfoundland in June, 1924, and a report on a hydrographical and plankton section extending from Gay Head to the Gulf Stream, made on the *Halcyon* in August, 1924, will be completed during the summer of 1925.

This investigation of the early history of the cod is designed to supplement and complete the study of the adults, which has been under way for the past two years. The study of the adults includes extensive tagging experiments testing the migrations and growth and scale examinations. The work has been conducted by William C. Schroeder, with the advice and aid of Dr. Henry B. Bigelow of Harvard University. Doctor Bigelow's interest has done much to make the investigations a success.

The tagging operations connected with this investigation were brought to a close for the calendar year when the *Halcyon* completed her final cruise on October 28. During 1923 operations extended from April 17 to October 17, and during 1924 from July 12 to October 28. The progress of the investigation from its beginning in April, 1923, until November 24, 1923, may be summarized as follows:

	1923	1924		1923	1924
Number of cruises	7	9	Total number of fish tagged	10,244	10,348
Days of actual fishing	43	51	Average number of fish tagged per day	238	203
Hours of actual fishing	333	318.5	Average number of fish tagged per hour	30.76	32.5
Number of cod tagged	7,618	6,209			
Number of pollock tagged	2,215	916			
Number of haddock tagged	411	3,223			

During 1923 about 98 per cent of the fish were tagged on Nantucket Shoals in the general region of Great Round Shoal whistling buoy. The remaining 2 per cent were tagged off No Man's Land, Pollock Rip, Chatham, and on Stellwagen Bank.

Operations during 1924 were more extended, and a large part of the fish was tagged off the coast of Maine. The catch was divided as follows: Nantucket Shoals, 4,384 fish; Massachusetts, north of Cape Cod, 163; New Hampshire, 8; Maine, 5,793.

The number of recaptured tagged fish recorded up to November 24, 1924, is 457, segregated as follows:

Tagged in 1923, recaptured in 1923 by fishermen	128
Tagged in 1923, recaptured in 1923 by the *Halcyon*	43
Tagged in 1923, recaptured in 1924 by fishermen	86
Tagged in 1923, recaptured in 1924 by the *Halcyon*	39
Tagged in 1924, recaptured in 1924 by fishermen	119
Tagged in 1924, recaptured in 1924 by the *Halcyon*	102
	517

There are now eight instances of tagged fish being recaptured twice, all of them codfish. In each case the *Halcyon* made the first recapture, liberating the fish after obtaining the record. Three of the second recaptures were made by the *Halcyon* and five by fishermen. Six of these fish were taken each time in the locality where tagged, while two had migrated from Nantucket Shoals to Rockaway, N. Y.

Although no pollock are included in the preceding lot, pollock No. 16418 holds the unique record of having been recaptured three times, each time by the *Halcyon* at Great Round Shoal whistling buoy, Nantucket Shoals, Mass. The record of this fish follows: Tagged October 15, 1923, length 22½ inches; recaptured July 16, 1924, length 23 inches; recaptured September 11, 1924, length 23½ inches; recaptured October 26, 1924, length 23½ inches.

Platts Bank, also called New Ledge, lies more than 30 miles from the nearest land, off Portland, Me., has a depth of 29 to about 50 fathoms and an area of about 35 square miles. Of 174 cod tagged in this locality the latter part of July, 1924, the *Halcyon* recaptured 3 on August 15, although only 48 cod were caught on that date. This instance was considered remarkable, but subsequent records have proved even more so. A total of 218 cod was tagged on Platts Bank last summer, and 22 have been recaptured by Portland fishermen. Of these 22 fish, 2 were included in the 3 fish recaptured by the *Halcyon* on August 15, being, therefore, second recaptures.

The scales of more than 10,000 cod, pollock, and haddock were taken during this period for use in a study of age. It has been determined that one of the most important parts of the cod scale is that which registers the first year's growth, for from this it may be possible to tell whether a fish was hatched in the fall, midwinter, or spring. A careful study of this kind might reveal whether schools of cod remain together during a large part of their lives, whether a fishing ground is populated with cod hatched during various seasons (and therefore probably originating from various localities), or whether the opposite might prevail. A careful study of the cod scale indicates that a large amount of important data might be obtained from this source. The possibilities here are very promising indeed. The pollock scale and the haddock scale, too, are very satisfactory as a means for age determination. During 1924 an excellent series of scales was obtained from each of these species.

The results of the North Atlantic fish-tagging operations during the past two years have been so satisfactory that tagging will be resumed in 1925. Considerable information already has been obtained on age, rate of growth, and migration of these important food fishes.

The outstanding results of the fish tagging to December, 1924, are as follows:

1. A definite and apparently extensive migration of cod from the region of Nantucket Shoals, Mass., to the shores of Rhode Island, Long Island, New Jersey, and possibly farther south, occurring late in the fall.

2. Many of the cod migrating to the south and west return to Nantucket Shoals the following spring.

3. The cod on Nantucket Shoals do not scatter to various feeding grounds during the summer, but appear to remain together from spring to fall; they were found to be very much localized, not only here but in various localities along the Maine coast. Not only do cod remain together in a general way, but small shoals of fish have been found to remain close together for months at a time (June to October) and to have moved not more than one-quarter mile from where they were tagged. There are numerous records to prove this.

4. Not many cod migrate from Nantucket Shoals to South Channel and very few go to Georges Bank from the Shoals. This result was entirely unexpected, but upon a close examination of the facts it was found that the plain, sandy bottom of South Channel is not sufficiently attractive to the cod to lure them from Nantucket Shoals, where conditions in many respects are ideal. South Channel is principally a haddock ground, although many cod are taken there.

5. The relation of water temperature to the movements of the cod is not so well understood. At the present time it is thought that the effects of temperature are not nearly as great as was supposed. Whatever the influence, it appears to be indirect. It has been fairly well determined that the water temperature (bottom) on the Cholera Bank, N. Y., is as low as or perhaps lower than that of Nantucket Shoals month for month throughout the year. Cod may be found on the Cholera Bank from November to May, with none at all during the summer, but they are found the year around on Nantucket Shoals and are particularly abundant in the summer. There is, of course, some reason why cod do not remain on the Cholera Bank throughout the year, but this reason apparently is not the temperature. Many temperature records are lacking from these two localities, but an effort will be made to obtain this information.

FISHES OF THE SOUTH ATLANTIC COAST

The investigation of the fisheries of the South Atlantic coast, which was begun late in the fiscal year 1924, has been continued by Elmer Higgins, director of the Key West (Fla.) biological station.

The shark investigations were continued at Big Pine, Fla. The object of the investigation was to study the destructiveness of sharks to commercial fisheries and to discover something concerning their biology which might have bearing upon their control should that prove desirable. A month was spent in field observations at the shark fishery of the Ocean Leather Co., and through their courtesy many data were collected bearing upon the natural history of the sharks common to that locality. Detailed descriptions of the seven species occurring in the fishery at Big Pine in summer were obtained, including many measurements of body proportions which will correct errors and omissions in current published accounts. Size variations, food habits, and breeding also were studied. Sharks are not abundant in that locality in summer, however, so the investigation was discontinued until opportunity was afforded to make observations during a winter season.

Of the seven species occurring in the summer fishery, the nurse (*Ginglymostoma cirratum*), leopard (*Galeocerdo arcticus*), and dusky sharks (*Carcharhinus commersonii*) are the most abundant. Of these the leopard is the largest and most valuable commercially, because of the size and quality of the skin when tanned, the large amount of oil produced, and the quality and whiteness of the flesh, which is dried for food. More than two-thirds of the sharks taken had empty stomachs. In the rest, sharks, turtles, and crustaceans formed the chief articles of diet. No conclusions as to the real destructiveness of sharks could be drawn, therefore, without further investigation in the winter season, when food fish are more abundant in that locality.

Upon completion of the field work at Big Pine the investigator returned to the fisheries station at Beaufort, N. C., where the data were analyzed and a preliminary report was drawn up and submitted.

Attention was then directed to the fisheries of North Carolina. A general survey of the history of the fisheries was undertaken, and a trip of inspection was made over the more important fishing grounds of the State. There are abundant indications that the more important fisheries of the State are undergoing depletion, that of the mullet (*Mugil cephalus*) being perhaps the most serious. The total catch of mullet in North Carolina, according to the bureau's figures, fell from 6,750,000 pounds in 1902 to a little more than 1,000,000 pounds in 1918, a decrease of 84 per cent in 16 years, and subsequent years have shown no tendency toward recovery. Therefore it was decided to conduct an investigation of the mullet fishery to discover if the decline in total yield is due to natural or artificial causes (such as overfishing), if the whole stock is endangered, and what measures of protection can be applied to increase the fish stock and rehabilitate the fishery. The investigation was begun early in September, 1924, and the autumn season was spent in preliminary work in making a survey of the fishery, discovering its peculiar needs, and laying a foundation for more intensive work during the following year. John C. Pearson was assigned to the investigation as assistant on November 15 and stationed at Beaufort.

The course of the fishery at Beaufort during the fall was studied by taking frequent samples of the commercial catch landed at the markets. From September 9 to November 8, the period covered by the greater part of the commercial run, 11 samples were taken, comprising about 400 specimens. These specimens were carefully measured and otherwise observed, and records and biological material thus collected were preserved for later analysis. The size composition of the catch was studied by tabulating the length measurements and constructing frequency curves. It appears that the range in size of the mullet landed in Beaufort is from 159 to 509 millimeters body length (7.7 to 24.3 inches total length). The minimum legal limit is 8 inches total length. There are two distinct groups within this range—small fish from 15 to 23 centimeters (6 to 9 inches) body length and medium and large from 25 to 44 centimeters (9.8 to 13 inches) body length. By far the greater number of fish range around 28 centimeters (11 inches) body length (11.7 inches total length). The sampling of the catch of the past season is inadequate to give the relative abundance of each size class in the fish stock, and therefore more complete sampling must be made next year.

The analysis of the season's run for age composition has been undertaken. Scales from each fish collected have been preserved and many have already been prepared and mounted for microscopic examination, by which the age of each individual is determined.

The question of the interdependence of different fishing areas, and hence the chance of success of measures of conservation applied in one State or another, has been attacked by studying the racial composition of the fish stock of North Carolina and Florida. About 5,000 measurements of the physical proportions of the mullet from the former locality and about 5,500 measurements from the latter have been made and the results partly analyzed. It is commonly believed by both naturalists and fishermen that the mullet migrate annually from the sounds of North Carolina southward along the coast into Florida waters and, some say, into the Gulf of Mexico, but a preliminary analysis of the data on racial composition indicates that the stock of mullet supplying the commercial fishery in North Carolina is entirely distinct from that of Florida, hence these theories of intermigration between the two localities are false. The data further indicate the possible existence of two distinct races entering the fishery in North Carolina, and several along the Florida coast.

Other data have been collected from the season's observations and await analysis. The advance of sexual maturity has been recorded and materials for the study of spawning and egg production have been collected. Samples of the roe were taken at frequent intervals throughout the fall and were preserved for microscopic study. Records of the localities of the catches were kept for a study of the distribution and movement of schools. Records of the daily receipts of mullet by all the dealers in Carteret County also were collected as a basis for the study of the movements of the fish and factors influencing migration.

No survey covering the fishing season for mullet was undertaken in Florida, but a brief inquiry was made on the occurrence of spawning on the east and west coasts and the question of local races also was considered. Nine samples of the commercial catch (607 specimens) were taken. The data are unavoidably inadequate to settle the questions, but in some cases are sufficient to warrant tentative conclusions until verified or corrected by next season's observations. They may be summarized as follows:

Sizes.—On the east coast (Jacksonville, Fort Pierce, and Miami) samples were taken having a typical size of 15.7 inches total length. On the west coast (Pensacola and Apalachicola) the typical length was 12.3 inches, while on the southwest coast (Punta Gorda) a single sample had the typical length of 19.7 inches.

Size at maturity.—On the west coast all fish under about 9 inches total length are immature as late as December 2, and probably do not spawn until the following year. Practically all other fish observed had spawned or were in spawning condition.

Spawning period.—Neither the exact beginning nor, of course, the end of the spawning season was observed, but all the data indicated that spawning on both coasts is well under way by the middle of November.

Racial localization.—While such evidence as differences in size and apparent rates of growth, apparent sizes at first maturity, etc., indicate, from a preliminary examination, race differences in different localities; the evidence from differences in physical proportion is not as clear as in the case of the North Carolina fish. It is hoped that future observations will make possible the final solution of this important problem.

During 1925 it is hoped, on the basis of the experience of the present year's studies, to continue and extend the investigation of the mullet fishery along the coasts of all the South Atlantic States. A vigorous continuance of the studies already begun should yield results of the utmost practical value in the conservation of this important fishery.

SALMONIDÆ AND SMELTS

The investigation of the salmon and smelt was continued by Dr. W. C. Kendall. During the period covered by this report the investigator was occupied principally with a continuation of his observation upon the Salmonidæ and the preparation of a manuscript concerning the Atlantic smelt and smelt fisheries. In addition to his regular work he was called upon to decide questions as to the identification of salmonids and other problems pertaining to those fishes submitted by persons in various parts of the United States as well as from foreign countries, notably New Zealand, Greenland, and Canada.

A specimen of Atlantic salmon was received from Dr. Morton P. Porsild, director of the Danish biological station at Disko Island, Greenland, an account of which was published in the Fisheries Service Bulletin for October 1, 1924.

A small collection of fishes, principally chars, and some invertebrates were brought back from Greenland by Donald B. MacMillan on his last expedition. The chars were retained by Doctor Kendall for study and the balance of the material was transmitted to the United States National Museum.

Considerable progress was made in the determination of the ages of brook trout by a study of the scales. It was found that a large trout is not necessarily an old one nor a small trout necessarily young. It is believed that the results of this study, which has not previously been undertaken, will prove of value in trout culture.

In the late fall about a week was spent in studying the spawning habits of trout in tributaries of Cranberry Lake, N. Y., in cooperation with the Roosevelt Wild Life Forest Experiment Station and the State Conservation Commission.

LARVAL FISHES

This work has been continued by Marie D. P. Fish, and has been extended to include the study of larval fishes taken in other regions than Woods Hole. Previous investigations along this line have been practically confined to the Woods Hole region. Valuable material and data have been received in connection with the study of the early history of the cod, pollock, and haddock, mentioned above. Other data have been secured in the region about Woods Hole as a result of the collections made during the past summer with seines and young-fish trawls. The general nature of this work was outlined in the report of the division for the fiscal year 1924.

TROPICAL FISHES OF THE WOODS HOLE REGION

In June, 1924, a study of the tropical and subtropical fishes that visit the shores of New England in summer, often in considerable numbers, was begun by Marie D. P. Fish. The materials were obtained from the following sources:

1. A series of collections made at Katama Bay on the seaward side of Marthas Vineyard in 1924. The collecting was done by means of a 150-foot shore seine and a Petersen young-fish trawl towed through the Zostera zone lining the shore.
2. All previous collections and records from the Woods Hole region, including those at the station and those in the National Museum.
3. All tropical fishes taken in the surface collections along the Atlantic coast by the *Albatross*, *Grampus*, *Fish Hawk*, and *Bache*.

The influence of temperature and winds upon the local appearance of southern forms has been most strikingly demonstrated during the past three years. In the summer and fall of 1922, when the temperature ranged below normal and southerly winds did not prevail, seinings in Katama Bay and elsewhere about Woods Hole yielded no small tropical or subtropical fishes. A few large specimens, however, were caught in the fish traps in the vicinity—wanderers hardy enough to have withstood the drop in temperature as they made their way into the colder waters. In 1923 conditions were similar. With the exception of a few large sharks and rays and a number of ladyfish (*Albula vulpes*) on October 22, no southern ranging fishes were found. No Sargassum weed was to be seen anywhere about. During the past summer, however, the search for these stragglers from the Gulf Stream was well rewarded. Between the middle of July and the end of October, 13 species of fishes having a distinctly southern range were seined in Katama Bay, 4 of them in abundance. For the first time in the history of local fisheries the yellow crevalle (*Carangus crysos*) was so abundant in the traps of Buzzards Bay and Vineyard Sound that several barrels of them were shipped to the Boston market. Two specimens of *Carangus latus*, a crevalle never before recorded north of Virginia and which is most common about the West Indies, were seined in Katama Bay on September 9 and 12. The absence of young southern fishes at Woods Hole in 1922 and 1923 and their abundance in 1924 apparently were due to the much higher temperature existing during the past year as well as to the great predominance of southwest winds. *Mnemiopsis leidyi*, reliable indicator of a drift from the south, was everywhere abundant in local waters throughout August and September, 1924, but did not appear during the two previous years.

All records seem to show that the date of appearance of the tropical and subtropical fish is dependent upon the temperature of the coastal waters. They must await a rise in temperature in the surface waters over the continental shelf in order that they may lose the boundaries of the Gulf Stream and follow the Sargassum as it is blown into the area outside. No doubt the immediate waters about Woods Hole are prepared to receive the visitors long before the outer waters permit their passage through. For that reason, although approximately 12.5° C. may be taken as their minimum temperature for existence in local waters, the date when the inshore waters rise to 12.5° C. far precedes the same rise in surface water off the coast and also the actual arrival of the first summer forms. In the fall, however, reverse conditions exist. The date when the surface water locally reaches the minimum temperature for these forms is then of great importance, because this drop directly affects those which are already here and they disappear at once. During 1924 the first summer visitors appeared on July 12 and the last on October 22. The complete absence of southern fish after that date would seem to be a result of a sudden drop in temperature that occurred on October 20, when the temperature of the air fell 16 degrees overnight and a really cold spell set in. A trip was made to Katama Bay on November 7, when the surface temperature was 12.5° C., but diligent seining brought in nothing except young cunners, tautog, sculpins, winter flounders, and other typically resident fauna.

To date 92 truly tropical species, which are undoubtedly mere "accidents" of the Gulf Stream, and 70 species with a predominantly southern range, whose northern limit of migration is Woods Hole, have been taken in local waters. A general account of their appearance, distribution, and disappearance in this region, together with descriptions and illustrations of the various tropical species, is nearly complete.

CHESAPEAKE BAY

The work of preparing for publication the data bearing on the fish and fisheries of Chesapeake Bay, which were secured in connection with the hydrographic and biological survey of this region undertaken several years ago, has gone forward. The work has been delayed frequently, owing to the more pressing need of other investigations, but satisfactory progress can be reported. This work has been carried out under the direction of Samuel F. Hildebrand aided by William C. Schroeder and Isaac Ginsburg.

NORTH AMERICAN COMMITTEE ON FISHERY INVESTIGATIONS

Only one meeting of the committee was held during the period covered by this report. This occurred at Montreal, Canada, on November 7 and was attended by W. A. Found and Dr. A. G. Huntsman, representatives for Canada, and Henry O'Malley, Dr. H. B. Bigelow, and Dr. W. H. Rich, representatives for the United States. No change in the personnel of the committee has taken place since the last report.

Oceanographic work and cod-tagging operations received particular attention, and plans were made for an extension of both of these lines of investigation. Further steps were taken to coordinate more closely the collection and publication of fishery statistics for the various countries interested in the great bank fisheries of the western North Atlantic, and as a part of this program it was suggested and agreed upon by both the Canadian and the United States representatives that definite plans be laid for systematic fish measuring, such as has been conducted by various European countries for a number of years. This systematic sampling of the commercial catch has proved to be of great value in the investigations of the fisheries of the eastern North Atlantic and North Sea, and it is believed that similar work on the American side of the Atlantic would prove equally valuable.

Other matters discussed were the need for investigation of the mackerel and halibut fisheries and the collection of water temperatures at various points along the entire Atlantic coast.

INTERIOR WATERS

COREGONINÆ OF THE GREAT LAKES

With regard to the investigation of the systematic relations and ecology of the whitefishes and related species of the Great Lakes Basin that is being made by Dr. Walter Koelz and John Van Oosten, the first draft of the account of all the species of Leucichthys and the one species of Prosopium in that region was finished during the latter half of 1924. There remain the consideration of coregonus and the unifying of the various accounts before the manuscript will be ready for publication. Valuable observations on the Coregonine fishes were made also in several inland lakes of Marquette County, Mich.

Studies were made of the life history of the Lake Huron whitefish (*Coregonus clupeaformis*), as found at Alpena, Mich. Many data were obtained from the analysis of the scales, including rates of growth, age composition of commercial catches, year of sexual maturity, etc.

The analyzed data of whitefish captured in July, 1923, revealed some interesting facts hitherto unknown. The samples indicate that in summer 70 per cent of the commercial catches of whitefish at Alpena consist principally of fish in their fifth year. The youngest fish taken were in their fourth year, the oldest in their eighth. Those in their fourth year averaged 401 millimeters (15.8 inches) in length and those in their eighth year 517 millimeters (20.4 inches), the increase during each of the intervening years being about 1 inch in the length of each fish. The data also definitely indicate that the opinion generally held by the hatchery employees and others relative to the age at which whitefish first become sexually mature is erroneous. Whitefish reared under artificial conditions may become sexually mature in 3 years but those grown in Lake Huron certainly do not. No sexually mature fish under five years of age has been taken by the investigators. Of the female whitefish in their fifth year taken in 1923, 33 per cent were mature while 67 per cent were still sexually immature. It is not until the sixth year that the majority (74 per cent) become mature.

Another result having important bearing on the problem of conservation is that 55 per cent of the females of these summer samples were sexually immature while only 45 per cent were mature. This was the case in spite of the fact that none of the fish were below the legal weight limit (1½ pounds in the round).

There is some evidence, however, that the commercial catches of the fall are differently constituted, being composed almost entirely of breeding fish and presumably, therefore, of larger and older individuals. To obtain additional material from these spawning schools some time was spent in the field at Alpena. These data are now being studied.

In addition to the whitefish study the herring run in the fall of 1924 in Saginaw Bay was investigated. Abundant scale material and other data were collected each day during the entire herring run until ice conditions made fishing impossible, but they have not yet been carefully analyzed.

PACIFIC COAST AND ALASKA

ALASKA SALMON

As before, these investigations have been conducted under the direction of Dr. C. H. Gilbert, of Stanford University. The summer of 1924 was spent principally in investigating the run of red salmon to the Karluk River on Kodiak Island. Enough specimens were taken at random from the daily catch to afford a fair sample, and by means of their scale structure these were classified with respect to their total age and as to the length of their early sojourn as fingerlings in fresh water.

The Karluk has been selected as a favorable stream in which to investigate the efficiency of natural propagation and in particular what constitutes a reasonable expectation for future runs based on a known volume of spawning fish. In order to ascertain the number of spawners the bureau has each year since 1921 maintained a weir or rack constructed entirely across the Karluk River, near its mouth, and provided with a number of narrow openings through which the ascending fish must pass and where they can be enumerated.

The size of the runs in successive years has varied widely and the escapement tallied through the weir has varied proportionately from about 1,330,000 spawners in 1921 to approximately 300,000 in 1922. Such widely differing brood years should produce equally differing results when their progeny reach maturity, unless other factors interfere. This is a matter that has never been investigated, and it is hoped to secure results of scientific and practical value from the Karluk experiment.

It is the bureau's plan to ascertain the total returns from the various spawnings by enumerating the progeny of each year when they return as mature fish. This could be easily accomplished if all individuals matured at the same age, but this is far from the case. In the Karluk race, as we ascertained during the season of 1924, some individuals mature in their third year while others mature in the fourth, fifth, sixth, or seventh year. The progeny of the 1921 spawning are therefore to be looked for in the runs of a number of successive years. The 3-year-olds would make their appearance in 1924, the 4-year fish in 1925, and so on until 1928, when the last of the brood would mature at the age of 7 years. To ascertain the total returns from the 1,330,000 spawners in 1921 it is obvious, therefore, that the runs of each of the years from 1924 to 1928 must be analyzed and the numbers of fish of each age determined. Our analysis of the run of 1924 during the past season represents the first of this series. To trace the complete history and fate of the Karluk broods already tallied at the weir will require an analysis of the runs from 1924 to 1932.

SALMON OF THE PACIFIC COAST STATES

During the fishing season on the Columbia River attention was given mainly to the collection of data regarding returns from salmon-marking experiments. Records of the capture of fourteen 5-year-old fish that had been marked at the Little White Salmon River station of the Bureau of Fisheries were reported from the commercial fishery, and eight were taken during the egg-taking operations of the hatchery from which the fingerlings were liberated. Twenty fish from this marking were taken during the 1923 season when they were in their fourth year, and a few more may be expected to return during the 1925 season. These records, though few in number, are of considerable interest from the standpoint of scale study, as they supply evidence which corroborates that from other sources in assigning the proper significance to certain troublesome types of scale nuclei.

Sockeye salmon from the brood of 1920, which were introduced from Alaska and marked and liberated at the Herman Creek station of the Oregon Fish Commission during the fall of 1921, were expected to return during the 1924 season in their fourth year, but none were reported from the commercial fishery and none entered Herman Creek. These fish may mature as 5-year-olds and return to spawn during the 1925 season, but judging from the returns from former marking experiments and our general knowledge of sockeye salmon, few if any returns are now expected. The apparent failure of the fish from this experiment to survive to maturity and the quite satisfactory returns from two experiments in which the young fish were liberated during the spring of their second year seem to indicate that success in the artificial propagation of sockeyes is achieved only when the fish are held until the spring of their second year or are provided with conditions favorable to their residence in fresh water until that time.

A report on the Columbia River marking experiments to date, which is being prepared for publication, will be completed in the very near future.

Probably the most important phase of the past season's work was an investigation of the spawning grounds of blueback salmon in the Okanogan River. The knowledge that this spawning district exists is of considerable interest, since until it was discovered nothing was known of the present spawning grounds of the Columbia River bluebacks, and in the absence of that knowledge it has been impossible to give the fish adequate protection or to secure their eggs for artificial propagation. Interest in this spawning district is greatly increased by the fact that it appears to be the most important blueback spawning district now remaining in the Columbia Basin; that is, that part of the run which spawns in the Okanogan contributes the largest part of the commercial catch of this species in the Columbia. Plans are being made to further investigate this district during the coming season.

FISHERIES OF CALIFORNIA

The cooperation with the California Fish and Game Commission in the study of the tuna and sardines has been continued. This work is being done under the efficient direction of William F. Thompson, of the California commission. Mr. Thompson ranks as one of the leading scientists engaged in fishery research, and one of the primary objects in entering into the present cooperative arrangement was to make possible the training of additional investigators. It is expected that one of the men thus trained will be taken over by the bureau in the near future and assigned to an independent investigation. The arrangement has proved very successful and will doubtless be continued.

FISHES OF EL SALVADOR

Reports on the investigations in El Salvador conducted by Samuel F. Hildebrand and Fred J. Foster during January and February, 1924, have been completed. A joint and final report by these investigators, dealing with the status of the fisheries and embodying recommendations for the rehabilitation of the sadly depleted waters, was prepared and forwarded to the Government of El Salvador. Mr. Hildebrand also completed and submitted for publication a descriptive catalogue of the fresh-water fishes of El Salvador, which embodies the descriptions of several new species, together with a list of marine fishes taken at two of the ports of El Salvador.

INVESTIGATIONS OF SHELLFISH AND TERRAPIN

OYSTERS

Investigations relating to oyster culture were conducted during the period July 1 to December 31, 1924, by Dr. P. S. Galtsoff at Woods Hole, Mass., Herbert F. Prytherch at Milford, Conn., and by J. S. Gutsell in Great South Bay, Long Island, N. Y. All of these investigations have now been placed under the direction of Doctor Galtsoff, whose wide experience with oceanographic research particularly fits him for this difficult task.

Previous observations in Long Island Sound have shown that the pollution of inshore waters by trade wastes is one of the factors affecting the setting of the oyster larvæ in the Sound. Since the trade wastes discharged into Bridgeport Harbor, the Housatonic River, and New Haven Harbor contain considerable amounts of inorganic acids and consequently increase the hydrogen-ion concentration of the water, it was of interest to determine the effect of the increase of hydrogen-ion concentration upon the fertilization of oyster eggs and the vitality of oyster larvæ. The experiments were carried out at the Woods Hole laboratory by Dr. P. S. Galtsoff. The larvæ were raised in the laboratory tanks from artificially fertilized eggs, only 3 or 4 day old larvæ being used for the experiments. The results show that the increase of hydrogen-ion concentration has a marked effect on the vitality of the larvæ. At a pH of 5.8, 64 per cent die within 11 hours; at a pH of 5.4, 100 per cent die in 7 hours; while water having a pH of 5.2 kills them almost instantly.

It is a matter of common knowledge that the union of sperm and egg of many marine organisms is greatly affected by the environment, but information relative to the fertilization of oyster eggs is lacking. First a series of tests was made to determine the necessary dilution of sperm in artificial fertilization. The best results were obtained when the dilution of 1:40,000 was used; in a denser suspension polyspermy takes place and the development of the egg is hampered.

The viability of sperm and eggs in sea water was also studied. It was found that 12 hours after spawning the sperm becomes inactive and does not penetrate the egg. The viability of the eggs is longer, but eggs fertilized after being left for six hours in sea water give a great percentage of irregular development. Both sperm and eggs are very susceptible to changes in the reaction of water. The increase of hydrogen-ion concentration affects them, and when the pH value is lowered from 8.1, which is normal for Woods Hole water, to 7.0 only a small percentage of the eggs is fertilized and develops, while in the control 99 per cent develop into larvæ.

In the summer of 1923 experiments were undertaken by Herbert F. Prytherch to determine a method whereby oysters might be artificially propagated and, if possible, to develop the method to such an extent as to make it of practical commercial value. A small hatchery was built at the plant of the Connecticut Oyster Farms Co., at Milford, Conn., and various types of apparatus were tested out for rearing the larval oysters. By carefully imitating natural conditions a new method was perfected by which over 1,000 oyster larvæ were reared from the egg until they attached to the collectors. These experiments were continued during the summer of 1924, the chief object being to improve the method to such an extent that sufficiently large numbers of oysters might be produced to make the process of practical value to the oyster industry.

The equipment, which was successfully used the previous summer, was again put in operation after making a few minor changes in the arrangement of the filters. During the latter part of July, in a battery of small wooden tanks, several lots of oyster larvæ were reared, and from these over 5,000 spat were collected. The output of such a small hatchery could hardly be sufficient to demonstrate the value of the method for commercial purposes, so in order to get as great a production of oysters as possible additional equipment was installed. This consisted of a tile hatchery trough 100 feet long and having a capacity of 300 gallons, in which the water was continually replenished and circulated by means of electrical devices. Several million oyster larvæ and a few thousand hard-clam larvæ were reared successfully in the large trough for a period of 10 days, when an unforseen accident, following a violent wind and rainstorm, suddenly terminated the experiment.

The oysters artificially propagated by the bureau during the summer of 1923 were placed on suitable inshore beds at Milford, and up to August 1, 1924, they had attained an average growth of 2½ inches. It is expected that by the fall of 1925 they will make excellent half-shell stock.

Experiments were also conducted with the soft clam, *Mya arenaria*, and over 8,000 were artificially propagated and grown in one of the hatchery troughs until sufficiently large to be placed in the harbor. The larvæ of the soft clam are much larger than those of the oyster, and during the short free-swimming period and subsequent "setting" stage are more vigorous and better able to take care of themselves.

The relationship between water temperature and occurrence and distribution of oyster larvæ in Great South Bay was studied by J. S. Gutsell. Evidence was obtained that the small larvæ appear in the water quickly following a rise in temperature. Later in the summer, however, the larvæ disappeared abruptly and almost completely from the bay without forming a set. Their disappearance coincided with the appearance of a great number of ctenophores, which are known to feed on the larvæ of bivalve mollusks.

ALASKA CLAMS

During the summer of 1924 Dr. F. W. Weymouth, of Stanford University, and H. C. McMillin, scientific assistant, spent nine weeks in the field, from July 1 to September 3. The razor-clam beds in the vicinity of Cordova were twice visited (once early and again later in the season), and some time was spent on the beds near Kukak in Shelikof Straits. Incidental observations were made on other mollusks, chiefly "butter clams" (Saxidomus), and on the crab and shrimp forming the basis of the fisheries of Petersburg and Wrangell. Mr. McMillin later visited the razor-clam beds on the Washington coast and the "butter clam" beds on some parts of Puget Sound.

These observations and a review of the data for this and the previous season have shown the annual ring method of age determination to be reliable, and have given a mass of age and size records from which satisfactory norms for growth in the commercially important districts (Washington, Cordova, and Shelikof Straits) have been determined.

Further observations made by McMillin on the Washington coast have given interesting data on the time of spawning and its relation to water temperature. Material obtained through the cooperation of Alaskan canners has permitted the approximate determination of the spawning season here, which is less sharply marked and occurs later than on the Washington coast. Extensive data showing the relation of length and age to sexual maturity have been worked out, making it possible to determine the effect of the size limit upon the breeding reserve.

On the basis of these findings a size limit of 4½ inches has been placed on all Alaskan beds. Those in the vicinity of Cordova are now greatly overfished and it is hoped that this regulation will limit the pack to an amount which the beds can sustain; if not, more stringent size limits will be proposed.

During the year the State of Washington published the results of Mr. McMillin's investigations on the Washington coast. A report covering the points discussed above is now nearing completion.

FRESH-WATER MUSSELS

Of immediate public interest probably the most outstanding investigation pertaining to fresh-water mussels made during the last half of 1924 was the survey of Lake Pepin, a widened portion of the Mississippi River located between Wisconsin and Minnesota. This survey indicated definitely the great value of giving four and five year periods of rest from shelling operations to fresh-water mussel beds, the population of which has become materially depleted. The sections of Lake Pepin opened to shelling in 1924 after having been closed four years seemed to have regained almost their full original mussel population, although they were greatly depleted at the start. Dr. R. E. Coker while connected with the bureau was largely instrumental in promoting concurrent action by the two bordering States that effected the closure of alternate sections of Lake Pepin. The survey mentioned shows the wisdom of this measure.

After the system of closing alternate sections in Lake Pepin became effective similar action was taken by several other States with regard to their mussel areas. There are a number of States, however, that might also enact similar conservation measures to the benefit of their mussel resources.

Mussel surveys were also made of various other portions of the Mississippi River.

The culture of mussels in hatchery troughs was continued. Several thousand young mussels were produced but no striking advance in mussel-cultural methods was made, although some negative information was gained. Research work with regard to the food of young mussels was continued during the summer of 1924 by Dr. E. P. Churchill, of the University of South Dakota, who was employed as special investigator. An important line of investigation with regard to the relation of fish slime to glochidial action was begun during this summer by an independent investigator, Dr. M. M. Ellis, of the University of Missouri.

TERRAPIN

The experiments in the culture and breeding of diamond-back terrapin, which have been conducted at Beaufort, N. C., for a number of years, have been continued with marked success. The work is under the general supervision of Samuel F. Hildebrand and in immediate charge of Charles Hatsel. No changes in the 30 lots of terrapins used in the various experiments have been made since the last report was published.

The total number of young terrapins removed from the egg beds during the fall of 1924 was 3,458. Of this number 2,406 were placed in a hothouse, where they are kept warm and will be fed throughout the winter. Considerable progress has been made in the methods of handling the terrapins in the hothouse. Growth has continued and the death rate has decreased.

ECOLOGICAL AND OCEANOGRAPHIC STUDIES

CONTROL OF MOSQUITOES BY MEANS OF FISH

Investigations relative to the use of fish for mosquito control were continued at Augusta, Ga., by Samuel F. Hildebrand, assisted by Irving L. Towers, until October 5. The season was unfavorable because of periods of heavy rainfall, causing flood conditions to prevail. Some interesting data, nevertheless, were obtained. The results of these and similar investigations of three previous summers have been studied and a rather comprehensive report is being prepared for publication.

Mr. Hildebrand also prepared and read before the annual conference of field workers in malaria, held in New Orleans from November 23 to 25, a paper dealing with the propagation of the top minnow, Gambusia, for mosquito control on large tracts of land which are to be flooded as in damming rivers for hydroelectric purposes. This paper will be published by the United States Public Health Service.

OCEANOGRAPHY

A study of the hydrogen-ion concentration of sea water in Long Island Sound was made by Dr. P. S. Galtsoff. It is known that the colorimetric determination of the pH value in sea water can not be accurate because of the so-called salt error. The latter varies with the concentration of salts and with the indicator used. So far the salt error has been determined for phenolphtalein and alpha-naphtolphtalein. It has been noticed that previous colorimetric determinations made in Long Island Sound give too high values. In order to check up these observations a series of experiments was made at the Woods Hole laboratory to determine the salt error of cresol red. A set of phosphate mixtures with cresol red was made up, poured into non sol glass tubes, and sealed. The pH values of the buffer mixtures were checked up by the electric method. The determination of the salt error was made in a buffered artificial sea water at pH values ranging from 6.9 to 8.6 and at the concentrations of salts from 10 to 32 per thousand.

In October a special cruise was made on the *Fish Hawk* in Long Island Sound. The hydrogen-ion concentration was determined by comparison with buffer solutions with cresol red as indicator and by using the Palitsch borax-boric acid mixtures with alpha-naphtolphtalein. The latter were checked up by the electric method before and after the cruise. Both methods gave identical results, indicating a considerable increase in hydrogen-ion concentration in the Housatonic River and in Bridgeport and New Haven Harbors.

The report on the plankton of the Gulf of Maine, a part of a comprehensive study of this body of water which is being conducted by Dr. H. B. Bigelow, of Harvard University, has been completed and is in press. The report on the fishes of the Gulf of Maine was completed some time ago and the report on the physical oceanography is nearly finished.

During the latter part of the summer a series of drift bottles was set out on three lines across the Vineyard Sound–Nantucket Sound region. Thirty-nine recoveries were reported, showing a movement of water eastward out of the sound and then south and west around Nantucket.

Other oceanographic observations in the way of serial temperatures and horizontal and vertical tows were made from the *Halcyon* and the *Fish Hawk* along the coast of Maine, in Massachusetts and Cape Cod Bays, and on Nantucket Shoals. These were primarily a part of the program of study of the spawning of cod and the subsequent fate of the eggs and larval fishes.

Arrangements have been completed to have extensive series of temperatures taken at a number of carefully selected lightships and lighthouses along the Atlantic coast.

The work on the oceanographic survey of Chesapeake Bay has gone forward and the data are gradually being put into shape for publication.

ECOLOGY OF FRESH-WATER LAKES

The quantitative studies of the flora and fauna of Green Lake, Wis., were completed in 1924, and a report based upon the data obtained in this investigation is now being prepared. Observations on the plankton of Green Lake were begun on February 28, 1924, and were continued until November 8. The organic matter in the centrifuge plankton reached a maximum of 1,370 milligrams per cubic meter of water on April 30, and then declined to a minimum of 542 milligrams per cubic meter on July 3. The quantity rose to 660 milligrams on July 30 and to 1,179 milligrams on September 3, then fell to 912 milligrams on October 11 and rose to 1,131 milligrams per cubic meter on November 8.

During the month of July a special study of the number and distribution of the shrimplike crustacean, *Mysis relicta*, was made. In summer this animal is very generally distributed over the bottom of Green Lake, where the water reaches a depth of 12 meters or more. It is most abundant, however, over certain types of bottom, such as sand, gravel, or marl that is kept free of mud by the action of currents. As many as 1,105 individuals were obtained in one haul of the dredge off Sandstone Bluff, for example, while hauls over mud bottom yielded relatively small numbers. This animal forms an important item in the food of the ciscoes, and enough material was obtained for a food analysis.

During the month of August 50 lakes in northern Wisconsin were visited for the purpose of making temperature, hydrogen-ion, and plankton observations. These northern lakes have a somewhat lower temperature and less calcium and magnesium in solution; some of them, in fact, have very soft water, containing only 1 to 2 cubic centimeters of fixed carbon dioxide per liter of water. The chief purpose of the investigation was to determine whether these northern lakes support as large a growth of plankton in summer as do the lakes of southeastern Wisconsin, where the water is somewhat warmer and has a distinctly larger amount of calcium and magnesium in solution.

The hydrogen-ion concentration varied from pH 8.9 to 5.2 in the northern lakes. In those having very soft water the surface was about neutral or slightly acid (pH 7.1 to 6.5), while the lower water was distinctly acid (pH 5.4 to 5.2). In those lakes containing larger amounts of calcium and magnesium in solution the surface water was alkaline (pH 8 to 8.9), but the lower water was usually on the acid side (pH 6.8 to 6.5). In the hard-water lakes of southeastern Wisconsin the upper stratum in summer ranges from pH 8.5 to 9.0. while the lower water ranges from pH 7.6 to 7.2 even when it contains considerable free carbon dioxide.

In the soft-water lakes the centrifuge plankton yielded from 750 to 1,280 milligrams of dry organic matter per cubic meter of water. In the lakes having somewhat harder water the range was from 970 to 3,850 milligrams of organic matter per cubic meter. Three lakes having depths of 4 to 9 meters yielded more than 3,000 milligrams per cubic meter, while two others with depths of 8 and 12 meters yielded more than 2,000 milligrams. The yield of lakes more than 12 meters deep varied from about 1,000 to 1,800 milligrams.

Computations per unit area on the basis of maximum depth give very different results. The highest yield, namely, 3,850 milligrams per cubic meter, was obtained in a lake with a maximum depth of 4.5 meters, which represents 17.3 grams per square meter of surface. A yield of 3,238 milligrams per cubic meter was obtained in a lake having a maximum depth of 9 meters, and this represents a yield of 29.1 grams per square meter of surface. On the other hand, the deepest lake yielded only 1,080 milligrams of dry organic matter per cubic meter, which represents 37.8 grams per square meter of surface for a maximum depth of 35 meters.

The centrifuge plankton of six hard-water lakes of southeastern Wisconsin, obtained in September and October, yielded from 876 to 1,875 milligrams of dry organic matter per cubic meter of water. These results are of the same general order of magnitude as those of the northern lakes having a medium amount of fixed carbon dioxide in solution, with the exception of the shallower northern lakes. No observations were made on southern lakes having a maximum depth of 4 to 8 meters.

These investigations have been carried on by Dr. Chancey Juday, of the Department of Zoology, University of Wisconsin.

FOULING OF SHIPS' BOTTOMS

The investigation on the fouling of ships' bottoms was continued during the past year by Dr. J. P. Visscher at New York City, Norfolk, Va., and Beaufort, N. C. About 10 ships per month were examined, giving an approximate total of 225 ships examined during the course of the investigation. Data concerning the length of voyage, route, ports visited, etc., were obtained in addition to the collection of the fouling material on the hulls. These data, gathered from more than 200 ships, have been tabulated and show that the organisms occuring most frequently on the bottom of marine vessels are algæ, hydroids, and barnacles. The following table gives the results of the examinations of the first 157 ships, 141 of which, or 89 per cent, were foul:

Character of fouling	Number of ships fouled	Percentage (of 141 ships)	Character of fouling	Number of ships fouled	Percentage (of 141 ships)
Barnacles	98	70	Protozoa	11	8
Hydroids	58	42	Tunicates	15	10
Polyzoa	54	40	Algæ	67	48
Mollusca	24	17			

Almost all of the organisms belong to groups typically found on rocks or other submerged structures near shore, which substantiates a previous conclusion that fouling occurs when ships are in harbor. Light also has been found to be a very important factor in the attachment of the larvæ of the various forms that have been found on the bottoms of ships. A study of the reactions of the cyprid larvæ of *Balanus eburneus* and *B. amphitrite* has been completed, which shows that spectral colors of equal values have different stimulating efficiencies. Light in the field of green and blue-green was found to have the maximum stimulating effect. For both of the barnacles studied the relative values were approximately equal.

Seasonal periodicity for attaching stages of many of the organisms causing fouling has been studied. In this connection 10 sets of panels have been issued to 10 naval vessels, the panels to be submerged in each port of call and then carefully preserved in order to correlate the fouling on the ship's bottom with the place of attachment as determined by the ship's log.

The life histories of the several barnacles found at Beaufort, N. C., are being studied in the hope of throwing light (1) on the problem of selective attachment; (2) on the formation of a workable key for recognition of various species of barnacles in their larval stages; and (3) to provide data for a critical analysis of some of the divergent results obtained during the extensive series of investigations by the paint division of the Navy Department.

Considerable time has thus far been spent in tabulating the results of the investigation and in its organization into the form of a report.

INVESTIGATIONS PERTAINING TO FISH-CULTURAL OPERATIONS

PATHOLOGY OF FISHES

The investigations on *Octomitus salmonis*, a parasitic flagellate of trout, were continued during the summer and fall by Dr. H. S. Davis, and the results are now being prepared for publication. This parasite, which lives in the intestine of the host, has a very interesting life history which shows that there are two distinct cycles in its development. During one stage of its existence the parasite lives within the cells lining the anterior end of the intestine and the pyloric cæca, while during the second or flagellated stage it is found swimming actively about in the fluid contents of the intestine.

The intracellular stage first appears as an inconspicuous rounded organism much smaller than the epithelial cell in which it occurs. The parasite quickly grows to many times its original size and then divides into a number of small cells similar to the original, which in their turn invade uninfected cells and repeat the cycle. Under certain conditions the intracellular parasites may multiply very rapidly, so that a large percentage of the cells become infected. Since the infected cells are destroyed eventually, this can not fail to result in serious injury to the host. On the other hand, some of the intracellular forms undergo a quite different course of development and eventually make their way into the lumen of the intestine as typical flagellates. The flagellates multiply by binary fission and often become enormously abundant, especially in young fish. In fact, in some hatcheries it is the exception to find trout less than one year old which do not harbor considerable numbers of the flagellates in their intestines.

The spread of the parasite from fish to fish probably is accomplished by means of cysts, which can ordinarily be found in small numbers in the intestines of infected fish. These cysts usually are ovoidal in form and at first contain a single flagellate surrounded by a thin, transparent membrane. Soon after encystment the inclosed organism divides into two, and in this condition the cysts pass from the body with the excrement. They no doubt remain alive for some time in the water, and when accidentally ingested by another fish presumably pass to the intestine, where they set up a new infection.

The injurious effects of the parasite on the host may take two quite different forms, which, it is believed, are correlated with the two cycles of development previously referred to. The most common result of infection by Octomitus is the production of thin, emaciated fish known to fish culturists as "pinheads." Such fish usually are found to be infected with large numbers of flagellates, which evidently seriously interfere with nutrition. This form of octomitiasis is common in many hatcheries, and while not necessarily accompanied by serious mortality, does much harm by interfering with the normal growth of the fingerlings. On the other hand, there is reason to believe that serious epidemics accompanied by heavy mortality may be traced to Octomitus. In such cases there is a very rapid increase in the intracellular stages, which ordinarily are not abundant, and this results in extensive destruction of the epithelium and more or less congestion of the intestinal wall.

Since the parasite is widely distributed and occurs in adults as well as in the young fish, it is believed that it will be impracticable to eradicate it from the hatcheries. However, there is every reason to believe that much can be done by improving the general conditions under which fish are held so as to increase their hardiness and vigor. The evidence at hand indicates that octomitiasis is likely to occur whenever trout fingerlings are subjected to unfavorable conditions which tend to lower their vitality, but if the fish are kept healthy and vigorous there is usually little trouble from the disease.

In addition to Octomitus, a species of ameba is very common in trout, although in spite of its abundance it apparently does little harm. Unlike Octomitus, the vegetative stages of the ameba occur only in the stomach, where they can be found crawling slowly about over the epithelial lining. This species is of considerable interest from a scientific standpoint, since it differs radically in many respects from the intestinal amebæ found in other animals. One of its most striking characteristics is the formation of multinucleate cysts, which may grow and divide while in the lumen of the stomach and intestine. The extraordinary life history of this species in the trout has been worked out and the results are now ready for publication.

An interesting trout parasite and one that may be of considerable economic importance was found in a specimen of golden trout from the Mount Shasta region in California. This fish was one of a number that died at the Steinhart Aquarium, San Francisco, and was infected with a myxosporidian belonging to the genus Myxidium. This genus is common in the gall bladder of fishes, but usually is not injurious. The parasite was very abundant in the bile ducts of the liver, causing a severe hypertrophy of the ducts, which evidently resulted in the death of the host. It is obvious that every precaution should be taken to prevent the introduction of this parasite into our hatcheries, where it might cause very serious injury.

An investigation of the so-called soft-egg disease was undertaken at the request of the Eastern Trout Growers' Association. During the last few years this disease has caused serious losses at a number of commercial trout hatcheries in New England. The trouble does not appear until some time after the eggs are laid, when they become soft and flaccid and a portion of the yolk may be extruded. During November M. C. James visited several of the hatcheries where the disease was most serious and brought back a quantity of infected eggs for further study. It was determined that the trouble is due to small openings which are formed in the egg membrane by some organism. These openings allow the water to pass freely in and out of the egg, thus destroying the turgidity characteristic of normal eggs. It is evident that the holes in the membrane are formed from the exterior, but it has not yet been possible to determine definitely what organism is the primary cause of the trouble, since several species of bacteria and a species of ameba are almost invariably present. It is planned to continue the investigation of this disease during the next spawning season.

PHYSIOLOGY AND NUTRITION OF FISHES

Feeding experiments on the addition of vitamins to trout foods were continued during the past summer. The principal experiments were conducted by M. C. James, under the direction of Dr. H. S. Davis, at the White Sulphur Springs (W. Va.) station, and in general the results were in complete accord with those obtained at the Manchester (Iowa) station during the summer of 1923. It was found that the addition of cod-liver oil and yeast to beef heart noticeably increased the growth, but an even more important result was the marked decrease in the mortality. In most instances the mortality among fish fed heart to which a small quantity of yeast and oil had been added was less than one-half that among the fish fed a straight heart diet. One of the most important results of the season's work was the discovery that only very small amounts of oil and yeast are required and that the addition of 1.5 per cent of oil and 2 per cent of dried yeast will produce fully as good results as do larger amounts.

The beneficial results from the addition of oil and yeast to sheep liver are not as evident as in the cast of heart, although a decreased mortality and slightly increased growth were noted in some cases. This was probably due to the fact that liver is much richer in vitamins than was formerly thought to be the case, and there are apparently sufficient quantities of these substances present to promote normal growth.

In comparing the efficiency of heart and liver as a diet for young trout it should be noted that at both Manchester and White Sulphur Springs the best results were obtained with fish fed beef heart containing small quantities of oil and yeast. Fish fed such a diet were noticeably more active and vigorous than any of the other experimental lots. However, the sup·riority of the heart, oil, and yeast diet was more noticeable early in the season than later, and there is some evidence that in practice it may be advantageous to change to a liver diet after the fish are 3 to 4 months old. It is planned to conduct further experiments along this line during the coming summer.

In conn ction with the work at White Sulphur Springs, feeding experiments were carried on at the Wytheville (Va.) and Erwin (Tenn.) stations. In each case rainbow-trout fingerlings were divided into two lots of 2,000 fish each, which were kept under as nearly identical conditions as possible. The only difference was in the food, one lot (the controls) being fed a straight heart diet while small quantities of oil and yeast were add d to the diet of the other lot. Owing, no doubt, to the fact that both lots of fish were fed the same amounts of food the difference in growth was not important, but a striking difference was noted in the mortality of the two lots.

At the Erwin station the experiment was complicated by the fact that there was a very heavy mortality from pop.ye among all the fingerlings, but even in this case the vitamin lot showed a distinct superiority, the mortality being approximately 30 per cent less than among the controls. It is also significant that in his report the superintendent stated that the fish fed yeast and oil had a better appearance and color than those given beef heart only.

The experiment at the Wytheville station was more successful and is still being continued. The total mortality between May 23 and Decemb r 23 was approximately 32 per cent in case of the vitamin lot, while among the controls the mortality during the same period was approximately 60 per cent.

Experiments on the addition of cod-liver oil and yeast to the food of brood trout to determine the effect on the quality of the eggs are being carried on at the White Sulphur Springs, Wytheville, and Erwin stations, but the results of thes experiments are not yet available.

At Madison, Wis., Dr. A. S. Pearse and three graduate students have carried on investigations on the consumption and assimilation of foods by fishes. For certain experiments painted turtles, terrapins, and gopher turtles were used because they are hardier than fishes. The rat of growth of cold-blooded animals fed on mixtures of pure foods with varying vitamin constituents has been determined and chemical analyses have been made on such animals after they had been fed for a year.

Studies have also been made on the amount of food consumed by fishes of various ages at different temperatures. In this connection the metabolic rate, as indicated by oxygen consumption, has been determined. It has been found that fishes soon become acclimatized when they are placed in water of a different temperature from that in which they were previously kept and there are characteristic differences in their metabolic processes. The chemical changes in the blood of fishes that are starved, fed, or subjected to other conditions are being investigated.

BIOLOGICAL LABORATORIES

The Woods Hole (Mass.) biological laboratory was open as usual during the summer of 1924, with Dr. W. H. Rich acting as director. Twenty-two independent investigators availed themselves of the facilities afforded and conducted several valuable researches.

Dr. Edwin Linton and Dr. G. A. MacCallum continued their investigations on the parasites of fishes. Dr. F. G. Hall, of Milton College, and Dr. S. Lepkowsky undertook a study of the blood of fishes, which promises important results. It was found that the oxygen-carrying capacity of the blood in different fishes is correlated in general with the activity of that particular species. There is also a correlation with the rate of metabolism of the fish when at rest. Perhaps the most significant results were in respect to changes that take place in the blood volume. A study was made of the external conditions that have an influence on the blood volume, and it was found that changes in salinity and oxygen tensions apparently were the most important of these.

Dr. N. A. Cobb, of the Department of Agriculture, continued an important investigation on the marine nematode fauna of the Woods Hole region. Many additional species were discovered, most of which are new to science. Attention is being given to the ecological relations which may exist between nematodes and fishes.

Paul S. Conger, of the Carnegie Institution of Washington, continued his research on diatoms, which has been carried on for a number of years under the direction of Dr. Albert Mann, also of the Carnegie Institution. Approximately 100 samples were taken, about 80 of which were dredged and the rest secured by means of tow nets. This work is intended to provide material and data for a study of the seasonal distribution of the diatoms and to serve as a basis for a manual of the diatom flora of the Woods Hole region. Attention is also being given to a study of the stomach contents of bottom-dwelling animals in order to get more definite ideas of the importance of diatoms in the food cycle of the sea.

Mary G. Springer conducted an investigation on the nervous mechanism of respiration in the dogfish, and some significant and important conclusions were reached.

In addition to the activities of the independent investigators, the laboratory was used by Dr. P. S. Galtsoff, Dr. C. J. Fish, and Marie D. P. Fish, regular employees of the bureau. The results of the work of these investigators has been mentioned elsewhere in this report.

The activities at the Beaufort (N. C.) biological laboratory have remained about the same. Arrangements have been made, however, for the appointment of Samuel F. Hildebrand, ichthyologist, to the position of director of this laboratory, and it is expected that this appointment will result in increased activity and accomplishment at that place.

During the summer of 1924 investigations on the nature and extent of the fouling of ships' bottoms were continued at Beaufort by Dr. J. P. Visscher. The Navy Department availed itself of the facilities of the laboratory in its investigation of the prevention of the fouling of ships and sent several of its investigators there for that purpose. Several independent investigators also were there during the summer. Elmer Higgins, director of the Key West biological station, also was present at Beaufort conducting his investigations on the life history of the mullet and other important food fishes of the South Atlantic and Gulf coasts.

The situation at the Key West biological station was unchanged. Although a competent director has been found in Elmer Higgins, the lack of adequate laboratory facilities has made it impossible to center any extensive investigations at this point. The grounds and buildings are being maintained in excellent condition and it is still hoped that adequate laboratory facilities will be provided ultimately.

At the Fairport (Iowa) biological laboratory have been conducted investigations on fresh-water mussels and on the propagation of some of the more important food fishes of the Mississippi region. These have been mentioned above. Since the last report was published T. K. Chamberlain, then acting director, was appointed director. Several independent investigators were at the laboratory during the summer of 1924. Dr. M. M. Ellis, of the University of Missouri, conducted a study of gland activity in fishes, and through this was led to a study of the glochidia of the fresh-water mussels during their parasitic stage. This study gives promise of most interesting and valuable results which may be of great importance in the development of methods for the artificial propagation of mussels. The staff of the laboratory has also maintained close relations with various State and private organizations concerned with the conservation of the aquatic resources of the Mississippi Basin.

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FIG. 1.—Lifting a salmon trap in southeast Alaska

ALASKA FISHERY AND FUR-SEAL INDUSTRIES IN 1924 [1]

By Ward T. Bower, *Administrative Officer*

CONTENTS

[1] Appendix IV to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 992.

INTRODUCTION

The bureau's work in Alaska in the calendar year 1924 was conducted along much the usual lines, the matter of greatest importance to the fisheries being the approval on June 6 of a new fisheries act, which gave the Department of Commerce increased authority over the fisheries of Alaska and made possible the promulgation of regulations for stricter control of fishery operations. A greatly expanded patrol was maintained for the enforcement of the new law and the regulations issued thereunder, particularly for the protection and conservation of the salmon fishery. The Commissioner of Fisheries spent a considerable portion of the fishing season in Alaska observing conditions and the working of the new law and regulations.

Salmon-tagging operations were carried on at a number of localities in southeastern Alaska to secure data on the migration routes and runs of salmon in that district. Weirs used to facilitate the counting of salmon ascending to the spawning grounds were again maintained in Karluk and Chignik Rivers and in certain streams tributary to Alitak Bay waters. In central Alaska a special investigation in respect to clams was made in an effort to determine the best method of conserving this fishery. The annual closed season on halibut, provided for in the North Pacific halibut treaty, became effective for the first time in 1924.

On the Pribilof Islands fur-sealing operations were carried on as usual, the chief features being the marking and reserving, for breeding purposes, of a larger number of 3-year-old male seals than heretofore and the blubbering, at St. Paul Island, of practically the whole of the 1924 take. The total take of sealskins on St. Paul Island was 13,453, and on St. George Island 3,766, a grand total of 17,219 skins.

A special study was made of the fox herds, and methods were developed for the systematic feeding of the herd on St. Paul Island. Experiments in feeding various kinds of food were also conducted, and equipment was installed for the preparation of more satisfactory food to take the place of the preserved seal carcasses heretofore fed on St. George Island. In the winter of 1924–25, 81 blue and 26 white fox skins were taken on St. Paul Island and 600 blue and 2 white on St. George Island.

Two sales of fur-seal skins and one of fox skins were held during the year by the department's selling agents.

Acknowledgment is made of the invaluable assistance rendered by the office staff in the compilation and preparation of this report.

TRIP OF THE COMMISSIONER OF FISHERIES TO ALASKA

On June 28, 1924, soon after the promulgation of the Alaska fisheries regulations (June 21), which was made possible by virtue of the increased authority conferred by the act of June 6, 1924, Commissioner O'Malley left Washington for an extended trip to Alaska to observe the effect of the new regulations and to consider the necessity for any modifications or additions. He arrived at Juneau on July 13, and from that time until his departure on September 8 he was constantly engaged in inspections of fishery grounds and in consultation with officials and others concerned with the fisheries of the Territory.

Four cruises were made to various places in southeastern Alaska on the bureau's patrol vessel *Widgeon*. These included visits to Icy Strait, Cross Sound, Port Althorp, Port Frederick, Chatham Strait, Funter Bay, Tenakee Inlet, Sitkoh Bay, Eva Lake, Red Bluff Bay, Big Port Walter, Port Armstrong, Port Alexander, Tebenkof Bay, Bay of Pillars, Frederick Sound, Gambier Bay, Saginaw Bay, Seymour Canal, Lake Bay, Anan Creek, Quadra, Petersburg, Wrangell, and Ketchikan. Other less important places were visited also. On these cruises the commissioner was accompanied by Assistant Agent E. M. Ball.

On August 13 the commissioner left Juneau for Cordova, returning to Ketchikan on August 27. During this time an inspection of Prince William Sound waters was made.

On September 8 the commissioner participated in a meeting at Juneau of the Alaska fisheries advisory committee appointed by the Secretary of Commerce to make recommendations in regard to necessary measures for the protection and conservation of the fisheries of Alaska.

Following his departure from Alaska, the commissioner devoted some time to an investigation of fishery matters in the Pacific Coast States and arrived in Washington on October 8.

FISHERIES ADVISORY COMMITTEE

To assist in developing the best methods of controlling and conserving the fisheries of Alaska under the broad authority conferred by the act of June 6, 1924, the Secretary of Commerce appointed an Alaska fisheries advisory committee, as follows: Gov. Scott C. Bone, chairman, Juneau; Anthony J. Dimond, Valdez; Carl A. Sutter, Ketchikan; Samuel Butts, Sitka; J. R. Heckman, Ketchikan; Calvin C. Hazelet, Cordova; and Harry E. Ellsworth, Seward. Both the Alaska Territorial Fish Commission and commercial interests were represented on this committee.

A meeting of the committee was held at Juneau on September 8, at which the Commissioner of Fisheries was present. As a result, the committee submitted recommendations that were helpful to the department in formulating the revised fishery regulations appearing under date of December 2, 1924. As indicated by its name, the functions of the committee are advisory in character.

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 westward from Unimak Pass, Bristol Bay, and the Kuskokwim and Yukon Rivers. These divisions are solely for statistical purposes and do not coincide with areas established in departmental regulations.

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 that were the objects of special investigation or inquiry.

ALASKA FISHERIES LEGISLATION

After many years of unsuccessful effort, a much-needed act for the protection and conservation of the fisheries of Alaska was passed by Congress and approved by the President under date of June 6, 1924, amending the act of June 26, 1906. The text of the new act is as follows:

An Act for the Protection of the Fisheries of Alaska, and for Other Purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of protecting and conserving the fisheries of the United States in all waters of Alaska, the Secretary of Commerce from time to time may set apart and reserve fishing areas in any of the waters of Alaska over which the United States has jurisdiction, and within such areas may establish closed seasons during which fishing may be limited or prohibited as he may prescribe. Under this authority to limit fishing in any area so set apart and reserved, the Secretary may (a) fix the size and character of nets, boats, traps, or other gear and appliances to be used therein; (b) limit the catch of fish to be taken from any area; (c) make such regulations as to time, means, methods, and extent of fishing as he may deem advisable. From and after the creation of any such fishing area and during the time fishing is prohibited therein, it shall be unlawful to fish therein or to operate therein any boat, seine, trap, or other gear or apparatus for the purpose of taking fish; and from and after the creation of any such fishing area in which limited fishing is permitted, such fishing shall be carried on only during the time, in the manner, to the extent, and in conformity with such rules and regulations as the Secretary prescribes under the authority herein given: *Provided*, That every such regulation made by the Secretary of Commerce shall be of general application within the particular area to which it applies, and that no exclusive or several right of fishery shall be granted therein, nor shall any citizen of the United States be denied the right to take, prepare, cure, or preserve fish or shellfish in any area of the waters of Alaska where fishing is permitted by the Secretary of Commerce. The right herein given to establish fishing areas and to permit limited fishing therein shall not apply to any creek, stream, river, or other bodies of water in which fishing is prohibited by specific provisions of this Act, but the Secretary of Commerce through the creation of such areas and the establishment of closed seasons may further extend the restrictions and limitations imposed upon fishing by specific provisions of this or any other Act of Congress.

It shall be unlawful to import or bring into the Territory of Alaska, for purposes other than personal use and not for sale or barter, salmon from waters outside the jurisdiction of the United States taken during any closed period provided for by this Act or regulations made thereunder.

Sec. 2. In all creeks, streams, or rivers, or in any other bodies of water in Alaska, over which the United States has jurisdiction, in which salmon run, and in which now or hereafter there exist racks, gateways, or other means by which the number in a run may be counted or estimated with substantial accuracy, there shall be allowed an escapement of not less than 50 per centum of the total number thereof. In such waters the taking of more than 50 per centum of the run of such fish is hereby prohibited. It is hereby declared to be the intent and policy of Congress that in all waters of Alaska in which salmon run there shall be an escapement of not less than 50 per centum thereof, and if in any year it shall appear to the Secretary of Commerce that the run of fish in any waters has diminished, or is diminishing, there shall be required a correspondingly increased escapement of fish therefrom.

Sec. 3. Section 3 of the Act of Congress entitled "An Act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, is amended to read as follows:

"Sec. 3. That it shall be unlawful to erect or maintain any dam, barricade, fence, trap, fish wheel, or other fixed or stationary obstruction, except for purposes of fish culture, in any of the waters of Alaska at any point where the distance from shore to shore is less than one thousand feet, or within five hundred yards of the mouth of any creek, stream, or river into which salmon run, excepting the Karluk and Ugashik Rivers, with the purpose or result of capturing salmon or preventing or impeding their ascent to the spawning grounds, and the Secretary of Commerce is hereby authorized and directed to have any and all such unlawful obstructions removed or destroyed. For the purposes of this section, the mouth of such creek, stream, or river shall be taken to be the point determined as such mouth by the Secretary of Commerce and marked in accordance with this determination. It shall be unlawful to lay or set any seine or net of any kind within one hundred yards of any other seine, net, or other fishing appliance which is being or which has been laid or set in any of the waters of Alaska, or to drive or to construct any trap or any other fixed fishing appliance within six hundred yards laterally or within one hundred yards endwise of any other trap or fixed fishing appliance."

Sec. 4. Section 4 of said Act of Congress approved June 26, 1906, is amended to read as follows:

"Sec. 4. That is shall be unlawful to fish for, take, or kill any salmon of any species or by any means except by hand rod, spear, or gaff in any of the creeks, streams, or rivers of Alaska; or within five hundred yards of the mouth of any such creek, stream, or river over which the United States has jurisdiction, excepting the Karluk and Ugashik Rivers: *Provided*, That nothing contained herein shall prevent the taking of fish for local food requirements or for use as dog feed."

Sec. 5. Section 5 of said Act of Congress approved June 26, 1906, is amended to read as follows:

"Sec. 5. That it shall be unlawful to fish for, take, or kill any salmon of any species in any manner or by any means except by hand rod, spear, or gaff for personal use and not for sale or barter in any of the waters of Alaska over which the United States has jurisdiction from six o'clock postmeridian of Saturday of each week until six o'clock antemeridian of the Monday following, or during such further closed time as may be declared by authority now or hereafter conferred, but such authority shall not be exercised to prohibit the taking of fish for local food requirements or for use as dog feed. Whenever the Secretary of Commerce shall find that conditions in any fishing area make such action advisable, he may advance twelve hours both the opening and ending time of the minimum thirty-six-hour closed period herein stipulated. Throughout the weekly closed season herein prescribed the gate, mouth, or tunnel of all stationary and floating traps shall be closed, and twenty-five feet of the webbing or net of the 'heart' of such traps on each side next to the 'pot' shall be lifted or lowered in such manner as to permit the free passage of salmon and other fishes."

Sec. 6. Any person, company, corporation, or association violating any provision of this Act or of said Act of Congress approved June 26, 1906, or of any regulation made under the authority of either, shall, upon conviction thereof, be punished by a fine not exceeding $5,000 or imprisonment for a term of not more than ninety days in the county jail, or by both such fine and imprisonment; and in case of the violation of section 3 of said Act approved June 26, 1906, as amended, there may be imposed a further fine not exceeding $250 for each day the obstruction therein declared unlawful is maintained. Every boat, seine, net, trap, and every other gear and appliance used or employed in violation of this Act or in violation of said Act approved June 26, 1906, and all fish taken therein or therewith, shall be forfeited to the United States, and shall be seized and sold under the direction of the court in which the forfeiture is declared, at public auction, and the proceeds thereof, after deducting the expenses of sale, shall be disposed of as other fines and forfeitures under the laws relating to Alaska. Proceedings for such forfeiture shall be in rem under the rules of admiralty.

That for the purposes of this Act all employees of the Bureau of Fisheries, designated by the Commissioner of Fisheries, shall be considered as peace officers and shall have the same powers of arrest of persons and seizure of property for any violation of this Act as have United States marshals or their deputies.

Sec. 7. Sections 6 and 13 of said Act of Congress approved June 26, 1906, are hereby repealed. Such repeal, however, shall not affect any act done or any right accrued or any suit or proceeding had or commenced in any civil cause prior to said repeal, but all liabilities under said laws shall continue and may be enforced in the same manner as if committed, and all penalties, forfeitures, or liabilities incurred prior to taking effect hereof, under any law embraced in, changed, modified, or repealed by this Act, may be prosecuted and punished in the same manner and with the same effect as if this Act had not been passed.

Sec. 8. Nothing in this Act contained, nor any powers herein conferred upon the Secretary of Commerce, shall abrogate or curtail the powers granted the Territorial Legislature of Alaska to impose taxes or licenses, nor limit or curtail any powers granted the Territorial Legislature of Alaska by the Act of Congress approved August 24, 1912, "To create a legislative assembly in the Territory of Alaska, to confer legislative power thereon, and for other purposes."

Approved, June 6, 1924.

Following the passage of the above act, the need for the two fishery reservations created in 1922 ceased to exist. The Executive orders of February 17 and November 3, 1922, which created the Alaska Peninsula Fisheries Reservation and the Southwestern Alaska Fisheries Reservation, respectively, were therefore revoked by Executive orders dated June 7, 1924. These orders are as follows:

EXECUTIVE ORDER

Whereas on the 17th day of February, 1922, an Executive order was promulgated creating the Alaska Peninsula Fisheries Reservation to insure the protection of the fisheries in the waters therefore; and

Whereas the act of Congress of June 6, 1924, entitled "An Act for the Protection of the Fisheries of Alaska and for other Purposes," provides for the protection and administration of the fisheries in all Alaskan waters, and the Executive reservation aforesaid has therefore become unnecessary;

Therefore the said Executive order of February 17, 1922, creating the Alaska Peninsula Fisheries Reservation is hereby revoked.

This revocation shall not affect the Executive order of March 3, 1913, creating the Aleutian Islands Reservation, which shall remain in full force and effect.

Calvin Coolidge.

The White House,
June 7, 1924.

EXECUTIVE ORDER

Whereas on the 3d day of November, 1922, an Executive order was promulgated creating the Southwestern Alaska Fisheries Reservation to insure the protection of the fisheries in the waters therefore; and

Whereas the act of Congress of June 6, 1924, entitled "An Act for the Protection of the Fisheries of Alaska and for other Purposes," provides for the protection and administration of the fisheries in all Alaskan waters, and the Executive reservation aforesaid has therefore become unnecessary;

Therefore the said Executive order of November 3, 1922, creating the Southwestern Alaska Fisheries Reservation is hereby revoked.

This revocation shall not affect the Executive order of March 3, 1913, creating the Aleutian Islands Reservation, which shall remain in full force and effect.

CALVIN COOLIDGE.

THE WHITE HOUSE,
June 7, 1924.

Under date of June 7, 1924, an act for the protection of the North Pacific halibut fishery was approved, the text of which is as follows:

AN ACT FOR THE PROTECTION OF THE NORTHERN PACIFIC HALIBUT FISHERY

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.—This Act may be cited as the Northern Pacific Halibut Act.

SEC. 2. DEFINITION OF TERMS.—For the purposes of this Act "close season" shall mean the period from the 16th day of November in any year to the 15th day of February in the next following year, both days inclusive, or any other close season hereafter fixed by agreement between the United States and Canada; "territorial waters of the United States" shall mean the waters contiguous to the western coast of the United States and the waters contiguous to the coast of Alaska; "territorial waters of Canada" shall mean the waters contiguous to the western coast of Canada, and "prohibited waters" shall mean the territorial waters of the United States, the territorial waters of Canada, and the high seas, including Bering Sea, extending westerly from the limits of the territorial waters of the United States and of Canada.

SEC. 3. FISHING UNLAWFUL, WHEN.—It shall be unlawful for any person to fish for, or catch, or attempt to catch, any halibut (Hippoglossus) at any time during the close season in the territorial waters of the United States, or for any national or inhabitant of the United States to fish for, or catch, or attempt to catch, any halibut at any time during the close season in prohibited waters. The unintentional catching of halibut, when legally fishing for other species of fish, shall not constitute a violation of this Act if such halibut shall be used for food by the crew of the vessel catching the same, or be landed and immediately delivered to any authorized official of the Bureau of Fisheries of the Department of Commerce of the United States or the fishing authorities of the Dominion of Canada. The halibut delivered to any official of the United States pursuant to the provisions of this section shall be sold by the Department of Commerce to the highest bidder for cash and the proceeds therefrom, exclusive of necessary expenses in connection therewith, shall be covered into the Treasury of the United States.

SEC. 4. UNLAWFUL PORT USE; DEPARTURES.—No person, firm, or corporation shall use any port of or place in the United States to furnish, prepare, or outfit any vessel, boat, or other craft intended to be used in violation of this Act, nor shall any person permit, or cause to be permitted, any vessel, boat, or other craft intended to be used in violation of this Act to depart from any port of or place in the United States.

SEC. 5. UNLAWFUL PORT ENTRY; POSSESSION.—It shall be unlawful for any vessel, boat, or other craft having on board any halibut caught contrary to the provisions of this Act to enter any port or place in the United States, or for any vessel, boat, or other craft to enter any such port or place while upon or in the prosecution of any voyage during which the vessel, boat, or other craft fished or was used in fishing for halibut in prohibited waters in the close season. It shall be unlawful for any person knowingly to have in his possession any halibut unlawfully caught under the provisions of this Act.

SEC. 6. PENALTY.—Any person violating any of the provisions of this Act shall be fined not less than $100 nor more than $1,000 or imprisoned not more than one year, or both.

SEC. 7. PATROLS; SEARCHES.—The President shall cause a patrol of naval or other public vessels designated by him to be maintained in such places and waters as to him shall seem expedient for enforcing this Act, and any officer of any vessel engaged in such service, and any other officers designated by the President, may search any vessel, boat, or other craft in the territorial waters of the United States and any vessel, boat, or other craft of the United States on the high seas when suspected of having violated or being about to violate the provisions of this Act.

SEC. 8. CANADIAN VESSELS AND NATIONALS.—Every national or inhabitant and every vessel of Canada found violating this Act shall be delivered as soon as practicable to an authorized official of Canada at the nearest point to the place of seizure or elsewhere as the officials of the United States seizing the same and the authorized officials of Canada may agree upon, and the witnesses and proof necessary to the prosecution of said persons and vessels of Canada shall be furnished with reasonable promptitude to the authorities of Canada having jurisdiction thereof.

SEC. 9. SEIZURE AND FORFEITURE.—Every vessel, boat, or craft employed in any manner in violating this Act shall be seized by any collector, surveyor, inspector, officer of a revenue cutter, or person specified in section 7 hereof, and except as provided in section 8 hereof, every such vessel, boat, or craft, including its tackle, apparel, furniture, cargo, and stores, shall be forfeited to the United States by proper proceedings in any court of the United States in Alaska, California, Oregon, or Washington.

SEC. 10. FISHERIES COMMISSION EXEMPTION.—None of the inhibitions contained in this Act shall apply to the International Fisheries Commission when engaged in any scientific investigation.

SEC. 11. APPROPRIATION.—There is hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $15,000 for the fiscal year 1925 for the salaries and expenses of the International Fisheries Commission.

SEC. 12. DURATION OF ACT.—This Act shall take effect immediately and continue in force until the termination of the convention concluded by the United States and Great Britain on March 2, 1924, for the protection of the halibut fishery of the northern Pacific Ocean.

Approved, June 7, 1924.

The convention of March 2, 1923, between the United States and Great Britain, for the preservation of the halibut of the northern Pacific Ocean was duly ratified by both Governments, ratifications being exchanged on October 21, 1924, and on October 22 a proclamation was issued by the President as follows:

PRESIDENTIAL PROCLAMATION REGARDING THE CONVENTION BETWEEN THE UNITED STATES AND GREAT BRITAIN FOR THE PRESERVATION OF THE HALIBUT FISHERY OF THE NORTHERN PACIFIC OCEAN, INCLUDING BERING SEA

Whereas a convention between the United States of America and Great Britain for the preservation of the halibut fishery of the northern Pacific Ocean, including Bering Sea, was concluded and signed by their respective plenipotentiaries at Washington on the second day of March, one thousand nine hundred and twenty-three, the original of which is word for word as follows:

The United States of America and His Majesty the King of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, Emperor of India, being equally desirous of securing the preservation of the halibut fishery of the northern Pacific Ocean, have resolved to conclude a convention for this purpose, and have named as their plenipotentiaries:

The President of the United States of America: Charles Evans Hughes, Secretary of State of the United States; and

His Britannic Majesty: The Honorable Ernest Lapointe, K. C., B. A., LL. B., Minister of Marine and Fisheries of Canada;

Who, after having communicated to each other their respective full powers, found in good and due form, have agreed upon the following articles:

ARTICLE I

The nationals and inhabitants and the fishing vessels and boats of the United States and of the Dominion of Canada, respectively, are hereby prohibited from fishing for halibut (Hippoglossus) both in the territorial waters and in the high seas off the western coasts of the United States, including Bering Sea, and of the Dominion of Canada, from the 16th day of November next after the date of the exchange of ratifications of this convention, to the 15th day of the following February, both days inclusive, and within the same period yearly thereafter, provided that upon the recommendation of the International Fisheries Commission hereinafter described, this close season may be modified or suspended at any time after the expiration of three such seasons, by a special agreement concluded and duly ratified by the high contracting parties.

It is understood that nothing contained in this article shall prohibit the nationals or inhabitants and the fishing vessels or boats of the United States and of the Dominion of Canada from fishing in the waters hereinbefore specified for other species of fish during the season when fishing for halibut in such waters is prohibited by this article. Any halibut that may be taken incidentally when fishing for other fish during the season when fishing for halibut is prohibited under the provisions of this article may be retained and used for food for the crew of the vessel by which they are taken. Any portion thereof not so used shall be landed and immediately turned over to the duly authorized officers of the Department of Commerce of the United States or of the Department of Marine and Fisheries of the Dominion of Canada. Any fish turned over to such officers in pursuance of the provisions of this article shall be sold by them to the highest bidder and the proceeds of such sale, exclusive of the necessary expenses in connection therewith, shall be paid by them into the Treasuries of their respective countries.

ARTICLE II

Every national or inhabitant, vessel or boat of the United States or of the Dominion of Canada engaged in halibut fishing in violation of the preceding article may be seized except within the jurisdiction of the other party by the duly authorized officers of either high contracting party and detained by the officers making such seizure and delivered as soon as practicable to an authorized official of the country to which such person, vessel, or boat belongs, at the nearest point to the place of seizure, or elsewhere, as may be mutually agreed upon. The authorities of the nation to which such person, vessel, or boat belongs alone shall have jurisdiction to conduct prosecutions for the violation of the provisions of the preceding article or of the laws or regulations which either high contracting party may make to carry those provisions into effect, and to impose penalties for such violations; and the witnesses and proofs necessary for such prosecutions, so far as such witnesses or proofs are under the control of the other high contracting party, shall be furnished with all reasonable promptitude to the authorities having jurisdiction to conduct the prosecutions.

ARTICLE III

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 members, two to be appointed by each party. This commission shall continue to exist so long as this convention shall remain in force. Each party shall pay the salaries and expenses of its own members, and joint expenses incurred by the commission shall be paid by the two high contracting parties in equal moieties.

The commission shall make a thorough investigation into the life history of the Pacific halibut, and such investigation shall be undertaken as soon as practicable. The commission shall report the results of its investigation to the two Governments and shall make recommendations as to the regulation of the halibut fishery of the north Pacific Ocean, including the Bering Sea, which may seem to be desirable for its preservation and development.

ARTICLE IV

The high contracting parties agree to enact and enforce such legislation as may be necessary to make effective the provisions of this convention, with appropriate penalties for violations thereof.

ARTICLE V

This convention shall remain in force for a period of five 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 it. It shall be ratified in accordance with the constitutional methods of the high contracting parties. The ratifications shall be exchanged in Washington as soon as practicable, and the convention shall come into force on the day of the exchange of ratifications.

In faith whereof the respective plenipotentiaries have signed the present convention in duplicate, and have thereunto affixed their seals.

Done at the city of Washington, the second day of March, in the year of our Lord one thousand nine hundred and twenty-three.

Charles Evans Hughes. [seal.]
Ernest Lapointe. [seal.]

And whereas the said convention has been duly ratified on both parts, and the ratifications of the two Governments were exchanged in the city of Washington on the twenty-first day of October, one thousand nine hundred and twenty-four;

Now, therefore, be it known that I, Calvin Coolidge, President of the United States of America, have caused the said convention to be made public, to the end that the same and every article and clause thereof may be observed and fulfilled with good faith by the United States and the citizens thereof.

In testimony whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the city of Washington, this twenty-second day of October, in the year of our Lord one thousand nine hundred and twenty-four, and of the Independence of the United States of America the one hundred and forty-ninth.

[seal] Calvin Coolidge.

By the President:
Charles E. Hughes,
Secretary of State.

Under date of November 3, 1924, an Executive order was issued in regard to the maintenance of a patrol for the enforcement of the provisions of the northern Pacific halibut act, as follows:

Executive Order Regarding the Enforcement of the Act for the Protection of the Northern Pacific Halibut Fishery, Approved June 7, 1924

It being expedient for the enforcement of the act for the protection of the northern Pacific halibut fishery, approved June 7, 1924, that a patrol be maintained in certain waters, and that public vessels be designated for that purpose and officers be designated to enforce said act:

Therefore it is hereby ordered:

1. That a patrol be maintained in the territorial waters of the United States and the high seas, including Bering Sea, extending westerly from the territorial waters of the United States and Canada, to be conducted by any naval or other public vessels on service in such waters and including specifically the following named vessels of the Bureau of Fisheries: *Widgeon*, *Murre*, *Auklet*, *Petrel*, *Eider*, *Kittiwake*, *Blue Wing*, *Merganser*, and *Scoter*.
2. That the masters of such vessels, and the agents, assistant agents, inspectors, and wardens of the Bureau of Fisheries are hereby designated as officials to exercise all powers of search and seizure conferred by said act upon persons so designated by the President.

Calvin Coolidge.

The White House,
November 3, 1924.

NEW FISHERY REGULATIONS

Under the authority conferred by the act of June 6, 1924, regulations covering the fisheries of Alaska were issued by the Secretary of Commerce June 21, 1924, as follows:

By virtue of the authority vested in the Secretary of Commerce, fishing areas are hereby set apart and regulations governing fishing therein are made immediately effective, as follows:

I. BRISTOL BAY AREA

The Bristol Bay area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Cape Menshikof to Cape Newenham.

1. Commercial fishing for salmon shall be conducted solely by drift gill nets. The use of salmon traps, beach seines, and purse seines is prohibited.

2. The total length of gill nets on any salmon fishing boat shall not exceed two hundred (200) fathoms, hung measure.

3. King-salmon nets shall have a mesh at least 8½ inches, stretched measure, and red-salmon nets a mesh at least 5¾ inches, stretched measure, between knots.

4. Commercial fishing for king salmon may begin at any time after the appearance of the run, but must close by midnight of July 25 of each year.

5. Commercial fishing for red salmon shall not begin prior to midnight of June 25, and must close by midnight of July 25 of each year, when all commercial fishing for salmon shall cease in this area.

6. The trailing of web behind any fishing boat is prohibited above the markers fixing closed waters.

7. The use of motor-propelled fishing boats in catching salmon is prohibited.

8. Fishing for smelts in localities where red salmon are migrating is prohibited.

9. Commercial fishing for salmon is prohibited in the Ugashik River above a line extending at right angles across said river 500 yards below the mouth of King Salmon River.

10. Commercial fishing for salmon is prohibited above a line extending at right angles across Kvichak Bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic.

II. ALASKA PENINSULA AREA

The Alaska Peninsula area is hereby defined to include all territorial coastal and tributary waters of the Alaska Peninsula from Cape Menshikof on the Bering Sea shore and extending in a southwesterly direction to Unimak Pass, thence in a northeasterly direction along the Pacific side of the Alaska Peninsula to Castle Cape (Tuliumnit Point). The waters of Unimak, the Sannak, the Shumagin, and other adjacent islands are included.

1. In the waters of Nelson Lagoon, Herendeen Bay, and Port Moller the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, and from 12 o'clock midnight of each Tuesday until midnight of the following Wednesday, making a total weekly closed period in these waters of 84 hours, which shall be effective throughout the entire salmon-fishing season of each year.

2. In all other waters of this area the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours: *Provided*, That this extension of 24 hours closed period each week shall not be effective after midnight of July 20 each year.

3. Commercial fishing for salmon is prohibited in Thin Point Lagoon and stream and within a distance of 500 yards outside the entrance to said lagoon.

III. CHIGNIK AREA

The Chignik area is hereby defined to include the territorial coastal and tributary waters of Alaska along the mainland shore from Castle Cape (Tuliumnit Point) to Cape Kumnik.

1. The take of salmon within a line from Castle Cape to Cape Kumliun shall not exceed fifty (50) per cent of the total run as determined at the weir in Chignik River operated by the Bureau of Fisheries.

IV. KODIAK AREA

The Kodiak area is hereby defined to include the waters of the mainland shore extending from Cape Douglas southwestward to Cape Kumnik and the territorial coastal and tributary waters of Alaska surrounding Kodiak and adjacent islands, but excluding the waters embraced within the Afognak Forest and Fish Culture Reserve established by presidential proclamation of December 24, 1892.

Salmon fishery.—1. The use of purse seines and floating traps for the capture of salmon is prohibited.

2. Commercial fishing for salmon is prohibited along the western shore of Kodiak Island between Cape Alitak and Cape Karluk.

3. Commercial fishing for salmon is prohibited in the Karluk River and within one hundred (100) yards of its mouth where it breaks through Karluk Spit into Shelikof Strait. The take of salmon in Karluk waters shall not exceed fifty (50) per cent of the total run as determined at the weir in Karluk River operated by the Bureau of Fisheries.

4. Commercial fishing for salmon is prohibited from the village of Uyak in a general westerly direction to Cape Uyak.

5. In all waters inside of a line from Outlet Cape to Cape Uganik and to Miners Point, including Uganik Bay, Viekoda Bay, Terror Bay, and connecting and tributary waters, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.

6. The taking of salmon within a line from Alitak Cape to Trinity Cape shall not exceed fifty (50) per cent of the total run as determined at the weirs on tributary waters of Alitak Bay operated by the Bureau of Fisheries.

7. Commercial fishing for salmon inside of a line from Cape Alitak to Trinity Cape shall be conducted solely by beach seines and traps.

Herring fishery.—1. Gill nets used in catching herring shall not be of smaller mesh than three (3) inches, stretched measure.

2. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

V. COOK INLET AREA

The Cook Inlet area is hereby defined to include Cook Inlet, its tributary waters, and all adjoining waters north of Cape Douglas and west of Point Gore. The Barren Islands are included within this area.

Salmon fishery.—1. The 36-hour closed period for salmon fishing prescribed by section 5 of the act approved June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon is prohibited above a line from Point Possession to the western limit of the closed area around the mouth of the Susitna River.

3. Commercial fishing for salmon is prohibited in Chinik Inlet, Kamishak Bay, within a line which joins the outer headlands of the inlet and passes outside the two small islands which lie near its entrance.

4. The use of purse seines and floating traps for the capture of salmon is prohibited.

Herring fishery.—1. Fishing for herring is prohibited during the period from January 1 to May 31 of each calendar year, except for bait or for local food purposes.

2. The use of purse seines in the capture of herring is prohibited at all times in Halibut Cove and Lagoon, including the waters within a line drawn from the light on Ismailof Island to the outermost point on Glacier Spit.

3. The maintaining of a herring pound or the dumping of offal and dead herring in the waters of Halibut Cove and Lagoon is prohibited.

4. Gill nets used in catching herring shall not be of smaller mesh than three (3) inches, stretched measure.

5. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

VI. PRINCE WILLIAM SOUND AREA

The Prince William Sound area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Point Whitshed on the east to and including Resurrection Bay on the west.

Salmon fishery.—1. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon is prohibited at all times within one thousand (1,000) yards of the mouth of Coghill River, the mouth of Eshamy (Chenaga) River, and the mouths of Robe River, Lowe River, and other unnamed streams flowing into Port Valdez in the immediate vicinity of Valdez.

3. In Eshamy Bay, Eshamy Lagoon, and tributary waters, outside the closed area around the mouth of Coghill River, and outside the closed area around the mouths of Robe River, Lowe River, and other unnamed streams flowing into Port Valdez in the immediate vicinity of Valdez there shall be a distance interval of at least two hundred (200) yards both endwise and laterally at all times between all nets operated. Nets operated in these waters shall not exceed one hundred (100) yards each in length, and shall be set in substantially a straight line.

Herring fishery.—1. Fishing for herring is prohibited during the period from January 1 to June 24, both dates inclusive, and from November 1 to December 31, both dates inclusive, of each calendar year, except for bait or for local food purposes.

2. Gill nets used in catching herring shall not be of smaller mesh than three (3) inches, stretched measure.

3. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

VII. COPPER RIVER AREA

The Copper River area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Point Whitshed on the west to and including Bering River on the east.

1. Commercial fishing for salmon shall not begin prior to midnight of May 25 of each year.

2. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.

3. Stake nets for the capture of salmon shall not exceed 600 feet in length, and shall be set in substantially a straight line.

4. The use of traps for the capture of salmon is prohibited.

VIII. SOUTHEASTERN ALASKA AREA

The southeastern Alaska area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Dixon Entrance on the south to and including Yakutat Bay on the north.

1. In the waters of this area west of the 139th meridian of west longitude the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon within the waters between the 57th and 60th parallels of north latitude and east of the 139th meridian of west longitude is prohibited for 20 days from midnight of August 11 to midnight of August 31 of each year.

3. Commercial fishing for salmon within the waters south of the 57th parallel of north latitude, except the west coast of Prince of Wales Island and adjacent islands, is prohibited for 20 days from midnight of August 20 to midnight of September 9 of each year.

4. Commercial fishing for salmon within the waters of the west coast of Prince of Wales Island from Point Baker to Cape Chacon, including the waters of adjacent islands, is prohibited for 20 days from midnight of August 25 to midnight of September 14 of each year.

5. Commercial fishing for salmon is prohibited at all times in Yes Bay and within one thousand (1,000) yards outside of a line from Bluff Point to Syble Point.

6. Commercial fishing for salmon is hereby prohibited inside of markers which shall be established therefor in the following-described waters within this area:

(*a*) Thorne and Tolstoi Bays, indenting the eastern shore of Prince of Wales Island.

(*b*) Walker Cove, on the mainland tributary to Behm Canal.

(*c*) Naha Bay, indenting the western shore of Revillagigedo Island.

(*d*) Thoms Place, indenting the southwestern shore of Wrangell Island on Zimovia Strait.

(*e*) Olive Cove, indenting the northeastern shore of Etolin Island.

(*f*) Anita Bay, on Etolin Island, opening into Zimovia Strait.

(*g*) Tenakee Inlet and Freshwater Bay, indenting the eastern shore of Chichagof Island.
(*h*) Wilson Cove, indenting the western shore of Admiralty Island.
(*i*) Whitewater Bay, indenting the western shore of Admiralty Island.
(*j*) Saginaw Bay, indenting the northwestern shore of Kuiu Island.
(*k*) Ankau Creek and Inlet, in the Yakutat Bay region.
(*l*) Akwe or Ahquay River, in the Yakutat Bay region.

GENERAL REGULATIONS

By virtue of the authority conferred by the acts approved June 6, 1924, and June 26, 1906, the following regulations shall be immediately effective in all waters of Alaska, including the special areas already described above:

1. During closed periods all salmon traps within the areas affected shall be closed in accordance with the method prescribed by section 5 of the act of June 6, 1924.
2. All persons engaged in fishery operations are warned to give due regard to all markers erected by the Department of Commerce to indicate waters closed to fishery operations by the provisions of the act of June 6, 1924, and of regulations promulgated thereunder. Section 3 of that act specifically states that the mouths of creeks, streams, or rivers shall be taken to be as determined by the Secretary of Commerce and marked in accordance therewith.
3. In waters where a rack or weir is maintained by the Bureau of Fisheries for the purpose of counting salmon ascending to the spawning grounds records of the catch of salmon shall be furnished daily by all operators to the local representative of the Bureau of Fisheries in charge, and upon notification by the Commissioner of Fisheries or his authorized representative that an excessive proportion of the run is being taken, so that the escapement of any species is less than the 50 per cent specified by section 2 of the act of June 6, 1924, all commercial fishing operations shall at once be discontinued and shall not be resumed until permission therefor is granted by the Commissioner of Fisheries or his duly authorized representative.
4. 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.
5. During the inspection of the salmon fisheries by the agents and representatives of this department they shall have at all times free and unobstructed access to all canneries, salteries, and other fishing establishments, and to all hatcheries.
6. All persons, companies, or corporations owning, operating, or using any stake net, set net, trap net, pound net, or fish wheel for taking salmon or other fishes shall cause to be placed in a conspicuous place on said trap net, pound net, stake net, set net, or fish wheel the name of the person, company, or corporation owning, operating, or using same, together with a distinctive number, letter, or name which shall identify each particular stake net, set net, trap net, pound net, or fish wheel, said lettering and numbering to consist of black figures and letters, not less than 6 inches in length, painted on white ground.
7. If in the process of curing salmon bellies the remaining edible portion of the fish is not used such action will be regarded as wanton waste within the meaning of section 8 of the act of June 26, 1906, and those who engage in this practice will be reported for prosecution as provided for in the act.
8. These regulations do not apply to the Afognak Reservation, fishing within which is prohibited, except by resident natives, by the terms of the law and Executive order creating it.
9. The minimum size of razor clams taken for commercial purposes is fixed at four and one-half (4½) inches in total length of shell. Not more than five (5) per cent of the clams taken may measure less than this minimum.
10. These regulations shall be subject to such change or revision by the Secretary of Commerce as may appear advisable from time to time. They shall be in full force and effect immediately from and after date of issue.

Under date of August 20, 1924, the following supplementary regulations were issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, tenth edition, under date of June 21, 1924, all of which remain in full force and effect, are hereby supplemented by the following regulations:

ALASKA PENINSULA AREA

In all waters of the Alaska Peninsula area all commercial fishing for salmon shall cease at midnight August 23, 1924. This includes all territorial coastal and tributary waters of the Alaska Peninsula from Cape Menshikof on the Bering Sea shore and extending in a southwesterly direction to Unimak Pass, thence in a northeasterly direction along the Pacific side of the Alaska Peninsula to Castle Cape (Tuliumnit Point). The waters of Unimak, the Sannak, the Shumagin, and other adjacent islands are included.

SOUTHEASTERN ALASKA AREA

All commercial fishing for salmon is prohibited in the waters of Portage Bay, indenting the northern end of Kupreanof Island, southeastern Alaska, within a line drawn from West Point to Boulder Point. This prohibition shall become effective immediately.

Under date of August 26, 1924, the following supplementary regulation was issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, tenth edition, under date of June 21, 1924, together with additional regulations promulgated August 20, 1924, all of which remain in full force and effect, are hereby supplemented by the following regulation:

ALEUTIAN ISLANDS AREA

By virtue of the authority vested in the Secretary of Commerce there is hereby set apart the Aleutian Islands area, which is defined to include all territorial coastal and tributary waters of the Aleutian Islands westward of and including Unimak Pass. In this area all commercial fishing for salmon during the remainder of the year is prohibited after August 26, 1924.

Under date of August 29, 1924, the following supplementary regulation was issued:

COPPER RIVER AREA

Paragraph No. 2 of the fishery regulations for the Copper River area, Department of Commerce Circular No. 251, tenth edition, issued June 21, 1924, is hereby amended to read as follows:

2. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours: *Provided*, That this extension of 24 hours from 6 o'clock postmeridian of Friday of each week until 6 o'clock post meridian of the Saturday following shall not apply to the taking of coho salmon in 1924 after August 29.

Under date of August 30, 1924, the following supplementary regulation was issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, tenth edition, under date of June 21, 1924, together with subsequent regulations, are hereby supplemented by the following regulation:

SOUTHEASTERN ALASKA AREA

Commercial fishing for salmon, except by trolling, within the waters of the west coast of Prince of Wales Island from Point Baker to Cape Chacon, including the waters of adjacent islands, is prohibited from midnight of September 14 to midnight of October 31, 1924.

Under date of September 4, 1924, the following supplementary regulation was issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, tenth edition, under date of June 21, 1924, together with subsequent regulations, are hereby supplemented by the following regulation:

SOUTHEASTERN ALASKA AREA

Commercial fishing for herring in the waters of Kootznahoo Inlet, including Mitchell, Favorite, and Kanalku Bays, and connecting waters, within a line from Turn Point to Angoon village, is prohibited during the remainder of the year after September 4, 1924.

Under date of September 9, 1924, the following supplementary regulation was issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, tenth edition, under date of June 21, 1924, together with subsequent regulations, are hereby supplemented by the following regulation:

SOUTHEASTERN ALASKA AREA

Commercial fishing for salmon in Lynn Canal and all tributary waters north of the 59th parallel of north latitude is prohibited during the remainder of the year after September 9, 1924.

Under date of October 13, 1924, the following supplementary regulations were issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, under date of June 21, 1924, together with subsequent regulations, are hereby supplemented by the following regulations:

ALEUTIAN ISLANDS AREA

The order issued by the Acting Secretary of Commerce under date of August 26, 1924, creating the Aleutian Islands area and prohibiting all commercial fishing for salmon therein during the remainder of the year after August 26, 1924, is hereby modified so as to permit the taking of coho salmon in 1924 after October 13.

PRINCE WILLIAM SOUND AREA

Commercial fishing for herring in the waters of the Prince William Sound area will be permitted with gill nets of mesh not smaller than 3 inches, stretched measure, from November 1 to November 30, 1924, inclusive.

Under date of October 25, 1924, the following supplementary regulation was issued:

PRINCE WILLIAM SOUND AREA

The regulation of October 13, 1924, permitting commercial fishing for herring in the waters of the Prince William Sound area with gill nets of mesh not smaller than 3 inches, stretched measure, from November 1 to November 30, 1924, inclusive, is hereby modified to permit the use of gill nets of mesh not smaller than 2¼ inches, stretched measure, in the Prince William Sound area from November 1 to November 30, 1924.

Under date of November 24, 1924, the following supplementary regulations were issued:

The regulations for the protection of the fisheries of Alaska published in Department of Commerce Circular No. 251, under date of June 21, 1924, are hereby supplemented by the following regulations:

PRINCE WILLIAM SOUND AREA

Commercial fishing for herring with purse seines in the waters of the Prince William Sound area will be permitted through December 15, 1924.

COOK INLET AREA

Commercial fishing for herring with gill nets only in the waters of Halibut Cove and Lagoon, including the waters within a line drawn from the light on Ismailof Island to the outermost point on Glacier Spit, will be permitted through January 31, 1925.

Revised regulations covering the fisheries of Alaska were issued by the Secretary of Commerce under date of December 2, 1924, as follows:

By virtue of the authority vested in the Secretary of Commerce, fishing areas are hereby set apart and regulations governing fishing therein are made effective as follows:

I. YUKON AREA

The Yukon area is hereby defined to include all territorial coastal and tributary waters of Alaska between the parallels of 61 degrees north latitude and 64 degrees north latitude.

1. In the Yukon area all commercial fishing for salmon is prohibited at all times: *Provided*, That this prohibition shall not prevent the taking of fish for local food requirements or for use as dog feed.

2. After October 1, 1925, the Yukon area will be extended to include Kuskokwim waters, in which no commercial fishing will be permitted.

II. BRISTOL BAY AREA

The Bristol Bay area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Cape Menshikof to Cape Newenham.

1. Commercial fishing for salmon shall be conducted solely by drift gill nets. The use of salmon traps, beach seines, and purse seines is prohibited.

2. The total length of gill nets on any salmon-fishing boat shall not exceed 200 fathoms, hung measure.

3. King-salmon nets shall have a mesh at least 8½ inches, stretched measure, and red-salmon nets a mesh at least 5¾ inches, stretched measure, between knots. After 1925 red-salmon nets shall have a minimum mesh of 5½ inches, stretched measure, between knots. No red-salmon nets shall be over 28 meshes deep.

4. Prior to 6 o'clock antemeridian June 22 in each year commercial fishing with nets of mesh less than 8½ inches, stretched measure, between knots is prohibited.

5. Commercial fishing for salmon is prohibited during the remainder of each calendar year after July 25.

6. The trailing of web behind any fishing boat is prohibited above the markers fixing closed waters.

7. The use of motor-propelled fishing boats in catching salmon is prohibited.

8. Fishing for smelts in localities where red salmon are migrating is prohibited.

9. Commercial fishing for salmon is prohibited in the Ugashik River above a line extending at right angles across said river 500 yards below the mouth of Dog Salmon Creek.

10. Commercial fishing for salmon is prohibited above a line extending at right angles across Kvichak Bay from the marker on a high point on the east bank of Prosper Creek, about 700 yards above the Koggiung cannery of the Alaska Packers Association, to the marker on the opposite side, the course being about north, 44 degrees west, magnetic.

III. ALASKA PENINSULA AREA

The Alaska Peninsula area is hereby defined to include all territorial coastal and tributary waters of the Alaska Peninsula from Cape Menshikof on the Bering Sea shore and extending in a southwesterly direction to Unimak Pass, thence in a northeasterly direction along the Pacific side of the Alaska Peninsula to Castle Cape (Tuliumnit Point). The waters of Unimak, the Sannak, the Shumagin, and other adjacent islands are included.

1. In the waters of Nelson Lagoon, Herendeen Bay, Port Moller, and along the coast from Port Moller to Seal Island, including the mouths of Bear and Sandy Rivers, the 36-hour weekly closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the periods from 6 o'clock postmeridian of Tuesday of each week to 6 o'clock antemeridian of Thursday of each week and from 6 o'clock postmeridian of Friday of each week to 6 o'clock antemeridian of Saturday of each week, making a total weekly closed period in these waters of 84 hours, which shall be effective throughout the entire salmon-fishing season of each year.

2. In all other waters of this area the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include

the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours: *Provided*, That this extension of 24 hours closed period each week shall not be effective after midnight of July 25 each year.

3. The use of floating traps for the capture of salmon is prohibited.

4. The use of purse seines for the capture of salmon is prohibited, except that in the territorial coastal and tributary waters on the southern side of the Alaska Peninsula between the meridians of 159 degrees west longitude and 161 degrees 30 minutes west longitude seines not to exceed 100 fathoms in length and 150 meshes in depth may be used. Purse seines are permitted in waters between Lagoon Point and the southwest end of Seal Island.

5. In Port Heiden waters the catch of red salmon shall not exceed 35,000 in any calendar year.

6. All commercial fishing for salmon is prohibited as follows:

(*a*) Morzhovoi Bay: All waters within the bay east of 163 degrees 5 minutes west longitude.

(*b*) Thin Point Lagoon: All waters within the lagoon and its stream and within a distance of 500 yards outside the entrance to the lagoon.

(*c*) Cold Bay: All waters of the bay within a line extending from the eastern extremity of Thin Point to a point at 55 degrees 2 minutes north latitude and 162 degrees 25 minutes west longitude.

(*d*) Stepovak Bay and Balboa Bay: All waters of these bays and of their branches and arms, excepting Orzinski (Orzenoi) Bay, within a line drawn from the outer extremity of Kupreanof Point to the outer extremity of Cape Aliaksin. In Orzinski (Orzenoi) Bay beach seines only may be used and the catch of red salmon shall not exceed 25,000 in any calendar year.

(*e*) All waters between Kupreanof Point and Cape Ikti.

IV. ALEUTIAN ISLANDS AREA

The Aleutian Islands area is hereby defined to include all territorial coastal and tributary waters of the Aleutian Islands westward of and including Unimak Pass.

1. Commercial fishing for salmon is prohibited in the period from August 11 to October 1, both dates inclusive.

V. CHIGNIK AREA

The Chignik area is hereby defined to include the territorial coastal and tributary waters of Alaska along the mainland shore from Castle Cape (Tuliumnit Point) to Cape Kumnik.

1. The take of salmon within Chignik waters shall not exceed 50 per cent of the total run as determined at the weir in Chignik River operated by the Bureau of Fisheries.

2. The use of purse seines for the capture of salmon is prohibited.

3. Commercial fishing for salmon is prohibited prior to June 15 and after September 10 of each year.

4. Commercial fishing for salmon is prohibited in the waters surrounding Nakchamik and Chankliut Islands.

VI. KODIAK AREA

The Kodiak area is hereby defined to include the waters of the mainland shore extending from Cape Douglas southwestward to Cape Kumnik, and the territorial coastal and tributary waters of Alaska surrounding Kodiak and adjacent islands, but excluding the waters embraced within the Afognak Forest and Fish Culture Reserve established by presidential proclamation of December 24, 1892.

Salmon fishery.—1. The use of purse seines and floating traps for the capture of salmon is prohibited.

2. Commercial fishing for salmon in Alitak Bay and all its branches within a line from Cape Trinity to Cape Alitak prior to June 15 in each year is prohibited.

3. Commercial fishing for salmon in Karluk waters, extending from Cape Karluk to Cape Kuliuk, prior to June 15 and after September 10 in each year is prohibited. The take of salmon in these waters shall not exceed 50 per cent of the total run as determined at the weir in Karluk River operated by the Bureau of Fisheries.

4. In all waters inside of a line from Outlet Cape to Cape Uganik and to Miners Point, including Uganik Bay, Viekoda Bay, Terror Bay, and connecting and

tributary waters, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.

5. Commercial fishing for salmon in East Arm, Uganik Bay, within a line drawn from Mink Point to Rock Point, prior to July 21 in each calendar year is prohibited.

6. All commercial fishing for salmon between Cape Uyak and Cape Karluk except by beach seines is prohibited.

7. Commercial fishing for salmon within a line from Cape Trinity to Cape Alitak shall be conducted solely by beach seines and traps, but no traps whatever shall be used in fishing for salmon inside a line drawn from Bun Point through Turn Island at the entrance of Moser Bay.

8. The take of salmon within waters in which the runs are tributary to Olga Bay shall not exceed 50 per cent of the total run as determined at the weirs on tributary waters of Olga Bay operated by the Bureau of Fisheries.

9. All commercial fishing for salmon is prohibited as follows:

(*a*) Western shore of Kodiak Island: All waters along the western shore of Kodiak Island between Cape Alitak and Cape Karluk.

(*b*) Karluk River: All waters within Karluk River and within 100 yards of its mouth where it breaks through Karluk Spit into Shelikof Strait.

(*c*) Kizhuyak Bay, indenting the northeast shore of Kodiak Island: All waters within a line from Kekur Point to Inner Point.

(*d*) Kaflia Bay, on north shore of Shelikof Strait: All waters within a line drawn from Cape Ugyak to Cape Gull.

(*e*) Kiliuda Bay, southeastern shore of Kodiak Island: All waters within a line drawn from Right Cape to Left Cape.

(*f*) Eagle Harbor, in Ugak Bay, southeastern shore of Kodiak Island: All waters within the harbor.

Herring fishery.—1. Commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

2. Gill nets used in catching herring shall not be of smaller mesh than 3 inches, stretched measure.

3. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Clam fishery.—The minimum size of razor clams taken for commercial purposes is fixed at 4½ inches in total length of shell. Not more than 3 per cent by number of the clams taken may measure less than this minimum.

VII. COOK INLET AREA

The Cook Inlet area is hereby defined to include Cook Inlet, its tributary waters, and all adjoining waters north of Cape Douglas and west of Point Gore. The Barren Islands are included within this area.

Salmon fishery.—1. All commercial fishing for salmon is prohibited during the remainder of each calendar year after August 10.

2. The use of purse seines and floating traps for the capture of salmon is prohibited.

3. Commercial fishing for salmon is prohibited within 1 statute mile of all salmon streams, except in respect to the Kasilof and Kenai Rivers, where commercial fishing for salmon is prohibited within 2 statute miles of their mouths.

4. Commercial fishing for salmon is prohibited above a line from Point Possession to the western limit of the closed area around the mouth of the Susitna River.

5. Commercial fishing for salmon is prohibited in Chinik Inlet, Kamishak Bay.

Herring fishery.—1. Commercial fishing for herring is prohibited during the period from January 1 to May 31, both dates inclusive, of each calendar year: *Provided*, That herring fishing will be permitted in Halibut Cove and Lagoon, including the waters within a line drawn from the light on Ismailof Island to the outermost point on Glacier Spit, through January 31, 1925.

2. Commercial fishing for herring in Halibut Cove and Lagoon, including the waters within a line drawn from the light on Ismailof Island to the outermost point on Glacier Spit, is limited to gill nets.

3. The closed season herein specified for herring fishing shall not apply to any boat taking not to exceed 60 barrels of herring in any calendar week in waters open to fishing.

4. Commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

5. The maintaining of a herring pound or the dumping of offal and dead herring in the waters of Halibut Cove and Lagoon is prohibited.

6. Gill nets used in catching herring shall not be of smaller mesh than 3 inches, stretched measure.

7. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Clam fishery.—The minumum size of razor clams taken for commercial purposes is fixed at 4½ inches in total length of shell. Not more than 3 per cent by number of the clams taken may measure less than this minimum.

VIII. RESURRECTION BAY AREA

The Resurrection Bay area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Point Gore on the west and Cape Fairfield on the east.

1. In the waters of Resurrection Bay within a line from Cape Resurrection to the western side of Bear Glacier at its mouth, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock postmeridian of Friday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 60 hours.

2. Commercial fishing for salmon within 1,500 yards of the mouths of Bear Creek and Resurrection River is prohibited.

IX. PRINCE WILLIAM SOUND AREA

The Prince William Sound area is hereby defined to include all territorial coastal and tributary waters of the Gulf of Alaska between Cape Fairfield on the west and Point Whitshed on the east.

Salmon fishery.—1. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon is prohibited from August 10 to August 25, both dates inclusive, in each year.

3. All set or anchored gill nets shall not exceed 100 yards each in length and shall be placed in substantially a straight line: *Provided*, That not to exceed 20 yards of each net may be used as a hook. Only one such hook is permitted on a net. There shall be a distance interval of at least 200 yards both endwise and laterally at all times between all set or anchored gill nets operated.

4. All traps operated in the Prince William Sound area shall be at least 1½ statute miles apart laterally, except traps operating at Montague Island.

5. All commercial fishing for salmon is prohibited as follows:

(*a*) Boswell Bay, indenting Hinchinbrook Island: All waters in the bay west of 146 degrees 8 minutes west longitude.

(*b*) Robe River, Lowe River, and other unnamed streams flowing into Port Valdez in the immediate vicinity of Valdez: All waters within 1,000 yards of the mouths.

(*c*) Billy's Hole, tributary to Long Bay, between Valdez Arm and Unakwik Inlet: All waters within a line drawn from Point Scott to Point Hook and passing just westward of Observation Island.

(*d*) Unakwik Inlet, indenting mainland on north shore of Prince William Sound: All waters north of an east and west line passing through the northern side of the entrance to Jonah Bay.

(*e*) Coghill River, tributary to College Fiord: All waters within 2,000 yards outside of the mouth of the river.

(*f*) Long Bay, tributary to Culross Passage: All waters within the bay.

(*g*) Gumboot Creek, on northwest shore of Eshamy Bay: All waters within 1,000 yards of the mouth of the creek.

(*h*) Eshamy Lagoon and its tributary waters: All waters within the lagoon and its tributaries and within 50 yards outside the narrows at the entrance to the lagoon.

(*i*) Jackpot Bay: All waters within a line extending at right angles across its mouth 2,000 yards below the mouth of the red-salmon stream emptying into the bay.

(*j*) Port Bainbridge: All waters in the middle north arm of Port Bainbridge.

(*k*) Bay of Isles, indenting east shore of Knight Island: All waters within a line running northwest from the extremity of the point of land at the eastern side of the entrance to the middle south arm. This line extends across the Bay of Isles about 2 statute miles below the mouth of the red-salmon stream emptying into the bay.

Herring fishery.—1. Commercial fishing for herring is prohibited during the period from January 1 to June 24, both dates inclusive, and from November 1 to December 31, both dates inclusive, of each calendar year.

2. The closed seasons herein specified for herring fishing shall not apply to any boat taking not to exceed 60 barrels of herring in any calendar week in waters open to fishing.

3. Commercial fishing for herring is prohibited in all waters closed throughout the year to salmon fishing.

4. Gill nets used in catching herring shall not be of smaller mesh than 2¼ inches, stretched measure.

5. No one shall place, or cause to be placed, across the entrance of any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Clam fishery.—The minimum size of razor clams taken for commercial purposes is fixed at 4½ inches in total length of shell. Not more than 3 per cent by number of the clams taken may measure less than this minimum.

X. COPPER RIVER AREA

The Copper River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Whitshed on the west and Point Martin on the east.

1. Commercial fishing for salmon is prohibited in the period from July 11 to August 19, both dates inclusive.

2. From May 20 to July 10, both dates inclusive, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

3. Prior to May 20 in each year commercial fishing with nets of mesh less than 8½ inches, stretched measure, between knots is prohibited.

4. The use of stake nets, set or anchored gill nets, and traps for the capture of salmon is prohibited.

5. Commercial fishing for salmon shall be conducted solely by drift gill nets not exceeding 200 fathoms in length each.

6. Commercial fishing for salmon is prohibited within 500 yards of the grass banks.

XI. BERING RIVER AREA

The Bering River area is hereby defined to include all territorial coastal and tributary waters of Alaska between Point Martin on the west and Cape Suckling on the east.

1. Commercial fishing for salmon is prohibited in the period from July 11 to August 19, both dates inclusive.

2. From June 1 to July 10, both dates inclusive, the 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

3. Prior to June 1 in each year commercial fishing with nets of mesh less than 8½ inches, stretched measure, between knots is prohibited.

4. Commercial fishing for salmon shall be conducted solely by drift gill nets not exceeding 200 fathoms in length.

XII. SOUTHEASTERN ALASKA AREA

The southeastern Alaska area is hereby defined to include all territorial coastal and tributary waters of Alaska extending from Dixon Entrance on the south to and including Yakutat Bay on the north.

Salmon fishery.—This area is subdivided into the following districts, wherein regulations shall be effective as follows:

Yakutat district.—All waters of this area west of the one hundred and thirty-eighth meridian of west longitude.

1. The 36-hour closed period for salmon fishing prescribed by section 5 of the act of June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week until 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon is prohibited during the period from 12 o'clock midnight of July 20 until 12 o'clock midnight of August 5 in each year.

3. North of the parallel of 58 degrees north latitude all traps shall be at least 1½ statute miles apart laterally.

4. No salmon-fishing boat shall carry or operate more than one seine of any description. No purse seine shall be less than 200 meshes nor more than 300 meshes in depth, nor less than 150 fathoms nor more than 250 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches, stretched measure, between knots. No extension to any seine in the way of leads will be permitted.

5. All commercial fishing for salmon is prohibited as follows:

(*a*) Ankau Creek and Inlet.

(*b*) Akwe or Ahquay River.

(*c*) The "Basin" above Dry Bay.

Icy Strait-Cross Sound district.—All waters of this area north of the fifty-eighth parallel of north latitude and east of the one hundred and thirty-eighth meridian of west longitude.

1. Commercial fishing for salmon, except by trolling, is prohibited for the remainder of each year after 12 o'clock midnight of August 6. Fishing with gill nets only will be permitted from September 5 to October 15, both dates inclusive, in areas open to fishing.

2. North of the parallel of 58 degrees north latitude all traps shall be at least 1½ statute miles apart laterally.

3. No salmon-fishing boat shall carry or operate more than one seine of any description. No purse seine shall be less than 200 meshes nor more than 300 meshes in depth, nor less than 150 fathoms nor more than 250 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches, stretched measure, between knots. No extension to any seine in the way of leads will be permitted.

4. Gill nets used in that portion of Lynn Canal that is open to commercial fishing for salmon shall not exceed 200 fathoms in length each.

5. All commercial fishing for salmon is prohibited as follows:

(*a*) Port Frederick, northern shore of Chichagof Island: All waters east of a line drawn from Inner Point Sophia to Game Point, and all waters south of 58 degrees 4 minutes north latitude. A portion of the waters closed is in the central district.

(*b*) Glacier Bay: All waters within a line drawn from Point Carolus to Point Gustavus.

(*c*) Lynn Canal: All waters north of the south end of the first island south of Seduction Point.

(*d*) Taku Inlet: All waters within 1 statute mile of the mouth of Taku River.

Central district.—All waters of this area between the fifty-seventh and fifty-eighth parallels of north latitude.

1. Commercial fishing for salmon, except by trolling, is prohibited for the remainder of each year after 12 o'clock midnight of August 11.

2. No salmon-fishing boat shall carry or operate more than one seine of any description. No purse seine shall be less than 200 meshes nor more than 300 meshes in depth, nor less than 150 fathoms nor more than 250 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches, stretched measure, between knots. No extension to any seine in the way of leads will be permitted.

3. All commercial fishing for salmon is prohibited as follows:

(*a*) Portage Bay, north end of Kupreanof Island: All waters within the bay and all waters within 1 statute mile outside the entrance to the bay. A portion of the waters closed is in the southern district.

(*b*) Gambier Bay, east coast of Admiralty Island: All waters west of 134 degrees west longitude.

(*c*) Wilson Cove, southwestern shore of Admiralty Island: All waters within the cove.

(*d*) Whitewater Bay, southwestern shore of Admiralty Island: All waters within a line drawn from Point Caution to Woody Point.

(*e*) Chaik Bay, southwestern shore of Admiralty Island: All waters east of 134 degrees 29 minutes west longitude.

(*f*) Warm Spring Bay, eastern shore of Baranof Island: All waters within the bay.

(*g*) Hanus Bay, northeast shore of Baranof Island: All waters in the bay south of a line drawn from Point Hanus to Point Moses.

(*h*) Basket Bay, east coast of Chichagof Island: All waters within the bay.

(*i*) Tenakee Inlet and Freshwater Bay: All waters within a line drawn from North Passage Point to South Passage Point.

Stikine River district.—All waters within a line from Babbler Point on the mainland to Woronkofski Point on Woronkofski Island, thence to Middle Craig Point on Zarembo Island, thence to Point Howe on Mitkof Island, thence to Frederick Point on Mitkof Island, thence across Frederick Sound to Horn Cliffs on the mainland, thence along the mainland to Babbler Point.

1. The 36-hour closed period for salmon fishing prescribed by section 5 of the act approved June 6, 1924, is hereby extended to include the period from 6 o'clock antemeridian of Saturday of each week to 6 o'clock antemeridian of the Monday following, making a weekly closed period of 48 hours.

2. Commercial fishing for salmon is prohibited in the period from June 21 to July 5, both dates inclusive.

3. Commercial fishing for salmon shall be conducted solely by drift gill nets which shall not exceed 200 fathoms in length each.

Prince of Wales Island district.—All waters of the west coast of Prince of Wales Island and adjacent islands from Cape Chacon northward to Point Baker, and within a line from Point Baker to Pine Point, thence along the shore line to Point Colpoys, thence to Middle Craig Point on Zarembo Island, thence to Woronkofski Point on Woronkofski Island, thence to Babbler Point on the mainland, thence to Watkins Point on Cleveland Peninsula, thence following the watershed between Ernest Sound and Behm Canal to and including Lemesurier Point, thence to Tolstoi Point on Prince of Wales Island, thence following the watershed on Prince of Wales Island to Cape Chacon.

1. Commercial fishing for salmon, except by trolling, is prohibited from 12 o'clock midnight of August 22 to 12 o'clock midnight of September 14 in each year, and for the remainder of each year from 12 o'clock midnight of October 15; and in addition commercial fishing for salmon, except by trolling, is prohibited in all waters of the west coast of Prince of Wales Island and adjacent islands from Cape Chacon northward to Point Baker from January 1 to 12 o'clock midnight of July 14 in each year.

2. No salmon-fishing boat shall carry or operate more than one seine of any description. No purse seine shall be less than 200 meshes nor more than 300 meshes in depth, nor less than 150 fathoms nor more than 250 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches, stretched measure, between knots. No extension to any seine in the way of leads will be permitted.

3. All commercial fishing for salmon is prohibited as follows:

(*a*) Thorne and Tolstoi Bays, indenting the eastern shore of Prince of Wales Island: All waters within a line from Tolstoi Point to Thorne Head.

(*b*) Barnes Lake, at head of Lake Bay, northeast coast of Prince of Wales Island: All waters in Barnes Lake and within 50 yards outside its entrance.

(*c*) Whale Passage, northeast coast of Prince of Wales Island: All waters within 1,000 yards from mouths of all salmon streams.

(*d*) Shipley Bay, west coast of Kosciusko Island: All waters east of 133 degrees 32 minutes 30 seconds west longitude.

(*e*) Sarkar Cove, west coast of Prince of Wales Island, tributary to El Capitan Passage: All waters inside of a line across the entrance.

(*f*) Hetta Inlet, west coast of Prince of Wales Island: All waters north of a line running east from Eek Point to the opposite shore.

(*g*) Kasook Inlet, southern coast of Sukkwan Island: All waters within 1 statute mile of head of inlet.

(*h*) North Bay, northeast coast of Dall Island: All waters within 1,000 yards of the mouths of all salmon streams.

(*i*) Olive Cove, indenting the northeastern shore of Etolin Island.

(*j*) Anita Bay, opening into Zimovia Strait, Etolin Island.

(*k*) Thoms Place, indenting the southwestern shore of Wrangell Island, Zimovia Strait.

(*l*) McHenry Inlet, southwest coast of Etolin Island: All waters within 1,000 yards of the salmon streams emptying into the head of McHenry Inlet.

Southern district.—All waters south of the fifty-seventh parallel of north latitude, exclusive of the Stikine River and Prince of Wales Island districts herein described.

1. Commercial fishing for salmon, except by trolling, is prohibited from 12 o'clock midnight of August 18 to 12 o'clock midnight of September 14 in each year, and for the remainder of each calendar year after 12 o'clock midnight of October 15.

2. No salmon-fishing boat shall carry or operate more than one seine of any description. No purse seine shall be less than 200 meshes nor more than 300 meshes in depth, nor less than 150 fathoms nor more than 250 fathoms in length measured on the cork line. For the purpose of determining depths of seines measurements will be upon the basis of 3½ inches, stretched measure, between knots. No extension to any seine in the way of leads will be permitted.

3. All commercial fishing for salmon is prohibited as follows:

(*a*) Hidden Inlet, indenting mainland: All waters in the inlet north of 55 degrees north latitude.

(*b*) Very Inlet, indenting mainland: All waters within the inlet.

(*c*) Boca de Quadra, indenting mainland: All waters within 1 statute mile of the mouth of Sockeye Creek.

(*d*) Smeaton Bay, indenting mainland: All waters in Wilson and Bakewell Arms east of 130 degrees 40 minutes west longitude.

(*e*) Rudyerd Bay, indenting mainland: All waters in the north arm within 2 statute miles of the mouths of all salmon streams.

(*f*) Walker Cove, indenting mainland, tributary to Behm Canal: All waters within a line from Ledge Point to Hut Point.

(*g*) Chickamin River: All waters within a line from Fish Point to Trap Point.

(*h*) Yes Bay, Cleveland Peninsula: All waters within the bay and all waters outside the entrance within 1,000 yards of a line from Bluff Point to Syble Point.

(*i*) Anan Creek: All waters within 1 statute mile from the mouth of creek.

(*j*) Shrimp Bay, west coast of Revillagigedo Island: All waters east of a line running south from Dress Point to the opposite shore.

(*k*) Traitors Cove, west coast of Revillagigedo Island: All waters of the cove within a line 50 yards outside the neck of the salt-water lagoon.

(*l*) Naha Bay, indenting the western shore of Revillagigedo Island: All waters within a line from Grant Island to Indian Point.

(*m*) George Inlet, southern coast of Revillagigedo Island: All waters north of a line drawn from Bat Point to Tsa Cove.

(*n*) Moira Sound, éast coast of Prince of Wales Island: All waters in south arm of sound and in Frederick Cove.

(*o*) Dora Bay, arm of Cholmondeley Sound, east coast of Prince of Wales Island: All waters in the bay.

(*p*) Skowl Arm, Prince of Wales Island: All waters within a line drawn from Old Kasaan village to Khayyam Point.

(*q*) Kasaan Bay, east coast of Prince of Wales Island: All waters north of a line drawn from Sandy Point to the east shore of the bay.

(*r*) Wrangell Narrows: All waters between Point Alexander and Prolewy Point.

(*s*) Affleck Canal, southeastern coast Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Affleck Canal.

(*t*) Port Beauclerc, southeastern coast Kuiu Island: All waters within 1,000 yards of the mouths of all salmon streams tributary to Port Beauclerc.

(*u*) Saginaw Bay, indenting the northwestern shore of Kuiu Island: All waters in the bay.

(*v*) Bay of Pillars, west coast of Kuiu Island: All waters in south arm of bay.

(*w*) Tebenkof Bay, west coast of Kuiu Island: All waters in north arm of bay.

(*x*) Gut Bay, east coast of Baranof Island: All waters of the bay.

(*y*) Red Bluff Bay, east coast of Baranof Island: All waters in the bay; the waters of Falls Creek Bay are included.

Herring fishery.—1. Unless otherwise specified, commercial fishing for herring is prohibited in all waters closed throughout the entire year to salmon fishing.

2. Commercial fishing for herring is prohibited during the period from January 1 to May 31, both dates inclusive, and from September 16 to December 31, both dates inclusive, of each calendar year, with the following exceptions:

(*a*) Commercial fishing for herring may be conducted from March 15 to April 15, both dates inclusive, in waters in the vicinity of Sitka within a line from Halibut Point to Cape Burunof.

(b) Commercial fishing for herring may be conducted from December 15 to January 15, both dates inclusive, in the waters of Seward Passage and Ernest Sound.

(c) Commercial fishing for herring may be conducted from January 1 to February 15, both dates inclusive, in the waters of Clarence Strait within a radius of 3 statute miles of the town of Hadley, Tongass Narrows, Cholmondeley Sound, and Behm Canal and its tributary waters west of Bell Island to a line from Caamano Point to Point Higgins.

3. The closed seasons herein specified for herring fishing shall not apply to any boat taking not to exceed 60 barrels of herring in any calendar week in waters open to fishing.

4. No one shall place, or cause to be placed, across the entrance to any lagoon or bay any net or other device which will prevent the free passage at all times of herring in and out of said lagoon or bay.

Shrimp fishery.—Commercial fishing for shrimps is prohibited in the period from March 15 to April 30, both dates inclusive, in each year.

Crab fishery.—Dungeness crab (*Cancer magister*). No female of this species shall be taken at any time, and no male of this species measuring less than 6½ inches in greatest width shall be taken for commercial purposes.

GENERAL REGULATIONS

By virtue of the authority conferred by the acts approved June 6, 1924, and June 26, 1906, the following regulations shall be effective in all waters of Alaska, including the special areas already described above:

1. During closed periods all salmon traps within the areas affected shall be closed in accordance with the method prescribed by section 5 of the act of June 6, 1924.

2. All persons engaged in fishery operations are warned to give due regard to all markers erected by the Department of Commerce.

3. In waters where a rack or weir is maintained by the Bureau of Fisheries for the purpose of counting salmon ascending to the spawning grounds, records of the catch of salmon shall be furnished daily by all operators to the local representative of the Bureau of Fisheries in charge, and upon notification by the Commissioner of Fisheries or his authorized representative that an excessive proportion of the run is being taken, so that the escapement of any species is less than the 50 per cent specified by section 2 of the act of June 6, 1924, all commercial fishing operations shall at once be discontinued and shall not be resumed until permission therefor is granted by the Commissioner of Fisheries or his duly authorized representative.

4. 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.

5. During the inspection of the salmon fisheries by the agents and representatives of this department they shall have at all times free and unobstructed access to all canneries, salteries, and other fishing establishments, and to all hatcheries.

6. All persons, companies, or corporations owning, operating, or using any stake net, set net, trap net, pound net, or fish wheel for taking salmon or other fishes shall cause to be placed in a conspicuous place on said trap net, pound net, stake net, set net, or fish wheel the name of the person, company, or corporation owning, operating, or using same, together with a distinctive number, letter, or name which shall identify each particular stake net, set net, trap net, pound net, or fish wheel, said lettering and numbering to consist of black figures and letters, not less than 6 inches in length, painted on white ground.

7. If in the process of curing salmon bellies the remaining edible portion of the fish is not used, such action will be regarded as wanton waste within the meaning of section 8 of the act of June 26, 1906, and those who engage in this practice will be reported for prosecution as provided for in the act.

8. These regulations do not apply to the Afognak Reservation, fishing within which is prohibited, except by resident natives, by the terms of the law and Executive order creating it.

9. The taking of salmon for fox feed shall be considered as commercial fishing and subject to all of the limitations in respect thereto.

10. Any increase in the amount of fishing gear employed or any expansion of fishery operations in any district in any season shall in the discretion of the Secretary of Commerce result in the immediate imposition of such additional restrictions as may appear necessary.

11. These regulations shall be subject to such change or revision by the Secretary of Commerce as may appear advisable from time to time. They shall be in full force and effect immediately from and after January 1, 1925.

WATERS CLOSED TO COMMERCIAL FISHING

With the cancellation, by Executive orders, of the Alaska Peninsula Fisheries Reservation and the Southwestern Alaska Fisheries Reservation, the previous orders remained in effect in regard to the following waters: Afognak Reserve, Yes Bay and stream, Annette Island Fishery Reserve, and Aleutian Islands Reservation. The limitations on commercial fishing previously imposed under the order regarding the Aleutian Islands Reservation were removed.

In the regulations issued by the Secretary of Commerce during the calendar year, commercial fishing was prohibited in 76 restricted areas in various parts of Alaska. These localities are named in the regulations printed in this document.

AFOGNAK RESERVE

Permission to fish within Afognak waters for varying periods during the season of 1924 was granted to 86 natives living on Afognak and adjacent islands. Operations were carried on at eight different localities, and beach seines only were used. The total catch was 181,429 salmon, a decrease of 86,749 from the catch of 1923. The catch of cohos increased 12,380, chums 201, and kings 429, while humpbacks decreased 55,054, and red salmon 44,705. The natives sold the catch to the canneries of the Kadiak Fisheries Co. and Katmai Packing Co. Some additional salmon were taken by natives for food.

Fishing operations in the reserve were under the supervision of Fred R. Lucas, superintendent of the fisheries station at Afognak, to whom authority was delegated to issue orders governing fishing operations. No fishing for red salmon was permitted in Litnik (Afognak) Bay, but fishing for silver salmon was open from August 20 to September 4. The waters of Duck Bay, from Kostromitinof Cape to Izhut Cape, also were closed by an order issued July 3, and reopened for silver-salmon fishing on August 20, all red salmon having passed upstream by that time.

A weir was maintained for fish-cultural purposes in Litnik River below the Afognak hatchery. The total number of red salmon counted through the rack in the period from May 30 to September 20, when that species ceased to run, was 10,317.

Commercial catch of salmon, Afognak Island, season of 1924

Locality	Cohos	Chums	Humpbacks	Kings	Reds	Total
Little Afognak	20,922		5,237	148	12,689	38,996
Danger Bay	4,950					4,950
Litnik Bay	7,816					7,816
Paramanof Bay	4	3	10,325	3	20,919	31,254
Malina	34	376	18,269	316	32,203	51,198
Seal Bay	13		3,388	5	28,071	31,477
Izhut (Elia) Bay	25	6	4,580	3	8,174	12,788
Katine (Marqua)	2,950					2,950
Total	36,714	385	41,799	475	102,056	181,429

ANNETTE ISLAND FISHERY RESERVE

Fishing operations within the Annette Island Fishery Reserve were again conducted by the Annette Island Packing Co. under its lease from the Department of the Interior. Data regarding operations have been furnished by the Bureau of Education of that department, which administers the affairs of the reserve for the benefit of the Metlakatla Indians residing there.

In 1924 the total number of fish taken by traps within the reserve was 827,949 of all species, on which royalties amounting to $9,086.12 were paid. The per case tax on canned salmon under the Territorial law, which has been held payable to the Metlakatla Indians, amounted to $2,415.49; trap fees on six traps, at $200 each, amounted to $1,200; and rental of cannery building was $3,000. In addition, $36,910.09 was paid to 169 natives for labor, $4,124.95 for piling, $14,305.27 for fish, and $719.65 for merchandise and lumber, making a grand total amount disbursed by the Annette Island Packing Co. to the natives of $71,761.57.

FISHERY INTELLIGENCE SERVICE

As has been the practice for several years, the bureau continued to report by telegraph to the important points in southeastern and central Alaska the prices of fresh fish (chiefly halibut) at Juneau, Ketchikan, and Seattle. After the halibut close season began this service was discontinued.

STREAM MARKING

In general, stream marking consisted in replacing missing markers indicating the protected zone off the mouths of salmon streams. In southeastern Alaska several additional streams were marked and special notices were posted at the entrances of Freshwater Bay, Tenakee Inlet, Whitewater Bay, Wilson Cove, Saginaw Bay, Thoms Place, Anita Bay, and Olive Cove, all of which were closed under order of June 21, 1924.

STREAM GUARDS

The bureau employed 103 men as stream guards in 1924. Of these 79 were stationed in southeast Alaska, 13 in central, and 11 in western Alaska.

In southeast Alaska 75 localities were protected by 73 guards. Some of the men employed furnished their own power boats and were thus able to cover a district in which there were several streams. The period of employment averaged about 2½ months. In addition to these guards 1 special warden and 5 operators of chartered boats were employed.

In central Alaska 8 guards were located in the Copper River and Prince William Sound districts, 3 in Cook Inlet, and 2 in the Kodiak-Afognak district.

In western Alaska 1 guard was stationed at Port Moller, 9 in Bristol Bay, and 1 on the Yukon River Delta.

In addition there were 5 statutory employees of the bureau in southeast Alaska, 7 in central and 4 in western. There were also 27 persons on the bureau's vessels.

The foregoing makes a total of 16 statutory employees and 130 others, or a grand total of 146 persons identified with fishery protective work in Alaska in 1924.

VESSEL PATROL

Ten vessels owned by the bureau were operated in fishery patrol work in Alaska in 1924. The *Auklet*, *Murre*, *Petrel*, and *Widgeon* were used throughout the season in southeastern Alaska, the *Kittiwake* in Cook Inlet, the *Ibis* at Chignik, the *Merganser* at Ikatan and vicinity, the *Scoter* in Bristol Bay, and the *Tern* on the Yukon. The *Blue Wing* was in southeastern Alaska during August and part of September, and was used in Cook Inlet during the remainder of the season. This vessel was purchased in July, and is 55 feet in length, 12 feet 6 inches beam, and is equipped with a 50-horsepower Union distillate-burning engine. Launch No. 43, assigned to the Afognak hatchery, was used during part of the year for patrol work in the Kodiak-Afognak region.

The Pribilof Islands tender *Eider* was assigned to salmon work from July 17 to August 11. Dr. C. H. Gilbert went aboard the *Eider* at Ikatan on July 20 and visited canneries and salmon streams along the Alaska Peninsula, on Kodiak Island, and in Cook Inlet until August 11.

The *Swan*, formerly used on the Yukon River, was condemned and sold.

The following chartered vessels were used in fisheries patrol: *Igloo*, *Jazz*, *Murrelet*, and *Rainbow* in southeastern Alaska; *Prospector* and *Emma* in Prince William Sound; *Fog Auger* and *Blue Ointment* in Cook Inlet; and *Robin* on the lower Yukon. Patrol launches were used by a warden in the Shumagin Islands and the stream guard at Port Moller, and three small launches were hired for brief periods in the Bristol Bay district. Five launches owned by the trade were manned and operated by the bureau for patrol work in Bristol Bay.

COMPLAINTS AND PROSECUTIONS

The passage of the act of June 6, 1924, opened a new field of activities for those of the bureau's employees in Alaska who were designated peace officers with powers to arrest persons and seize property for violations of the act. In a number of instances both fish and fishing gear, consisting of boats, fixed and floating salmon traps, and nets, were seized and condemnation proceedings instituted.

The seizure of salmon traps caused considerable difficulty for court officials who were the custodians of the property during the resulting long legal proceedings. In some cases watchmen were employed for months to maintain lights and keep the traps free from drift. In the case of floating traps it was necessary to have the owners remove them. When condemnation proceedings were finally completed, and after considerable expense had been incurred for watching traps, their sale brought only small amounts—in one case only $10.

In the southeastern district six salmon traps were seized during the season for not having the heart walls open 25 feet on each side of

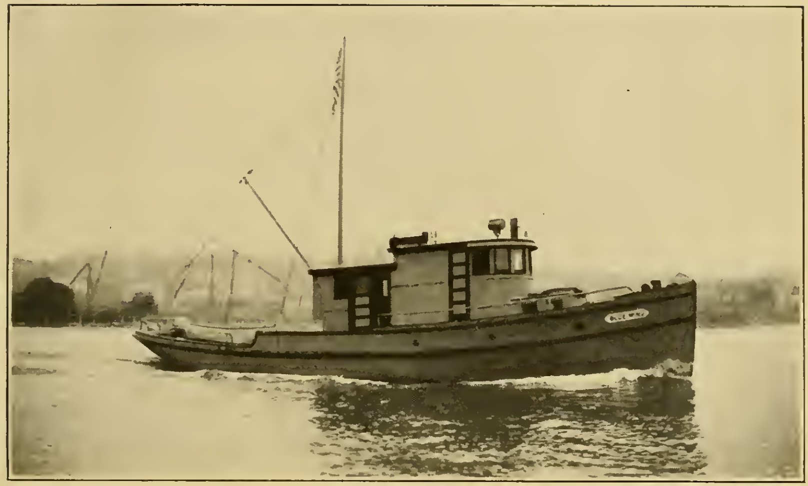

FIG. 2.—*Blue Wing*

FIG. 3.—*Scoter*. Bristol Bay

the pot during the weekly closed period, as required by law. In five cases (two against the Petersburg Packing Co. and one each against the Sunrise Packing Co., Alaska Pacific Fisheries, and the Beegle Packing Co.) the traps were condemned and sold at auction. The other case (against the Alaska Pacific Fisheries) was continued until the following spring term of court because of the absence of counsel for the company.

Four purse-seine boats—the *Hemmie*, *Andrew N.*, *Alice*, and *Pacific*—were seized for illegal fishing in the protected zones off the mouths of salmon streams. In each case the defense claimed that the boat had drifted over the line after the seine was pursed. The court held that the evidence of unlawful fishing was not conclusive and all four boats were ordered released.

A case of considerable importance was that brought in the district court at Juneau in December, 1924, against the Booth Fisheries Co. for (1) erecting and maintaining a floating fish trap near Lucky Cove within 500 yards of the mouth of a stream, thus impeding or preventing the ascent of salmon to their spawning grounds, and (2) fishing for and taking salmon by means of a floating trap within 500 yards of the mouth of a stream. The case resulted in a conviction on both counts and the court imposed a fine of $1,900. Motion for a new trial was overruled. The case was appealed.

Two fishermen were arrested for trolling on Sunday in Frederick Sound. Each pleaded guilty and was fined $50. Their boats were returned.

Three fishermen were arrested at Salmon Bay for laying a purse seine within the prohibited distance of another piece of fishing gear already set, and also for fishing without a license in violation of a Territorial law. They pleaded guilty and fines totaling $145 were imposed, with costs of $8.40.

Nine fishermen were arrested at Roosevelt Harbor for setting gill nets within the prohibited distance of gear already set. All pleaded guilty and paid fines totaling $450, and $63 costs.

A case brought in 1923 against the Alaska Pacific Fisheries for illegal fishing of a salmon trap on Sunday was tried at the May term of court and a fine of $50 was imposed, with costs of $3.05.

The test case against the Auk Bay Salmon Canning Co., under one of the 55 indictments returned against packing companies and individuals for fishing during a closed season provided by Territorial law, and which was decided in favor of the Territory in the district court at Juneau, was reversed by the circuit court of appeals at San Francisco on August 4, 1924, and remanded with instructions to quash the indictment. The question at issue was the right of the Legislature of Alaska to pass laws affecting the fisheries.

Another case of interest, brought under Territorial law, was that against the Pacific American Fisheries to test the constitutionality of the law passed by the Legislature of Alaska imposing a graduated tax on the pack of salmon after May 5, 1923. Judge Reed, of the district court at Juneau, held that the law was valid, and his decision was affirmed by the Circuit Court of Appeals for the Ninth Circuit, but in handing down its decision that court said:

> Unlimited power to tax an industry in one sovereignty seems rather inconsistent with the reservation of a power to regulate that industry by another sovereignty, as the power to tax involves the power to destroy, and may be so exercised as to

render any attempt at regulation useless and abortive. The question presented by the record in this case is, in our opinion, close to the border line, but we are not prepared to say that the Territory has exceeded the limits of its taxing power as heretofore defined by the courts.

Because of this question the case will, no doubt, be carried to the United States Supreme Court for final decision.

In the Seward-Katalla district of central Alaska prosecutions were instituted against two fishermen for fishing within the protected area on the Copper River Flats. When the case was brought before the United States commissioner both defendants pleaded guilty and paid fines of $75 each. In a case against two natives, who pleaded guilty to fishing on Copper River Flats during the weekly closed period, suspended sentences were imposed and a 200-fathom gill net was seized. This net, together with approximately 175 fathoms of unclaimed net and some miscellaneous salmon seized on the Copper River Flats, will be disposed of as directed by the Department of Justice.

In the Cook Inlet district of central Alaska two salmon traps owned by Libby, McNeill & Libby, one by the Northwestern Fisheries Co., and three by H. J. Emard were seized and indictments returned by the grand jury for illegal fishing during the weekly closed period. In addition, the vessel *North Cape* and certain equipment and a quantity of canned and dried salmon were seized from H. J. Emard. Two herring purse-seine boats, the *Altana* and *Pennsylvania*, owned by the San Juan Fishing & Packing Co., were also seized and the company indicted for wanton waste of herring. W. J. Imlach was indicted for wanton waste of herring, and two vessels, the *Waterland* and the *Commander*, owned by W. J. Imlach & Co., were seized. A number of trap watchmen were arrested in connection with the fishing of traps during the weekly closed period and, following hearings before the United States commissioner at Seldovia, were bound over along with the companies for action by the grand jury. In the case of these individuals, however, true bills were not returned. Information was filed against a number of other persons for alleged violations of the fishery laws and regulations, but the grand jury failed to return true bills. None of the cases originating in the Cook Inlet district had come to trial by the end of the year.

In the Bristol Bay district there were 14 cases, with two defendants each, for violation of the regulation prohibiting the use of gill nets of less than 5¾ inches, stretched measure. Nets totaling 840 fathoms were seized. Pleas of guilty were entered by all defendants and fines of $40 each, totaling $1,120, were imposed.

Complaint was lodged against Louis Knaflich for fishing inside the mouth of the Kuskokwim River. On hearing before the United States commissioner he was bound over to the grand jury under $2,500 bond. An indictment was returned later by the grand jury at Fairbanks, and on request of counsel change of venue was granted to Seattle.

METHOD OF ADJUSTING SALMON TRAPS DURING CLOSED PERIOD

In a decision rendered in 1923, and following a number of prosecutions for failure to observe the weekly closed period in southeastern Alaska, Judge Reed, of the district court, announced that substantial punishment would thereafter be imposed upon all who might be convicted of violation of that provision of the statute regarding the method of adjusting traps during the closed period, which in his judgment clearly meant that the heart walls on each side next to the pot must be raised or lowered for the full width of 25 feet specified in the law, and that a V-shaped opening that lessened this width at all stages of the tide was unlawful. For a number of years the bureau had felt that the law was complied with in spirit by the common practice of using "shove-downs" in the heart walls during the weekly closed period, thus making a V-shaped opening which, while not the full width of 25 feet at lower stages of the tide, nevertheless afforded an opening for the escape or free passage of all fish.

The act of June 6, 1924, reenacted the provision in regard to adjustment of salmon traps during the weekly closed period, using the exact language of the previous act of June 26, 1906. Following the passage of the new act, and in view of the court's interpretation, the bureau, under date of June 9, 1924, issued instructions to employees concerned, which, after referring to the provisions of law and the ruling of the court, contained in part the following:

In view of the foregoing decision, based upon a provision of law identical in language with that of the present law of June 6, 1924, and the announcement in October, 1923, by the judge of the District Court for the First Judicial Division of Alaska that the law would be enforced as construed by the courts and not as construed by any other agency, and that thereafter all persons convicted of violating the fisheries laws would be given substantial fines and possibly jail sentences, you are instructed to take proper legal action in all cases where the heart walls of traps are not opened in accordance with the law as above cited.

You are instructed that if after the beginning of the fishing season any trap visited and inspected by you during any closed period is equipped with ineffective tunnel-closing or heart-wall-opening appliances, thus preventing the adjustment of the trap as required by law, you will forthwith give notice of your findings, in writing, to the owner or operator and trap watchman. If the findings of your examination are such as to satisfy you that the faulty adjustment of the trap is due to the neglect, carelessness, or indifference of the watchman, you will institute a prosecution at the earliest opportunity, or as the United States attorney may direct. Palpable, deliberate, and inexcusable violations of the law and regulations are to be vigorously prosecuted.

You are hereby directed to expedite the prosecution of all actions brought before the courts of Alaska for infractions of the fishery laws and regulations by trap owners, operators, or fishermen.

Trap owners and operators should be given to understand that the bureau, through its representatives in Alaska, will insist on strict compliance with the laws and regulations, and that it expects their hearty cooperation in such matters.

The bureau at once gave wide publicity to this announcement, and vigorous protests were received from a number of operators, some of whom already had traps set and fishing. The complaint was chiefly that it was impossible to comply with the law as thus construed and that the only way they could escape being prosecuted for violation of law would be to discontinue operations altogether. Others felt that it would be impossible to make the necessary changes in traps already constructed in time to operate them profitably during the fishing season. A general feeling of dissatisfaction pervaded the district and was manifested in a suit, to which some 30 operators of traps were party, to restrain the officers of the Government directly concerned in the enforcement of the act of June 6, 1924.

This case, entitled "P. E. Harris & Co., a corporation, suing on its own behalf and on behalf of others similarly situated, *v.* Henry O'Malley, individually and as Commissioner of Fisheries; E. M.

Ball, individually and as Assistant Commissioner of Fisheries; George D. Beaumont, individually and as United States marshal, first division; Arthur G. Shoup, individually and as United States attorney; and all and singular the deputies, assistants, and agents of each and all of the parties above named," asked that the defendants and each of them be permanently enjoined from enforcing the provision of law in regard to opening of heart walls of traps in the manner described in the bureau's instructions to its employees, and from instituting prosecutions for failure to open heart walls of traps in such manner if they were opened in the manner previously employed.

The case was heard July 10 in the district court at Juneau, and on July 11 Judge Reed denied a temporary restraining order. A memorandum opinion in the matter was rendered on July 31, 1924, by Judge Reed, in which he summarized the case as follows:

The proposition simply amounts to this: The complainants claim that the methods heretofore used by them in opening the heart walls of traps comply with the terms of the statute. The contention is made in the face of an adjudication interpreting the statute otherwise by the circuit court of appeals; that the interpretation of the statute and of the adjudication thereof by the circuit court of appeals and by the prosecuting officers is erroneous, and that by not complying therewith they are not committing a crime; and that therefore a court of equity has jurisdiction to restrain the prosecuting officers from enforcing the statute as interpreted by the circuit court of appeals and by the prosecuting officers.

The court held that:

The authorities seem to be that no injunction will lie against prosecuting officers of the Government to restrain them from enforcing a constitutional criminal statute, even though, in attempting to enforce it, such prosecuting officers have misconstrued its effect.

* * * I am of the opinion that the motion for the temporary injunction should be denied, especially as to the United States attorney and his assistants, and as to E. M. Ball, of the Bureau of Fisheries, and his assistants, for the reason that I am not convinced that the construction placed upon the statute by the Bureau of Fisheries and the United States attorney is not correct.

I have carefully examined the records in the Thlinket case and am of the opinion that the question whether the method of opening the heart walls, as claimed by complainant to be sufficient, was directly before this court and the court of appeals. I am confident that the circuit court of appeals and this court had the manner of opening the heart walls, as contended for by the complainant, directly before it; and I am convinced that the V-shaped opening was decided by the circuit court of appeals not to be sufficient opening. * * *.

That it is impossible to construct traps so that the opening of 25 feet in the heart walls shall extend to the bottom is also a questionable statement. The assistant commissioner of the Bureau of Fisheries, Mr. Ball, testified that in the year 1919 he visited traps so constructed. The present traps of complainant may not have been constructed so that it was possible to make an opening 25 feet in width from the top to the bottom of the heart walls, and this construction may have been acquiesced in by the Bureau of Fisheries; but that does not afford any reason for construing the law so as to fit such cases. I am confident, however, that traps can be constructed so as to make the opening in the heart walls required by the statute; that it is neither impossible nor extremely difficult, though it may be less convenient than the method contended for by the complainant.

While at the present time I am not prepared to say that in all cases in order to comply with the statute that a section of the body of the webbing or net 25 feet in length of the heart walls next to the pot on either side shall be lifted or lowered and that the opening thereby made shall extend to the bottom of the trap at the same width, I do believe that that is, and should be, the proper construction of the statute. I base my belief on the declared purpose of the statute—the conservation of the fisheries of Alaska—that such construction of the statute would not only better accomplish that object but that it is a reasonable construction of the statute, and the only reasonable construction. Moreover, it will give a standard to which trap fishermen must adhere.

The case was heard on appeal by the Circuit Court of Appeals for the Ninth Circuit and decision confirmed by an opinion rendered December 15, 1924, in which it was said:

> Appellant does not contend that the statute of 1924, under which it is alleged the officials of the United States threaten to proceed by criminal prosecution and by proceedings for forfeiture, is unconstitutional or invalid, but takes the position that equity will enjoin the bringing of a criminal prosecution when it is necessary to prevent irreparable injury to property or a multiplicity of suits. The case of appellant can only stand by looking upon the question of a violation of the statute as a civil rather than a criminal proceeding. But it can not be so viewed.

As the season progressed, it became apparent that with slight alteration traps could be operated lawfully. The alterations made to the pile traps consisted, in most cases, of loosening the heart walls along the capping about 60 feet back from the pot, so that a wider section of the wall could be lowered and thus insure a full 25-foot opening next to the pot at all stages of the tide. In other cases a section of the heart wall was removed and an apron substituted. These alterations were made quickly and with comparatively little cost. The manner of opening heart walls of floating traps was unchanged.

ROBBERY OF FISH TRAPS

In its enforcement of the Alaska fishery laws and regulations, it is not a function of the bureau to engage directly in work having to do with the so-called fish piracy or robbing of fish traps. Sympathetic interest and cooperation, however, have been manifested at all times by the bureau and its employees in the activities of the Department of Justice and the United States Coast Guard to abate this unlawful and unwholesome practice, which in the season of 1924 assumed unusual proportions in southeastern Alaska.

The chief places of operation by these marauders were the Icy Strait region, the west coast of Prince of Wales Island, and the Ketchikan district. Packers in the Icy Strait region organized a private patrol, which was very efficient, under the direction of the United States deputy marshal at Hoonah, and practically eliminated piracy in that region. In the Ketchikan district 36 boats suspected of engaging in piracy were blacklisted for a time, and complaints were filed by a trap owner against two vessels but could not be substantiated. As some of the packers bought fish indiscriminately from any boat offering them for sale, it was exceedingly difficult to cope with the situation. On the west coast of Prince of Wales Island a trap watchman was fired on and wounded. As a result, four men, comprising the crew of the boat *Dolphin*, were arrested, and one was convicted of assault and sentenced to six months in jail.

TERRITORIAL LICENSE TAX

Fisheries license taxes were collected by the Territory under the revenue laws of Alaska as amended in 1921 and 1923. A statement from the treasurer, under date of March 25, 1925, gives the collections made to that date for the fiscal year 1924. It is stated that collections of salmon-pack taxes were complete, with the exception of approximately $15,000 still outstanding for the year 1924, so far as the basic per case rates were concerned, and approximately $10,000 was outstanding under the several smaller fisheries tax schedules. The total collected for the calendar year was about $37,000 less than in the preceding year. Many companies have withheld payment of the graduated pack tax pending the outcome of the test cases now in court, as referred to elsewhere in this document. The amounts withheld are approximately $140,000 for 1923 and $75,000 for 1924.

Fishery license taxes collected by Territory for fiscal year ended December 31, 1924

Schedule	Division No. 1	Division No. 2	Division No. 3	Total
Salmon canneries (pack)	$113, 109. 48		$173, 944. 98	$287, 054. 46
Salmon canneries (net income)	4, 900. 55		13, 172. 39	18, 072. 94
Clam canneries			289. 58	289. 58
Salteries	4, 452. 88	$568. 40	3, 688. 02	8, 709. 30
Cold-storage plants	1, 525. 00		500. 00	2, 025. 00
Fresh-fish dealers	2, 800. 59		1, 564. 77	4, 365. 36
Fish-oil works and fertilizer and fish-meal plants	6, 082. 40		964. 00	7, 046. 40
Fish traps	80, 873. 78		40, 712. 50	121, 586. 28
Gill nets	770. 20	41. 00	4, 874. 40	5, 685. 60
Seines	5, 445. 00		1, 785. 00	7, 230. 00
Total	219, 959. 88	609. 40	241, 495. 64	462, 064. 92

BRISTOL BAY DISTRICT

In 1924 a special force, consisting of two regular wardens and a number of other employees under the direction of Agent Dennis Winn, again operated in the Bristol Bay district. As in preceding seasons, attention was devoted during the spring to the destruction of predatory fishes, and after the beginning of active salmon-fishing operations a patrol was maintained on Bristol Bay and in tributary waters. Warden F. G. Morton was detailed to remain in the district over the winter for the purpose of making observations on the spawning grounds at the head of Iliamna Lake. Mr. Winn's report is as follows:

GENERAL REPORT OF SEASON'S OPERATIONS

Operations in 1924 were conducted and transportation for men and supplies was secured along the lines of former years. The ships for Bristol Bay were again delayed, owing to trouble with the fishermen, which shortened the season very materially at Ugashik, and the late seasonal break-up at Nushagak also delayed operations there. The crew for Wood River was in the bay before the ice broke in the river. At Ugashik the men arrived so late and were as a result so severely handicapped as to impair seriously their operations.

At Iliamna and Becharof Lakes operations were far in advance of previous years, due to having the men proceed by the regular transportation routes, thus arriving at the headwaters of the respective lakes early in the spring and being prepared for operations as soon as the ice broke sufficiently to permit fishing. The low water at that time also afforded better opportunity for the work.

In reviewing work covering the different districts in this field it is felt that operations are producing most encouraging results. The scarcity of trout in the different localities is becoming more noticeable each year. The large catches made at Iliamna and Becharof Lakes were due to the longer and more favorable periods of fishing and greater familiarity of the operators with the habits of the trout. The men in charge of the various Bristol Bay districts have been in the same locality through several seasons.

After the departure of the cannery ships from Bristol Bay in the fall of 1923, operations on predatory fish were continued as late as possible at Aleknagik Lake and tributaries, and a survey of the spawning grounds in the same district was made under the direction of Warden A. T. Looff. In connection with this work Mr. Looff also made a survey of the Nushagak River watershed, embracing the Tikchik Lake system.

DESTRUCTION OF PREDATORY FISHES

Wood River Lakes.—The Nushagak crew arrived at Nushagak Bay on May 16. Both Nushagak and Wood Rivers were as yet solid with ice, but the ice in the river broke on May 22. Travel was blocked for a few days by ice floating back and forth on the tides, but the ship transferred the crew to Snag Point on May 25. Supplies and equipment were in readiness, and the following day the men proceeded upriver to the lake. Ice still covered the lake, but by following a narrow channel along the shore we were able to reach the tally scow anchored near the lake outlet. Here camp was established and fishing begun with set nets and hand lines. Poor success was had until the ice left the lake June 8, after which operations were extended and catches improved. Another camp was established at a former location on the stream between Aleknagik and Nerka Lakes, where fishing was most successful. Trout were scarce at all points and noticeably fewer than in former years. All the trout areas were visited, and fishing progressed continuously and aggressively at various points with set nets, which were the most effective method of capture until July 2, when the salmon made their appearance, after which the nets were removed. Hand lines and beach seines were then the only effective gear.

Camp was established and fishing begun at Nerka Lake, but very little success resulted from our efforts. Few trout were noticed in our investigation of that lake, while high winds, which continued from the middle to the 24th of July, handicapped operations.

The outward migration of young salmon, representing the return from the escapement of 1922, was small. Schools were noticed descending intermittently from the beginning of our operations to the end of July, but no large schools were encountered during the season.

Trout were extremely scarce and at no time were good schools seen, although the operators covered the field fully several times. It is felt that the absence of migrating young salmon was partly responsible for this condition, as there was little schooling, but it is also believed that the intensity of operations in this section in previous seasons is mainly responsible for the satisfactory condition. The men on patrol assisted in the trout fishing before and after the commercial operations in the bay.

The season's operations on the Wood River Lakes resulted in the taking of 3,162 predatory fish, and in the work in the fall of the previous year (not included in the 1922 report) 2,389 fish were captured, making a total of 5,551 fish destroyed. About 95 per cent of these were Dolly Varden trout and the remaining 5 per cent were mainly pike. The average weight was 2½ pounds, or 13,877 pounds total. In addition, 1,300 Dolly Vardens were taken by two nets lent to a local fisherman during the late fall months but are not included in the above total.

Iliamna Lake.—Warden F. G. Morton, who supervised the work in the Iliamna district, left Seattle on a commercial steamer April 5 for Seldovia, where a boat was chartered for the trip to Iliamna Bay. He traveled thence via dog team to Iliamna village, which was reached on May 2. As the Iliamna River was partly free of ice early in April, work had been begun in a small way by local people with whom arrangements had been made the previous fall to begin operations as soon as conditions permitted in the early spring. Upon the arrival of Mr. Morton operations were undertaken on a much larger scale with the most satisfactory results yet accomplished in this section.

Water conditions were ideal for seining, the river being low and without much current, so that beach seining was conducted intensively wherever possible in the river and vicinity. Good results were obtained for several miles up the Iliamna River. All the trout captured were large Dolly Vardens, several specimens weighing 13 to 14 pounds. The larger number of trout in this vicinity during the last two years was probably due to the great number of salmon that spawned in the river, the resulting young from which constituted the attraction for the trout. Trips were made to Pile Bay and vicinity, but trout were not found in numbers in that locality, nor for several miles up the river. Very little salmon spawning was ever noticed in Pile River.

On May 15 enormous schools of salmon fry were noticed emerging from the gravel, and the trout then scattered and became more difficult to secure in satisfactory numbers. A few days later the snow began melting in the hills, and streams rose rapidly to such an extent that seine fishing became impossible. Other modes of fishing were tried, but with discouraging results.

It was felt that best results could be secured by operating in the lake during the very early spring and late fall. Mr. Morton was therefore transferred to

Bristol Bay to supervise the Kvichak patrol, and later returned with an assistant to an advantageous point near the head of the lake on Youngs Creek. From winter quarters at this place they will conduct operations as late in the fall as weather conditions permit, and will also make a survey of spawning areas, improve spawning grounds, and gather data relative to the streams and lakes in that vicinity and their connection with spawning salmon and trout. They will also be on the ground for the earliest possible operations during the coming spring.

The season's work at Iliamna Lake resulted in the taking of 20,591 Dolly Varden trout averaging 2½ pounds each, or 51,477 pounds. During the early part of the fishing the natives at the village utilized nearly all the trout taken, but their anxiety to secure the fish gradually lessened as their appetites became satisfied, and toward the end of our fishing they were so well fed as to refuse trout.

Naknek.—The Naknek party started upriver on May 25. Some floating ice was encountered and the banks on both sides of the rapids, for several feet out in the stream, were covered with ice, making the ascent very difficult. Camp was established at the outlet of the lake and fishing began May 27. A severe southerly storm with high wind and drifting ice forced the removal of the nets for a time. The hills and mountains were covered with snow and the weather continued cold and very disagreeable. The storm abated somewhat on the 30th and nets were reset. The first of the outgoing young salmon were noticed on this date. Trout appeared very scarce, and the stomachs of all those taken contained young migrating salmon.

On June 3 camp was moved to Kidawik Creek and work continued in the creek mouth. Here considerable floating ice was encountered but did not prevent operations. On the 8th large schools of migrating young salmon were noticed passing from Lake Brooks down Kidawik Creek to the main lake, and the catch of trout increased perceptibly at this point. On the following day severe storms set in and the water rose rapidly, bringing down quantities of drift and débris, which necessitated the removal of our nets for safety. Great schools of young salmon just out of the gravel completely lined both banks of the creek and were gradually working their way down into the lake. Trout appeared very scarce at every point in comparison with previous years, and natives reported extremely poor catches last winter and early spring in their traps around the lake.

On June 10 camp was moved to Grosvenor and Coville Lakes. Supplies were portaged across, and the following day fishing was begun in the narrows between the two lakes. The greater portion of the catch was taken here, and consisted mainly of lake trout, with about 10 per cent pike. Trout were extremely large during the early operations, Dolly Vardens measuring 29 inches in length being not uncommon. Lake trout measuring 39 inches in length and 20 inches in girth also were taken, as were pike 43 inches long. As the season advanced pike became more numerous, until at times they nearly equalled the take of trout, although in the total they averaged about 10 per cent. Few Dolly Vardens were caught, but all taken were very large.

The first salmon of the season reached Grosvenor Lake June 19. The trout and pike taken at this time were feeding on young whitefish and salmon fry, the migrating salmon apparently having passed out. On June 23 salmon began increasing in numbers and were noticed jumping in various places around the lake. The number increased so rapidly that the operators were compelled to remove the set nets.

As the interference from salmon was so great, camp was moved back to Kidawik Creek. A heavy storm prevented setting out the nets here for two days. No salmon were noticed in the creek or near its mouth, although some may have passed up while the operators were at Grosvenor Lake. The storm caused the streams to rise rapidly, which brought in the run of salmon with a rush, and great numbers ascended and passed over the falls to Lake Brooks. Nets could not again be used. Baited set lines were then resorted to, but results were meager, partly due to the extremely rough, dark weather. On bright, quiet days fair catches were made, but during the greater portion of the time the weather was bad.

The results of work in this locality show the trout are decreasing rapidly. Another year attention may be centered wholly on Grosvenor and Coville Lakes.

The total catch for the season was 2,192 fish, of which 85 per cent were lake trout, 10 per cent pike, and 5 per cent miscellaneous species. The average weight was 10 pounds, or a total of 21,920 pounds. The average weight of the pike was 14 pounds, but the trout ran much smaller than in previous years, bringing the total average to 10 pounds.

Becharof Lake.—The past season at Becharof Lake was the most successful yet conducted in the Bristol Bay district, which was primarily due to the longer period of operations and greater familiarity with equipment and the habits of the fish.

Henry Looff and an assistant, with necessary equipment and supplies, proceeded on a commercial steamer from Seattle April 5 and arrived at Kanatak April 17. Freight was transferred to the lake on pack horses, and work began immediately on arrival at Crooked Creek, this being the only place where fishing was possible at the time because of severe weather conditions and ice. Hand lines were used with but fair results pending the arrival of a creek seine from Kanatak. Seine fishing was conducted the entire length of the creek and very good catches made. Gill nets were also effective during this period in a small open stretch of water at the mouth of the creek. Other creeks in the vicinity that were open were prospected for trout before the ice left the lake, but almost no trout were seen except in Point Creek, where several fair catches were made.

The ice began to break up in the lake May 14, and warm weather, assisted by heavy rains, brought all of the creeks to flood stage, making fishing extremely difficult owing to the débris. As soon as weather conditions permitted traps were installed in the streams and produced fair results for a short period. All catches, however, fell off rapidly when the ice left the lake, the schools of trout breaking up and scattering.

Camp was then moved to various locations that had produced good catches in former seasons. No trout were in evidence at any of these points, and the operators returned to the base camp at Fish Village on June 4. The results here also were meager. On June 11 camp was established on Camp Creek. While the returns were small there, some large specimens were captured in 4-inch mesh gill nets. Dolly Varden trout 30 inches in length and weighing 15 pounds were taken, and none weighed less than 5 pounds.

After visiting all the important locations of former years, the operators returned to Crooked Creek on June 15. The water was yet too high for seining, but trout were noted schooling in considerable numbers. Gill nets produced fair results until salmon made their appearance on June 26. As salmon eggs were then available for bait, hand lines were operated thereafter with excellent results. After this date, also, record catches were made with beach seines along the lake shore, using salmon eggs as lure. The eggs were obtained from the natives at the village, and the trout caught were given in exchange.

No accurate check was possible on the outgoing migration of young salmon, as fishing activities were conducted near the head of the lake. However, through the latter part of May and early June enormous schools of fingerling salmon were noticed along the lake shore having every appearance of being prepared to pass out to the ocean.

Various trips were made during the season to prospect the different streams for trout, but the scarcity noted at each point visited compelled the centering of attention on Crooked Creek and vicinity. The season's catch was 40,307 Dolly Varden trout averaging 1½ pounds in weight, or a total of 60,460 pounds.

Ugashik.—As soon as weather permitted the Ugashik crew proceeded up the lake to the rapids between the two lakes, where camp was established June 22. It was too late to establish a trap in the stream, as the salmon were nearly due, so set nets were placed to block the passage and beach seines were used below the nets. Fair results were obtained. Drifting after dark also produced good results. Visits were made to the different creeks tributary to both lakes and trout fishing was conducted well up each stream with fair results. It was necessary for the crew to discontinue operations and proceed to the Red Salmon cannery July 28, where equipment was overhauled and stored for the winter.

The trout in general were in poor condition and all averaged much smaller than formerly. Some of them resembled an eel in shape. Specimens were taken measuring 15 inches in length and less than three-fourths of an inch through the thickest part of the body, and weighing less than three-fourths of a pound. Other specimens 22 inches long and 1 inch through the body weighed 1¼ pounds. Drift nets, set and fyke nets were the most effective gear until the salmon arrived in numbers, after which seines and hand lines produced the best results. The season's catch was 5,569 Dolly Varden trout averaging about 1½ pounds, or a total of 8,354 pounds.

Very few migrating salmon were noticed, but they may have passed out earlier. Small schools were seen passing out intermittently for a few days after the arrival of the party. Fewer salmon fry were noted coming out of the gravel than in previous years, due to the small escapement of last fall.

The short season here seriously handicapped operations. It is planned another year to have two operators for this district proceed on a commercial steamer from Seattle via Kanatak with the Becharof Lake crew, thence proceeding to the tributaries at the head of the second Ugashik so as to be prepared for intensive work as soon as weather and ice conditions permit.

NEW FISHERY REGULATIONS

The new law effective June 6, imposing a 36-hour weekly closed period, was at first resented by the fishermen, but as the season advanced many of them expressed themselves as wholly in favor of this restriction. Throughout the district every effort was made by most of the canneries and fishermen to conform fully with the regulations. No violations of the closed period were reported, with the exception of two fishermen, but there was insufficient evidence in their cases to warrant arrest. Several boats of different companies were found using illegal gear. The fishermen pleaded guilty on trial before the United States commissioner and were fined.

In the Nushagak section each cannery assigned a tug to tow all their fishing boats home on Saturday night and return them to the fishing grounds Monday morning. No attempt at illegal fishing was made in this section.

All the canneries cooperated by raising flags on their ships for two hours beginning at 6 p. m. Saturday night, and again for one hour beginning at 6 a. m. the Monday following, as notice to the fishermen of the beginning and ending of the closed period. A flag was displayed also from the wireless tower of Libby, McNeill & Libby's Koggiung cannery, which could easily be seen from every point in the Kvichak district. Many canneries displayed flags on their tally scows through the closed periods. All of this was of great assistance in the patrol.

The canneries were established and machinery assembled for operations in accordance with reservation regulations, which had called for a 50 per cent reduction in gear at Nushagak and 29 per cent reduction on the Kvichak side, and their cannery crews were reduced accordingly. In consequence packs in these districts were lessened and the escapement of spawning salmon facilitated.

RUN OF SALMON

The total pack of salmon in Bristol Bay for the season 1924 was about 818,000 full cases, of which 93½ per cent were red salmon.

In the Nushagak section the run of red salmon was the heaviest since 1918, and resulted in the most satisfactory escapement that has occurred for a number of years. The salmon struck in June 29 and held strong and steady until July 14. The run appeared to be especially heavy during the closed periods, July 6 and 13. Fair numbers were in the bay until the heavy storms that occurred during the closed period of July 20, after which the red salmon almost entirely disappeared and some cohos and pinks made their appearance. Some salmon were transferred to Naknek and Ugashik. As a result of the closed periods, together with the transfer of salmon, it was not necessary for some of the companies to place the fishermen on limit.

At Igushik there was a small number of salmon in the stream when the season opened and a fair number on the 29th, which increased satisfactorily the following day. The run held steady until July 9, when a perceptible falling off was noticeable. A fair number entered up to the 14th, after which the run continued small to the end of the season.

The natives who live near the lakes at the head of the Igushik and Snake Rivers reported that last fall the best salmon run for many years had entered those waters. A trip was made to the Snake River by one of the bureau's employees during the early winter, but nothing could be learned other than to verify the report by the natives. This, in view of the fact that a very meager escapement entered the Nushagak and Wood Rivers in the same period, would indicate that each stream supports an independent run.

At Kvichak-Naknek operations began with only a small run of salmon in evidence, and fishermen made deliveries of from 300 to 600 fish per boat during the first few days. On June 28 a fair run was reported near Egegik, but weather conditions were severe and very few fishermen endeavored to take advantage of it. The *Scoter* continued to cruise outside during the succeeding closed period. The run held small but steady to July 7, when the number increased perceptibly, and on the evening tide boats began to arrive at the tally scows with good catches.

The following day the run was again light. There was a fair run of red salmon at Egegik on July 26.

On July 11, during a strong southeast blow, fair numbers of salmon were noticed passing up the Naknek River, although the fishermen outside were not making encouraging catches. The fishermen well out beyond the ships, however, returned with fair numbers the following morning. The catches continued small from the 16th to the end of the season, and very few fishermen were out after July 21.

The number of salmon entering the Egegik River, while coordinated as to dates with the Kvichak-Naknek run, was proportionately much greater. The packs here were also affected by the reduction in gear and cannery personnel before referred to.

At Ugashik the closed periods, together with continuous stormy weather and reduction of gear, favored an escapement of spawning salmon that was much greater in relation to the pack than has occurred in previous years. No heavy run occurred, but greater numbers appeared to be ascending toward the end of the season than at any other time.

ESCAPEMENT

In the Wood River district a few salmon made their appearance at the lower lake on June 29, and small numbers entered daily until July 2, when great schools appeared and kept increasing. A trip down Aleknagik Lake and Wood River was made on July 10, when the lake and river seemed alive with salmon. On July 11 a prospector from Nerka Lake reported that large schools of red salmon were passing up that body of water. The run into the lake held strong until July 12, when a perceptible slackening was noted. During the height of the run an effort was made to estimate the numbers passing up, but the rush was so great that it was impossible to make an intelligent estimate. This escapement was the most satisfactory for the last several years, and it is felt that a sufficient number of salmon passed up to their spawning grounds to seed adequately all available territory. On July 15 the number of incoming salmon was small and no heavy rush was experienced throughout the remainder of the season. A few silver salmon made their appearance at the outlet of Aleknagik Lake on July 29.

At Ugashik the salmon were late in arriving at the lake, the first appearing on July 2. The main run reached the lower lake July 13 and on the following day arrived at the rapids between the two lakes. This passage rapidly filled with salmon ascending from the lower to the upper lake. Estimates of the fish passing up were made at several 20-minute intervals, and it was reported that about 250,000 salmon entered the upper lake. A survey of the lower lake was made also, and it was estimated that there were 100,000 salmon in that body of water. In addition, considerable numbers of salmon were noted on July 27 in the first rapids ready to enter the lake, but owing to weather conditions it was impossible to estimate the number.

At Egegik the ascending red salmon reached the spawning grounds at the head of Lake Becharof on June 28, and the run was of fair proportions until August 3, when it slackened. On August 14 a heavy rush occurred, continuing strong throughout August. Warden A. T. Looff visited the streams and spawning area along the lake shore and reported that all available spawning area was amply seeded.

The first red salmon seen at Naknek were at Coville Lake on June 19, where they appeared before entering Kidawik Creek, although the fish first pass the mouth of the creek. Numbers increased gradually, until large schools were passing between Grosvenor and Coville Lakes. Considerable schools were noted at various points in each lake, also, and on the return trip good-sized schools were noted at the falls of Kidawik Creek. While the weather was severe and precluded any possibility of estimating the number at each locality, the observer, who has worked in this district for four years, stated that in his judgment the escapement was possibly 40 per cent of that of 1923. The spawning grounds were not visited after spawning began.

Spawning areas on Iliamna Lake and tributaries were viewed several times throughout the season, but only in certain areas were salmon observed in any numbers. Kokhonak Creek and Copper River contained encouraging numbers early in the season, and later the red salmon were plentiful on the spawning beds also. These were the only places that received anywhere near an adequate number of spawners. On July 8 several thousand red salmon were noted schooling at the mouth of Copper River, and salmon were jumping in all directions, seemingly working toward this stream. On July 18 another visit was made to Copper River and conditions appeared most encouraging. Large schools of salmon were in the deep holes near the river mouth and numbers were observed jumping outside. Kokhonak Creek was visited at the same time and encouraging numbers were schooling at the mouth, but no estimate could be made as very few had as yet entered the stream. Fish were red and apparently close to spawning period. Other advantageous points were visited but no salmon were seen.

A final inspection of the spawning grounds was made, beginning August 9 at Belinda Creek. As in previous years, most of the spawning was in the lower mile of the creek and almost none above 3 miles. Two families of native reindeer herders were camped at Belinda Creek drying fish for home use and dog feed. They had already cured about 3,500 salmon, the usual number being from 4,000 to 5,000 fish. About 2,000 red salmon were spawning in the creek, but none were seen outside the mouth. This was about one-tenth the number that spawned in the previous two years. From Belinda Creek the lake line was followed for several miles in each direction, and salmon were seen spawning at several points along the beach. A storm was beating on-shore, and the salmon could be seen lifted on the waves and in some cases almost thrown on the shore. When the waves subsided they were noticed working at the same points in the gravel.

Kokhonak River and falls were next visited and 500 red salmon estimated below the falls, or about one-third the number observed last year. Some fish were working at the falls, but none as yet were spawning. The fishway blasted along the side of the falls in 1921 was washed away, as was a large portion of the rock wall forming the south shore. A trip was made up Kokhonak Creek for several miles and numbers of salmon were found in the stream. Fair numbers were schooling in the deep holes in the lower reaches and near the mouth of the river, and the spawning grounds were fairly well covered, but not in numbers comparable with last year. The greater portion of the river was examined and it was estimated that there were about 175,000 red salmon in the stream, or 13 per cent less than in 1923.

The flood in the fall of 1923, which washed out the fishway at the falls, also made many changes in the stream and its by-passes. The main channel of the river was changed for a distance of about 1 mile at a point near the outlet, and nearly all the sloughs, which had carried water from the main river and reentered it farther down, were completely filled with gravel. As these sections were well seeded last fall it is felt that severe losses of eggs resulted from the filling in of these channels. This flood is said to have been the highest water reported in the lake in the memory of the oldest resident, and all the lowlands bordering on the river appeared to have been under water.

At Copper River no salmon were noticed schooling outside the river, but numbers were seen along the banks as we proceeded upstream. Spawners in the lower reaches equaled or exceeded the number in previous good years, but above 4 miles they were not so numerous. An estimate of 150,000 red salmon was made, or equal to the number in 1923. There were signs of serious storms everywhere, but no damage to spawning areas was noticed along this stream. While indications show that the high water overflowed the banks on each side of the stream, the river and tributary sloughs remained with their original banks when the flood subsided. Bear trails and signs of their fishing were noticed along the entire river. Some spawning was in progress around certain of the islands in Intricate Bay, but it was not extensive.

All of the spawning localities on the north shore of Iliamna Lake were visited, but there were practically no fish anywhere except in the Newhalen River. Chekok Creek, always a good producer, was completely barren of salmon, as were all the streams along that shore, including the small creeks in the vicinity of Roadhouse portage, the Woody Island lakes, and outside shores. All the natives and locals were securing their winter's supply of fish for home use and dog feed from the Newhalen River, with the exception of a few taken at Iliamna. The number of salmon spawning in the Newhalen River could not be estimated owing to the discoloration of the water, which was high and of glacial origin. Some salmon were passing through the rapids on August 14.

Iliamna River was examined for about 10 miles from its mouth, including both its forks, and about 300 salmon were seen. The natives had utilized about 3,000 salmon—practically all that entered. All of the streams tributary to Iliamna Lake showed considerable damage from floods. New channels were made and old ones filled in in many places, which will have some bearing on the production of fry from eggs deposited last fall in these waters.

On the trip to Lake Clark salmon were spawning along the entire river and the lake. The number could not be estimated owing to water conditions, but they were not as numerous as in previous years.

The natives secured a sufficient number of fish for home use, their catch amounting to about 50,000 red salmon. They all agree, however, that the run this year was far smaller than those of the last two years. Some of the white men in the vicinity estimated the run as only 5 to 15 per cent as large as in 1922 or 1923. It is probable it was not over this latter figure, but might have been about 10 per cent of last year and a much smaller percentage of 1922.

The fish village near the outlet of the lake was visited on August 17, and it was noticed that some fresh salmon were still being taken, but the natives had nearly all the fish they needed and only a few very small pieces of web were in the water.

Taziminia River was visited, and 5 of its 6 miles of spawning area were examined. It was estimated that 40,000 red salmon had entered this stream, which was fewer than in any of the previous five years with the exception of 1920.

The escapement to this section was not wholly satisfactory, although in excess of expectations based on observations in passing up and down the Kvichak River, where few salmon were noticed ascending; the same report was made by others who had occasion to travel in this locality, though early in the commercial season parties traveling downstream from the lake had noticed salmon ascending.

The number entering the lake was greatly increased by the weekly closed period and by moving the markers downstream about 2½ miles to a point just above the Alaska Packers Association's Koggiung cannery.

PATROL

The patrol was effective at all points except Ugashik, where it is felt certain an organized effort by fishermen to evade the law was aided and abetted by certain cannery officials. The boats detailed for this work during the past season were not suitable or sufficiently speedy to cope with the situation. The matter has been laid before the Commissioner of Fisheries with the recommendation that the Ugashik section be entirely closed if this situation arises again.

A launch, with two men, was stationed at each of the following points: Kvichak, Naknek, Nushagak, and Igushik. One man with a small boat was detailed to Egegik for patrol through the open season, and with an assistant on a hired launch or sailboat the district was covered during the closed period. Another launch, with a warden and an assistant aboard, patrolled lower Nushagak Bay through each closed period, while a local launch, engaged to cover the territory between Kvichak and Naknek during the weekly closed period, patrolled the upper Kvichak and transported the writer to the lakes at various times through the commercial season. The bureau's boat *Scoter* covered the entire district, keeping in touch with the different localities. As the result of an accident launch *No. 4* was totally destroyed by fire in the Ugashik River after the commercial season was over.

Predatory fish taken in 1924

Location operated	Fish taken	Average weight	Total weight	Dolly Vardens	Lake trout	All others
	Number	*Pounds*	*Pounds*	*Per cent*	*Per cent*	*Per cent*
Naknek	2, 192	10	21, 920		85	15
Becharof	40, 307	3	60, 460	100		
Ugashik	5, 569	1½	8, 354	100		
Nushagak	5, 551	2½	13, 877	95		5
Iliamna	20, 477	2½	51, 477	100		
Total	74, 096		156, 088			

WINTER INSPECTION OF SALMON SPAWNING GROUNDS OF WOOD RIVER LAKE SYSTEM, 1922–23

A survey of the spawning grounds of the Wood River lake system was made during the winter of 1922–23 by Warden A. T. Looff. A report of his observations before the freeze-up in the fall was published in the document "Alaska Fishery and Fur-Seal Industries in 1922." The report on his inspection trip in January and February, 1923, apparently became lost in the mail and was not available for inclusion in the corresponding publication for 1923. The report by Mr. Looff on that trip is as follows:

During the months of January and February, 1923, a trip was made with dog teams to the lower Wood River lakes—Aleknagik and Nerka. It was the intention to go from Nerka Lake to the upper Wood River lakes, and from there across country to the Tikchik lakes for a preliminary survey of that district, but on account of deep snow this part of the plan could not be carried out. Streams tributary to Aleknagik and Nerka Lakes were examined to determine the effect of the winter cold on their flow. Air and water temperatures were taken and the gauges placed last fall prior to the freeze-up were visited to determine the change in the lake level. Spawning areas marked last fall during the spawning period were examined. Work on predatory fish, chiefly Dolly Varden trout, was carried on, but with poor results. Heavy snowfalls that covered the ice of lakes and streams with many feet of snow made the work difficult, and moving from place to place was almost impossible.

ITINERARY

Supplies and equipment were assembled at Snag Point and dog teams were engaged. Leaving Snag Point on January 2, at 7 a. m., the party, consisting of the writer, J. Paulsean, apprentice fish-culturist, and H. Henriksen and C. Neilsen, drivers, with two dog teams, proceeded across country to the outlet of Aleknagik Lake, thence over the ice of the lake to its head, and thence over the portage to Nerka Lake, where on January 6 one load was cached and C. Neilsen sent back to Snag Point with one of the teams. The party then proceeded with one team and a light load along the west shore of Nerka Lake to the outlet of Little Togiak River, reaching there January 6 at 4 p. m. At Little Togiak River a permanent camp was established, from which trips were made to the tributary streams in that vicinity and work on Dolly Varden trout was carried on. The dog team was sent back to the portage between Nerka and Aleknagik Lakes for supplies cached there.

On January 18 camp was moved 5 miles farther up Nerka Lake and established on the north shore, the team having carried one load forward on January 16. Fishing for Dolly Vardens was carried on, but with poor results.

On January 20 camp was moved to the south shore of Nerka Lake about 10 miles below its upper end. At this stage travel became very slow on account of deep snow, it being necessary for two men to snowshoe their way ahead of the dogs. From this camp trips were made to investigate spawning areas along the south shore of the upper end of Nerka Lake and tributary streams that enter along that shore.

On February 7 rain followed by a quick frost formed a crust on the deep snow that covered the ice of the lake and travel again became good, but the supply of dog feed was now so low that the plan to continue the trip on to the upper lakes was abandoned. On February 8 camp was moved 20 miles down Nerka Lake and established near the mouth of Lynx Creek. From this camp trips were made to the various tributaries in that vicinity, marked spawning areas were examined, and work on predatory fish was carried on.

On February 19 camp was moved over the portage to Aleknagik Lake and established at the mouth of the river that enters that lake from Nerka Lake. From this camp the river connecting the two lakes was examined, and fishing for Dolly Varden trout was carried on at the mouth of the stream. On February 25 the supply of dog feed was exhausted and the party started for Snag Point, reaching there the same day at 6 p. m.

EFFECT OF ICE ON SALMON SPAWN

To determine possible destruction of salmon spawn in lake-shore spawning areas by the winter ice, the level of the lake water was recorded at different times during the salmon spawning period last fall and until the freeze-up on stakes driven near the shore in both Aleknagik and Nerka Lakes. Several nests in shallow water were marked with poles, and such places were examined on this trip.

Last fall the water of the lakes reached its lowest level on September 5, which was during the height of the salmon spawning period, after which it rose steadily until on October 21 it was 18 inches higher. As the height of the spawning period was during the lowest stages of the lakes, and as the shallowest nest located during that time was covered with 12 inches of water, few spawning areas were covered with less than 30 inches of water at the time of the freeze-up.

On January 3 the level of the lakes had fallen 26 inches below the level of October 21 and 8 inches below the level of September 5. The position of the ice along the shore did not indicate that the level of the lakes fell after the freeze-up, but this is believed to be the case. During the months of January and February there was no change in the level of the lakes but a great increase in the thickness of the ice that covered the lakes, especially during January.

On January 3 the average thickness of the lake ice was 12 inches, and it increased rapidly to 30 inches during the cold weather of that month. During February the increase was slow, and on February 24 the average thickness was 36 inches. There was no difference in the ice on Aleknagik and Nerka Lakes.

Upon first reaching Aleknagik Lake and finding the low level of the lake and the thickness of the ice it was believed that spawning nests in shallow lake-shore areas would be frozen, but this was found not to be the case. All of the nests marked last fall were relocated and found to be centered in what are known in this district as "hot holes." Many of these "hot holes," most of which are located along the shores of the lakes, remained open during the coldest periods. Others formed a thin sheet of ice that increased in thickness as the water became deeper away from shore. All "hot holes" observed opened up promptly during periods of moderate weather. In traveling along the shores of the lakes it was noticed that important spawning areas observed last fall during the salmon spawning period were centered in "hot holes."

Tributaries of Aleknagik and Nerka Lakes that could be reached were examined to determine the effect of the winter cold on their flow, to ascertain their temperature, and to locate Dolly Vardens. With the exception of Little Togiak River, Creeks Nos. 11 and 27, and Lynx Creek, conditions in all tributaries examined were identical. All were laid over with from 6 to 12 inches of ice, which in turn was covered with many feet of snow. They were discharging approximately one-half the amount of water that they did last fall, and their temperature was 32° F. Little Togiak River was open in mid-channel and discharging only slightly less water than last fall. Its temperature was 32° F. Creeks Nos. 11 and 27 were dry or entirely frozen up. Lynx Creek was open throughout most of its length, being covered with ice only in reaches where the current is slow. Lynx Creek was discharging about two-thirds the amount of water that it did last fall, and its temperature was 32.5° F.

WATER TEMPERATURES

The temperature of the lake water was taken in many places, at various depths, and at different times when the temperature of the air ranged from 38 to 42° below zero. Immediately under the ice the temperature of the water was at all times 32° F. When the glass was lowered to a depth of 25 feet or more a slight rise in temperature was noticed. The highest water temperature found was in a group of "hot holes" on the east shore of lower Nerka Lake, which maintained a constant temperature of 35° on the bottom, the water at the surface being colder in proportion to the depth of the "hot hole" and the air temperature.

WORK ON PREDATORY FISH

Work on Dolly Varden trout was made difficult by the depth of ice and snow that covered the lakes and streams. This condition prevented the intelligent use of nets, as the fish could not be located. Camps were chosen with reference to favorable locations for trout, and many holes were cut through the ice but no concentration of trout was found. Fishing was carried on through these holes with hand lines at all available times, but with meager results. Only 56 trout were taken.

We feel that the failure in this part of the work was due largely to lack of experience with winter conditions. Last October at the close of the fall work P. Knutsen, who spent the winter trapping at the head of Aleknagik Lake, was furnished two trout gill nets to be used for Dolly Vardens. With these two nets and one of his own Mr. Knutsen took 1,300 Dolly Vardens at the head of Aleknagik Lake after our departure. They were taken just before and after the freeze-up, operations being stopped when the ice exceeded several inches in thickness. Part of the catch was frozen, several hundred of the fish having been seen by the writer during this trip.

INVESTIGATIONS IN NUSHAGAK REGION, FALL OF 1923. EXAMINATION OF TIKCHIK LAKE SYSTEM

At the end of the commercial fishing season of 1923 in Bristol Bay, a number of the bureau's employees, under the direction of Warden A. T. Looff, were assigned to the work of destroying predatory fish in Aleknagik Lake. J. Paulsean, master of the bureau's patrol vessel *Scoter*, was actively in charge of this work, which continued from August 3 to October 1. Operations centered in the vicinity of the main inlet of the river entering from Nerka Lake until August 16, and from that date until August 26 at the outlet of Aleknagik Lake; again at the inlet from August 27 to September 17, and thereafter at the outlet until the departure of the crew on October 1.

The total number of predatory fish destroyed during this period was 2,389, approximately 95 per cent of which were Dolly Varden trout, the remainder being pike and rainbow trout. Fair results were obtained during most of the time with gill nets, seines, and hand lines, but very poor catches were made with baited traps and their use was soon discontinued. On September 10 a period of heavy rainfall began, which raised the level of the lake 74 inches from noon on September 11 to noon on the 14th. Very few trout were caught thereafter on account of the high water.

A careful examination of all spawning areas in Aleknagik was also made during this period, and trips were taken to all tributary streams. It was estimated that 7,500 red salmon spawned in five of the nine main tributaries, but they did not enter the others. It was also estimated that 9,000 red salmon spawned along the lake shores, making a total of 16,500 in Aleknagik Lake and its tributaries, or approximately half the number estimated to have spawned there in the season of 1922.

While operations were being carried on at Aleknagik Lake Warden A. T. Looff made a trip to the Tikchik lakes. Spawning grounds were inspected and a map made of the region, showing the lakes and their tributaries and connecting rivers and the drainage system into Bristol Bay. Mr. Looff's report on this trip is as follows:

Before beginning the examination of the Tikchik lake system inquiries were made of prospectors and natives residing in Bristol Bay regarding the district to be visited, and it was found that practically nothing was known of the Tikchik district except that it is a region of numerous large lakes. Most maps of this section of Alaska show one or more lakes, known as the Tikchik lakes, lying to the north of the Wood River lake system and flowing through the Tikchik River into the Nushagak River. In the preparation of this report and the accompanying map the nomenclature of the natives of the Tikchik region is used with respect to the main features. F. A. Waskey, who was prospecting in the district and is very familiar with the Innuit language, was authority for the proper spelling of names and for information regarding some of the upper features of the district.

The Tikchik lake system lies directly to the north of the Wood River lake system and constitutes the main lake source of the Nushagak River. It comprises six lakes—First Nuyakuk, Second Nuyakuk, Chauiskuktuli, Chikoominuk, Nishlik, and Uppnuk—and derives its name from the Tikchik River, a small stream flowing from the two last-named lakes into First Nuyakuk Lake. The district is drained to the southeast by the Nuyakuk River, which flows into the Nushagak River, and the latter then empties into Nushagak and Bristol Bays.

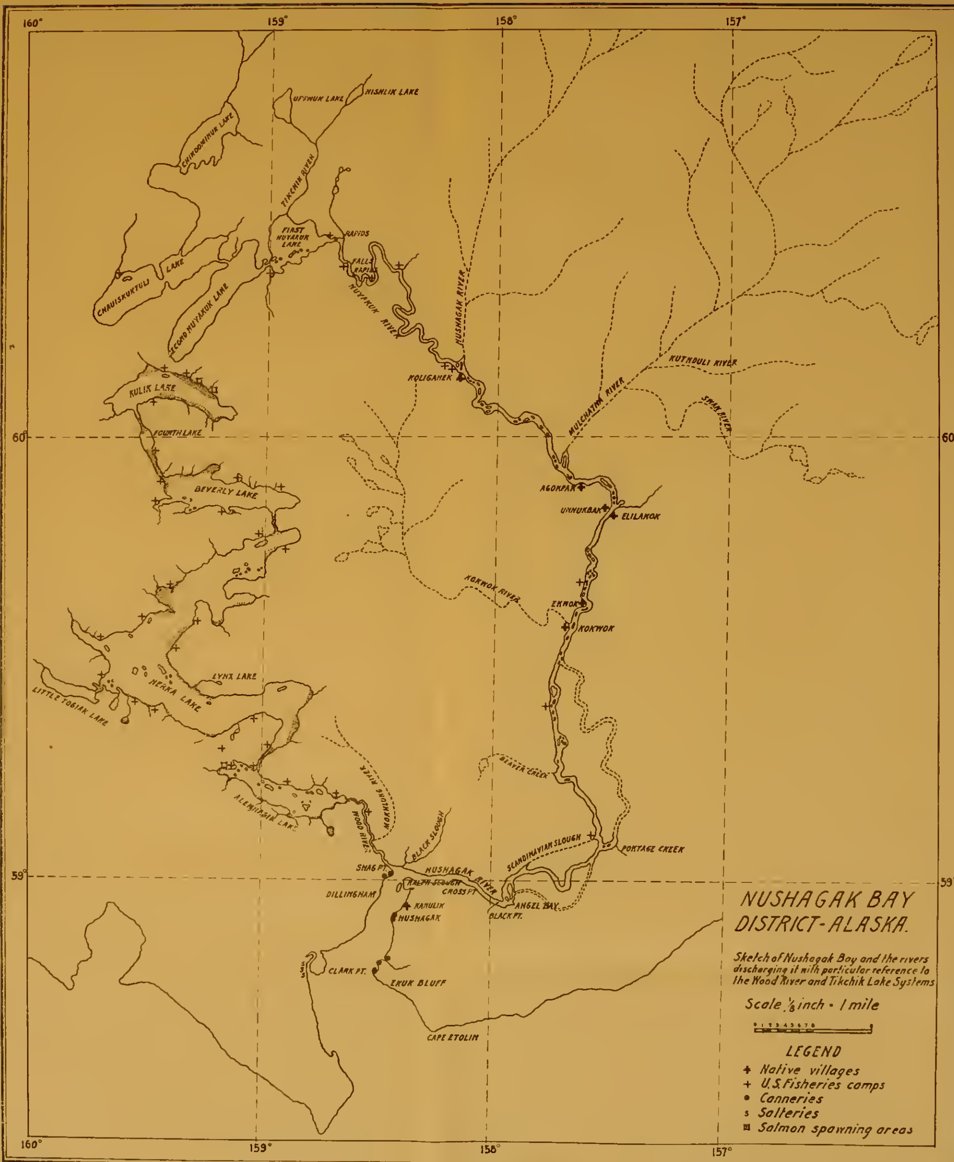

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FIG. 4

The Nuyakuk River enters the Nushagak River about 148 miles above the village of Snag Point, where the Nushagak widens into Nushagak Bay.

Leaving Snag Point August 25, 1923, the party proceeded up the Nushagak River to the mouth of the Nuyakuk River, thence up that river to First Nuyakuk, Second Nuyakuk, and Chauiskuktuli Lakes. Patrol boat *No. 4* was used as far as the first rapid on Nuyakuk River, 198 miles above Snag Point, and an 18-foot codfish dory equipped with an Evinrude engine was used above that point and for the work on the lakes. The entire shore line of these three main lakes was examined, and trips were made to ascertain the relative position of and secure information about the other three lakes. As salmon do not enter the stream connecting Chikoominuk Lake with Chauiskuktuli Lake, and as reliable information regarding Nishlik and Uppnuk was secured from another source, little was to be gained by a visit to them and it was decided to spend all available time on the examination of the main lakes. Work was completed and Snag Point reached September 17.

NUSHAGAK RIVER

In traveling to and from the Tikchik district that portion of the Nushagak River from its mouth at Snag Point to the mouth of the Nuyakuk River came under observation. Sketches were made and its main channel is included in Figure 4. From the mouth of the Nuyakuk River the general trend of the Nushagak River is southeast for a distance of 45 miles, then south for 68 miles, and then west to its mouth at Snag Point. This lower portion of the river flows between low, rolling hills well timbered with spruce, birch, and cottonwood. In places it breaks up into many channels. The effect of the tides from Bristol Bay are perceptible for a distance of 35 miles above Snag Point. The current is fairly swift and it takes a good launch to make headway upstream. Actual running time from Snag Point to the mouth of the Nuyakuk River with patrol boat *No. 4* was 49 hours.

Two large tributaries enter the Nushagak below the Nuyakuk River—the Kokwok River from the west, 80 miles above Snag Point, and the Mulchatna River from the east, 115 miles above Snag Point. There are six native villages on the Nushagak River, all of which were visited and inquiry made of the natives regarding the run of salmon and the extent of their catch. These villages evidently had a considerable population at one time, but they are nearly deserted now.

Kokwok village is located on the west bank of the Nushagak near the mouth of the Kokwok River. It was at one time large, but at the time of our visit only two families of natives lived there. They were reindeer herders and did no fishing, but reported having seen several hundred red salmon ascending the Kokwok River during the last days of July.

Ekwok village, which is the largest native village on the river, is on the west bank of the Nushagak, 5 miles above Kokwok village. Seven families lived there, all of whom were fishing. About 7,000 salmon, a little over 1,000 of which were red, the remainder being chum, king, and silver, had been caught during the summer, most of which were dried for winter use. The natives reported that the red-salmon run was extremely light this season and that most of the fish passed Ekwok during the last days of July.

Unnukbak village, containing one native family, is on the west bank of the Nushagak, 15 miles above Ekwok village and 100 miles above Snag Point. The natives were fishing with two traps constructed of split spruce strips and shaped much like a fyke net. With these traps they had taken about 800 salmon, of which about 150 were reds. A red salmon bearing tag No. 6743 was taken on the last day of July.

Elilakok village, on the east bank of the Nushagak 103 miles above Snag Point, was deserted.

Agokpak village, on the west bank of the Nushagak 113 miles above Snag Point, contained three native families. They had taken approximately 2,000 salmon, about 400 of which were reds.

Koliganek village is on the west bank of the Nushagak River near the mouth of the Nuyakuk, 148 miles above Snag Point. It is the farthest upriver of any native village, and evidently at one time had a considerable population, but there were now only two native families. They had been fishing during the summer and caught about 300 salmon, approximately half of which were reds.

NUYAKUK RIVER

The Nuyakuk is the largest tributary of the Nushagak River, on the basis of the volume of water discharged. It carries the waters of the Tikchik lake system over a distance of 60 miles in a southeasterly direction to the Nushagak River. For the first 10 miles it flows through a mountainous country, which breaks abruptly into low, rolling hills well timbered with spruce and birch. There are three rapids in the upper reaches.

The first rapid, one-third of a mile long, is 10 miles below the outlet of First Nuyakuk Lake. The river there breaks into three channels. Salmon ascend easily and small boats can be lined up the right channel.

The second rapid is 5 miles above the first rapid. Here the river falls fully 75 feet in a distance of one-eighth of a mile. Boats must be portaged when traveling either up or down the river. The portage is on the west bank and is 300 yards long, with a rise of 100 feet going up river and 25 feet going down. A windlass was used to portage the dory. Salmon ascend through a series of eddies.

The third rapid, half a mile in length, is at the outlet of First Nuyakuk Lake. Salmon ascend easily and small boats can be lined up along the south bank.

There are no native villages on the Nuyakuk River, and it has only one important tributary. Two native families camping at the mouth of this tributary during the fishing season had caught about 1,000 salmon, a large proportion of which were reds. These natives had no name for the stream, so it was called Camp Creek.

Camp Creek enters the left limit of the Nuyakuk River at the foot of the third rapid. It is about 10 miles long and averages about 10 feet wide and 2 feet deep. Its source is a series of small ponds to the north. Red, king, and silver salmon ascend the stream to spawn. It was estimated that 1,000 red salmon had spawned in the stream and ponds.

TIKCHIK LAKES

The Tikchik lakes consist of a chain of three main lakes and three less important ones. The main lakes—First Nuyakuk, Second Nuyakuk, and Chauiskuktuli—are closely united. Of the others, Nishlik and Uppnuk are tributary to First Nuyakuk and Chikoominuk is tributary to Chauiskuktuli. The country surrounding the lakes is extremely mountainous. Most of the streams flowing into the lakes are small, short, and too swift for salmon to ascend, and consequently are of little interest from a fishery standpoint.

FIRST NUYAKUK LAKE

First Nuyakuk is the smallest of the three main lakes. It is triangular in shape, 9 miles in length, with a maximum width of 7 miles. The direction from the outlet to the inlet is southwest. Except at the upper end the lake is shallow and the bottom is strewn with large bowlders. The entire shore line was examined and the greater part found to be rocky and unsuitable for spawning. A few red salmon were seen—about 25 in all—but none was found spawning. The lake has two tributary streams.

Creek No. 1 enters on the south shore near the inlet from Second Nuyakuk Lake. It has an average width of 20 feet and depth of 2 feet for the first 2 miles. The current is fairly swift and the bottom gravelly. No traces of salmon were found. The source is apparently mountainous.

Tikchik River is about 100 feet wide and 2 feet deep where it enters First Nuyakuk Lake on the north shore about 6 miles above the outlet. No salmon were seen in the mouth of the river or in its vicinity on September 6. Natives reported that in former years immense runs of red salmon passed up this stream to the two lakes above. F. A. Waskey, who descended the river during the time of our examination, furnished a sketch of the river and its lake source—Nishlik and Uppnuk Lakes. Lack of time prevented a trip to those lakes, but Mr. Waskey reported having seen about 75 salmon during his trip down the river.

SECOND NUYAKUK LAKE

Second Nuyakuk Lake is next above First Nuyakuk Lake, to which it is joined by what might best be termed a strait about 2 miles in length and one-fourth of a mile in width. The water of the strait is very deep, with barely perceptible current.

Second Nuyakuk Lake is 19 miles in length and has an average width of 4 miles. The distance from the outlet to the inlet is 4½ miles and the direction is west-northwest, the main portion of the lake lying southwest of the inlet and outlet. The country around the lake is mountainous and, except at the northern end, high mountains rise abruptly from the water's edge. Most of the shore line is rough and strewn with large bowlders, but there is good gravel bottom well suited for spawning for about 10 miles along the north shore from the inlet to the outlet. About 100 red salmon, all highly colored, were seen in this section of the lake but none were found working at nests. No salmon were found in other parts of the lake. The southern portion, particularly, receives many small tributary streams, which descend the mountain sides in cataracts that in many cases can be seen for their entire length from the lake. They are of no interest from a fishery standpoint, as fish can not ascend them.

Creek No. 2 enters the lake about a mile north of the point where the river connecting Lake Chauiskuktuli with Second Nuyakuk Lake enters the latter. It was examined for a mile above its mouth, in which distance it averaged 10 feet in width and 1 foot in depth. It has a good gravel bottom and the current is slow—about 3 miles an hour. No salmon were found in it.

CHAUISKUKTULI LAKE

Chauiskuktuli Lake is the third of the three main Tikchik lakes and the largest of the group. It is 21 miles in length, with an average width of 4 miles, and from outlet to the head the direction is southwest. It lies north and a little to the west of Second Nuyakuk Lake, with which it is connected by a river 1 mile in length and averaging 150 feet in width and 2 feet in depth. Upon leaving Chauiskuktuli Lake the river flows due east and is fairly swift. In ascending boats must be lined from the banks. Thirty-five red salmon were noted going up the river on September 8, but none were seen on the return trip on September 11.

Chauiskuktuli Lake also lies among lofty mountains. About 13 miles of its shore line, from a point directly opposite the outlet of the lake southwest to the mouth of Creek No. 5, is an almost continuous gravel beach. Practically all of the red salmon found upon an examination of the Tikchik lakes were along the beach. They were seen at intervals all along this shore, and several groups of 50 or more were noted. In some places work on nests was in progress from September 7 to 11. Along the northeast shore the lake has a mud bottom, and no salmon were found there. Only about 50 salmon were seen along the south shore. Chauiskuktuli Lake has three tributaries, in none of which were salmon found.

Creek No. 3 enters the northeastern end of the lake. For the first mile the stream averages 15 feet in width and 3 feet in depth. Its current is hardly perceptible and the bottom is mud-covered. The stream rises in the marshy land to the northeast, which is practically the only lowland bordering the lake.

Creek No. 4 is a swift mountain stream that enters the lake on its north shore 5 miles west of the outlet. It is 25 feet wide and 2 feet deep at its mouth, and was examined by land for a distance of about 2 miles above its mouth. It can not be ascended by a boat, nor can salmon ascend. F. A. Waskey, who had made the trip overland during the summer, furnished a sketch of the stream and its source—Chikoominuk Lake.

Creek No. 5 enters on the north shore 13 miles southwest of the outlet of the lake. In its lower reaches this stream averages 10 feet in width and 2 feet in depth. It has good gravel bottom apparently well suited for spawning purposes. It was examined for a distance of about 2 miles above its mouth, but no salmon were found.

EXTENT OF RED-SALMON RUN TO TIKCHIK LAKES

The Tikchik lakes, as the main lake source of the Nushagak River, are the logical destination of the greater part of the red salmon that pass up the Nushagak River to spawn. Natives residing on the upper Nushagak River report that red salmon pass up the Kokwok River, which drains a series of small lakes, and also up the Nuyakuk River to the Tikchik lakes, but that the run of red salmon up Nuyakuk River is much larger than the run up the Kokwok. They state also that red salmon are never found in any other tributaries of the Nushagak.

After leaving salt water in Bristol Bay, in order to reach the first of the Tikchik lakes salmon must ascend approximately 210 miles of river and negotiate three rapids, none of which is difficult. Of the run of red salmon that passed up the

Nushagak River in 1923, about 2,000 were caught by 13 native families that live along the river. All of these were caught above the mouth of the Kokwok River, and it is considered fairly certain that they were bound for the Tikchik lakes. The gear operated by these natives, consisting of gill nets and traps, most of which was inspected by the writer, was not capable of catching a large proportion of the salmon passing up the river. In examining the spawning grounds of the Tikchik lakes it was estimated that 4,000 red salmon were found, probably 3,000 of which were spawning along the north shore of Chauiskuktuli Lake and the remainder in Camp Creek, which enters the Nuyakuk River near the outlet of First Nuyakuk Lake. There was evidence that some red salmon pass up the Tikchik River to Nishlik and Uppnuk Lakes, but they do not ascend other tributaries.

OTHER FISH IN THE TIKCHIK DISTRICT

The natives living in the Tikchik district, consisting of three families, none of whom has ever been to Bristol Bay, reported that all five species of salmon now enter the lakes, but that humpback salmon never ascended above the second rapid previous to the season of 1920, when extensive changes occurred in the rapids during the spring break-up. During the examination of the district a few king salmon were noticed in the upper reaches of the Nuyakuk, but none were found in the lakes. Several hundred silver salmon and a few humpbacks were seen in the lower part of First Nuyakuk Lake, but none in the upper lakes. No chum salmon were seen during the examination of the lakes.

According to a story common among the natives of Bristol Bay, the Tikchik is the home of a great fish known as the "chieginuk," which is said to become so large and vicious as to attack and destroy caribou and other animals that attempt to cross the river and lakes, and the natives in the Tikchik never use brightly painted kayaks for fear they will attract these fish. Upon reaching the Tikchik district it was found that the story was true with respect to the painting of the kayaks and also that the natives are afraid of the fish. Excitement became keen when one of the natives volunteered to catch a small chieginuk, large ones never having been seen by them, but our disappointment was keen next morning when the native paddled up to camp, and with the word "chieginuk" tossed a fine specimen of lake trout (*Cristivomer namaycush*) on the beach. Great numbers of lake trout were found in all parts of the lakes. The natives reported that each fall, shortly before the freeze-up, a great run of these fish occurs from First Nuyakuk Lake up the Tikchik River, and it is from this run that they take most of their winter's supply of fish.

KUSKOKWIM RIVER

In July and August Stream Guard Charles McGonagall made a special trip from the Yukon to the Kuskokwim River, particularly to investigate allegations that commercial fishing operations were being carried on above the mouth of that river as established by the Bureau of Fisheries, but fishing operations had ceased by the time of his visit. Commercial products were as follows: Kings, 32 tierces mild cured and 329 tierces and 37 barrels pickled; chums and silvers, 430 barrels pickled; reds, 20 barrels pickled. Local residents also prepared 14,700 king salmon and 132¾ tons of dried dog salmon.

YUKON RIVER

Commercial fishing for salmon off the mouth of the Yukon River was carried on by three mild-cure and salting plants—Waechter Bros., Frank Kern, and O'Connor & Sheppard—all located on Leslie Island. The run of king and chum salmon was reported to be the largest since 1912. The run of kings began at the mouth of the river on June 9, and by July 3 all available containers had been filled and fishing ceased. During this period weather and fishing conditions were ideal and very little gear was lost. The total pack was as follows: Kings, 565 tierces mild cured and 10 tierces and 125 barrels pickled;

chums, 71 barrels and 1 tierce pickled. Practically all of this pack was shipped to the States. In addition 55 cases of smoked kings were canned for sale in the local market.

Fishing by natives along the Yukon and Tanana Rivers also was successful, although there was a heavy loss of spoiled fish as a result of continual rains from July 3 to August 10. It was estimated that there were 258 wheels and 600 fathoms of nets operated from Kwiguk to Rampart Rapids, and that about 685 tons of dried dog salmon were prepared. The catch on the Tanana River was approximately 50 tons of dried dog salmon. Contrary to custom, the natives were still fishing when the bureau's patrol passed up the river the latter part of August and early in September.

Inspector C. F. Townsend, with headquarters at Fairbanks, looked after the bureau's interests on the Yukon and tributaries and also supervised the Kuskokwim River investigation.

ALITAK SALMON COUNT

Red salmon ascending to spawn in two small streams in Olga Bay were counted, as in the previous season. Work of constructing the rack in the stream at the upper station was begun on May 12 and completed May 21. The rack in the stream at the home station was completed by May 27. Counting began at the upper station on May 24 and at the home station on May 29, and continued until October 8. The total number of red salmon that passed through at the upper station was 302,008, and at the home station 19,867, a grand total of 321,875.

A run of red salmon in Olga Bay was reported to have entered Horse Marine Lagoon. This stream was not racked, but it was estimated that about 30,000 red salmon were in the lake at the head of the stream.

The companies fishing in Alitak Bay and tributary waters reported the capture of 238,759 red salmon, or approximately 40 per cent of the total run. Once during the season the commercial catch of red salmon exceeded the escapement, as counted at the two weirs, and fishing was ordered discontinued from July 29 to August 11. During the latter part of the season the escapement exceeded the catch.

A small run of coho salmon through the racks lasted from July 31 until counting was discontinued on October 8, and a run of humpbacks lasted from July 30 to September 12, but these counts can not be regarded as a basis for computing the run, as both of these species spawned chiefly in other streams. It was estimated that there was an escapement of more than 2,000,000 humpbacks, and that the chum and coho escapement far exceeded the catch in the district.

Operations at Alitak were under the general supervision of Fred R. Lucas, superintendent of the Afognak hatchery.

CHIGNIK SALMON COUNT

Considerable difficulty was again experienced in putting in the rack for counting salmon ascending Chignik River in 1924. On May 11 work was begun on the construction of the rack about 150 feet below its location in the previous season. The river there is 460 feet wide and from 2 to 5½ feet in depth. Some delay was experienced in getting the lumber delivered at the rack from the Northwestern Fisheries Co.'s ship *St. Paul*, which had transported it from Seattle to Chignik. On May 21 work was resumed at the rack. High water made the work very slow and difficult, and on June 8 a part of the rack was washed out. The section was reconstructed and work finally completed on July 5.

The first salmon was noted passing up the river on June 4. Counting began July 6, and it was therefore necessary to estimate the number that had passed up before the completion of the rack. Red salmon ceased running on October 10, and the weir was dismantled and all material stored for use another season. Including an estimate of 115,000 red salmon believed to have ascended between June 4 and July 5, the total escapement for the season was computed at 1,010,436. Under the provisions of the act of June 6, 1924, commercial fishing operations were stopped three times during the season, from July 14 to 21, August 7 to 11, and August 21 to 25, in order to permit the spawning escapement to equal the commercial catch. During the latter part of the season the traps of the salmon canneries took a smaller percentage of the run, and the total reported catch by the three companies operating traps in Chignik waters was 867,544 red salmon, or approximately 46 per cent of the total run. In the season of 1923 the companies took a total of 677,602 red salmon, which was over three-fourths of the total run.

It was also reported that there was a very heavy run of humpbacks, but as they spawn chiefly in the creeks emptying into the lagoon and bay, no count was made of the number of this species passing through the rack. King salmon passing through the rack numbered 424, and 109,303 coho or silver salmon were counted also. Large schools of migrating young salmon were passing down the river from May 15 to July 25, and small schools were seen until the last of September.

Operations at Chignik were under the general supervision of Warden Charles Petry.

KARLUK SALMON COUNT

Plans were made for counting the escapement of red salmon to the spawning grounds of Karluk River, as in the two previous seasons. Work was begun on the rack in Karluk River on May 4 and it was completed on May 14. The first red salmon passed through on May 16 and counting continued until August 21. The very large number of spawned-out humpback salmon floating down the river then necessitated opening the weir, and as the heavy run of humpbacks continued it was impossible to close the opening again.

The total count of red salmon passing through the weir from May 16 to August 21 was 775,705. The commercial catch of reds in the Karluk district totaled 890,752. While the escapement up to August 21 was less than this number, more than enough salmon ascended later to exceed the commercial catch and thus easily meet the requirement of law as to an escapement of 50 per cent of spawning salmon where racks are maintained.

Operations at Karluk were under the general supervision of Fred R. Lucas, superintendent of the Afognak hatchery.

SALMON TAGGING IN SOUTHEASTERN ALASKA

The tagging of salmon in the waters of southeastern Alaska to determine their migration routes was undertaken for the first time in 1924. As salmon come from the ocean to the streams through several entrances, it seemed advisable to carry on the experiment at five places in order to get in one season a general knowledge of the movement of salmon after entering the district. Accordingly the following points were selected: Inian Islands in Cross Sound, Kingsmill Point in Chatham Strait, Ruins Point in Sumner Strait, Cape Chacon at the southern entrance of Clarence Strait, and Tree Point at the southern end of Revillagigedo Channel. It was intended that 1,000 salmon be tagged at each place, and all species except king salmon be tagged in approximately equal numbers. So far as possible tagging was to be done weekly through the period of the run. However, bad weather and other pressing duties interrupted and prevented the perfect execution of this program. Ruins Point was the only place where it was possible to follow closely the prearranged schedule.

The total number of salmon tagged at Inian Islands was 214; Kingsmill Point, 400; at or near Cape Bendel, 597; Kanagunut Island, 24; Tree Point, 275; Duke Point, on the east coast of Duke Island, 295; at or near Point White on the west shore of Duke Island, 199; and at Ruins Point, 987, making a total of 2,716. Of this number, 662 tags, or a little more than 24 per cent, have been reported as recovered. Analyses of the data will be covered in another report.

The work was under the general direction of Assistant Agent Edward M. Ball. The salmon tagged were purchased from or donated by the eight concerns in whose traps they were originally caught. A reward of 50 cents was paid for each tag returned with data regarding time and place of recapture.

HATCHERIES

EXTENT OF OPERATIONS

Salmon propagation in Alaska, exclusive of Territorial activities, was carried on by the Government at McDonald Lake in southeastern Alaska, by the Alaska Packers Association at Heckman Lake, and by the Northwestern Fisheries Co. at Hugh Smith Lake. Collections of red-salmon eggs at these stations in 1924 amounted to 61,770,000, or 2,855,000 more than in 1923. No eggs were taken at the Government's hatchery on Afognak Lake in 1924, as the hatchery was being rebuilt.

Operations of Federal and private hatcheries in Alaska in 1924

Location of hatchery	Red or sockeye salmon		
	Eggs taken in 1923	Salmon liberated in 1923–24	Eggs taken in 1924
McDonald Lake	25,550,000	21,817,800	30,080,000
Heckman Lake (Fortmann)[1]	15,480,000	13,875,000	11,640,000
Hugh Smith Lake (Quadra)	17,885,000	17,234,000	20,050,000
Total	58,915,000	52,926,800	61,770,000

[1] At the Fortmann hatchery 1,150,000 humpback-salmon fry were released in 1923–24, and 900,000 eggs of this species were taken in 1924

HATCHERY REBATES

The owners of private salmon hatcheries in Alaska, who are also packers of canned salmon, receive a rebate on license fees and taxes of every nature on their catch and pack of salmon at the rate of 40 cents per 1,000 king or red salmon fry liberated by them in Alaskan waters.

Rebates credited to private salmon hatcheries, fiscal year ended June 30, 1924

Owner	Location	Red-salmon fry liberated	Rebate due
Alaska Packers Association	Heckman Lake	13,875,000	$5,550.00
Northwestern Fisheries Co	Hugh Smith Lake	17,234,000	6,893.60
Total		31,109,000	12,443.60

HATCHERY OPERATIONS

M'DONALD LAKE

The Federal salmon hatchery at McDonald Lake produced and liberated 21,817,800 young red salmon from the 25,550,000 eggs taken in 1923, a loss of 14.6 per cent. There was a heavy loss of eggs attributed to the water being supercharged with air, causing bubbles to form on the eggs and float them to the lower end of the baskets, where congestion resulted.

In the period from September 8 to 25, 1924, 30,080,000 red-salmon eggs were collected at this station. In addition, from 15,000,000 to 20,000,000 red-salmon eggs were spawned naturally in waters adjacent to the station.

HECKMAN LAKE (FORTMANN)

The Alaska Packers Association liberated 13,875,000 red-salmon fry from its Fortmann hatchery on Heckman Lake in 1924, hatched from the 1923 take of 15,480,000 eggs, a loss of eggs of 10.4 per cent. In addition, 1,150,000 humpback-salmon fry, hatched from eggs collected in 1923, were released. Egg taking in 1924 began August 22 and ended November 18, during which time 11,640,000 red-salmon eggs and 900,000 humpback-salmon eggs were taken.

HUGH SMITH LAKE (QUADRA)

The Northwestern Fisheries Co. operated its salmon hatchery as usual on this lake on the mainland near Boca de Quadra. Egg collecting began August 7 and ended October 7, the total take being 20,050,000 red-salmon eggs, which was the full capacity of the hatchery. The take in 1923 was 17,885,000 red-salmon eggs, from which 17,234,000 fry were hatched and liberated in the headwaters of Sockeye Creek, a loss of 651,000, or 3.6 per cent.

TERRITORIAL HATCHERIES

Information received from the Governor of Alaska in regard to the three salmon hatcheries operated by the Territory is as follows:

At the Ketchikan hatchery 3,447,000 humpback-salmon eggs, 2,640,000 chum-salmon eggs, and 2,000,000 chinook-salmon eggs were

FIG. 5.—Government salmon hatchery at McDonald Lake, Alaska. Capacity, 72,000,000 red-salmon eggs

FIG. 6.—Whaling vessel with whales alongside, starting for shore station, western Alaska

handled, from which 2,952,000 humpback-salmon fry, 2,571,000 chum-salmon fry, and 1,949,000 chinook-salmon fry were hatched. An experiment in feeding 100,000 humpback-salmon fry in a salt-water pond at the Ketchikan hatchery early in 1924 was very satisfactory, and arrangements are being made to conduct salt-water feeding on a larger scale in 1925.

At the Cordova hatchery 5,250,000 red-salmon eggs and 571,000 chinook-salmon eggs were handled, and at the Seward hatchery 1,015,000 red-salmon eggs and 1,429,000 chinook-salmon eggs were taken care of. At the time of the report, on March 1, 1925, egg hatching had not been completed at these two hatcheries. The bureau cooperated with the Territorial Fish Commission by furnishing transportation from Cordova to Latouche for 1,700,000 red-salmon eggs, which were planted at Eshamy.

The chinook-salmon eggs handled at all three hatcheries were received from the State of Washington.

In connection with the operation of the Territorial hatchery near Cordova, a weir was maintained at the outlet of Eyak Lake for the counting of red salmon ascending to the spawning beds. Counting began on June 6 and continued until September 21, the weir being dismantled on September 30. Reports received indicate that during this period 44,245 red salmon passed through the weir.

OTHER HATCHERY OPERATIONS

Representatives of the Washington State Fish Commission collected humpback-salmon eggs and maintained an eying station at the head of Fidalgo Bay, on Prince William Sound, in the season of 1924. Egg taking began on August 8 and ended August 28, during which period 21,320 female humpback salmon were taken. Of the 42,217,100 eggs secured from these fish, 3,097,100 were lost and the remaining 39,120,000 eyed eggs were forwarded to Seattle in four shipments late in September and early in October.

TROUT OPERATIONS

The department of fisheries and game and the game commission for King County, both of the State of Washington, engaged in collecting trout eggs in southeastern Alaska early in the season before the run of salmon began. The department of fisheries and game operated at Eva Lake, tributary to Peril Strait, and secured about 200,000 cutthroat-trout eggs, of which 50,000 were hatched and planted in Eva Lake and the remainder delivered to the Forest Service. The game commission for King County operated at a stream tributary to Thorne Arm, indenting the southern shore of Revillagigedo Island, and took 568,000 steelhead-trout eggs, which were shipped to the State of Washington.

GENERAL STATISTICS OF THE FISHERIES

The total number of persons engaged in the fisheries of Alaska in 1924 was 25,194, or 52 less than in 1923. The total investment in the fisheries was $62,660,637, an increase of $2,620,960, or 4.4 per cent. The investment in the salmon industry was $54,633,179, an increase of $1,494,267 over 1923. The products of the fisheries were valued at $40,289,273, an increase of $1,610,448, or 4.2 per cent.

Summary of persons engaged, investment, and products of the Alaska fisheries in 1924

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Whites	6,642		3,549		4,280		14,471	
Natives	2,845		1,230		474		4,549	
Chinese	557		335		461		1,353	
Japanese	796		431		207		1,434	
Filipinos	1,060		317		322		1,699	
Mexicans	47		98		1,184		1,329	
Negroes	13		33		131		177	
Porto Ricans			3		126		129	
Miscellaneous	3		16		34		53	
Total	11,963		6,012		7,219		25,194	
INVESTMENT								
Salmon canning		$24,830,943		$12,400,644		$15,446,083		$52,677,670
Salmon mild-curing		1,319,340		24,186		235,709		1,579,235
Salmon pickling				6,125		156,114		162,239
Salmon, fresh		3,104						3,104
Salmon drying, smoking, and dry-salting						30,260		30,260
Salmon by-products		180,671						180,671
Halibut fishery		2,246,292		69,792				2,316,084
Herring fishery		1,499,018		2,342,730		7,674		3,849,422
Cod fishery				282,739		28,053		310,792
Shrimp fishery		326,683						326,683
Whale fishery						460,311		460,311
Clam fishery				707,970				707,970
Crab fishery		56,196						56,196
Total		30,462,247		15,834,186		16,364,204		62,660,637
PRODUCTS								
Salmon:								
Canned.....cases	2,787,789	14,711,842	1,605,107	10,067,602	902,019	8,227,691	5,294,915	33,007,135
Mild-cured.....pounds	4,410,400	992,946	97,600	20,655	679,200	123,700	5,187,200	1,137,301
Pickled.....do	40,700	3,187	296,952	21,092	1,025,300	107,944	1,362,952	132,223
Fresh.....do	2,201,653	202,528	5,291	1,096			2,206,944	203,624
Frozen.....do	2,244,666	164,519	43,000	1,290			2,287,666	165,809
Dried, smoked, and dry-salted.....pounds	6,400	206	36,028	2,426	1,591,540	79,577	1,633,968	82,209
Fertilizer.....do	1,397,300	34,320	362,000	9,050			1,759,300	43,370
Oil.....gallons	38,803	16,207	10,230	5,626			49,033	21,833
Herring:								
Fresh for bait.....pounds	150,000	3,040	1,387,750	13,877			1,537,750	16 917
Frozen for bait.....pounds	2,061,600	18,116					2,061,600	18,116
Pickled, Scotch cure.....pounds	3,518,512	304,594	15,353,538	1,342,517	148,600	13,880	19,020,650	1,660,991
Pickled, Norwegian cure.....pounds	7,200	576			11,400	1,250	18,600	1,826
Spiced.....do	9,600	1,000					9,600	1,000
Dry-salted.....do	17,200	4,075	75,250	2,826			92,450	6,901
Bloaters.....do			770,500	25,790			770,500	25,790
Fertilizer.....do	8,079,625	187,379	1,280,000	35,341			9,359,625	222,720
Oil.....gallons	974,918	428,426	169,754	75,683			1,144,672	504,109
Halibut:								
Fresh.....pounds	4,398,528	528,023					4,398,528	528,023
Frozen.....do	8,334,088	837,870	2,305,000	253,550			10,639,088	1,091,420
Cod:								
Dry-salted.....do			1,250,750	85,233	280,000	13,800	1,530,750	99,033
Stockfish.....do			2,000	300			2,000	300
Tongues.....do			1,325	66			1,325	66
Frozen.....do	45,951	1,378					45,951	1,378
Whale:								
Oil.....gallons					554,500	305,000	554,500	305,000
Sperm oil.....do					78,700	31,480	78,700	31,480
Fertilizer.....pounds					2,189,120	47,551	2,189,120	47,551
Whalebone.....do					1,500	1,500	1,500	1,500
Pickled meat.....do					200,000	6,250	200,000	6,250
Clams.....cases	4,848	33,186	78,313	596,226			83,161	629,412
Shrimp.....pounds	528,432	227,979					528,432	227,979

Summary of persons engaged, investment, and products of the Alaska fisheries in 1924—Continued

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
PRODUCTS—contd.								
Crabs:								
Canned.....cases..	2,241	$22,410					2,241	$22,410
Meat.....pounds..	66,630	25,981					66,630	25,981
Whole in shell ....dozens..	160	336					160	336
Trout:								
Fresh.....pounds..	46,345	5,702	10,300	$618			56,645	6,320
Frozen......do....	4,617	421					4,617	421
Sablefish:								
Fresh........do....	23,006	831					23,006	831
Frozen......do....	204,344	8,977					204,344	8,977
Smelts.........do....	24,484	2,348					24,484	2,348
Flounders.....do....	6,993	349					6,993	349
Red cod.......do....	1,175	34					1,175	34
Total..........		18,768,786		12,560,864		$8,959,623		[1]40,289,273

[1] These figures represent the value of the manufactured product. It is estimated that the value of the catch to the fishermen was approximately $10,400,000. The round weight of the salmon catch landed by the fishermen was approximately 438,516,157 pounds, and the corresponding figures for herring were approximately 100,000,000 pounds. The cod figures given above do not include the offshore catch from waters adjacent to Alaska, which amounted to 6,584,819 pounds dry-salted and 94,000 pounds of tongues, having a total value of $367,513, landed at ports of the Pacific Coast States. It is estimated that approximately 240 persons were engaged in the offshore cod fishery, with an investment of about $200,000; these figures are not included in the tabulations.

SALMON

The production of salmon in Alaska in 1924 as a whole showed an increase of approximately 2½ per cent over 1923, due primarily to a very heavy run of humpback salmon in the central district, where the total catch increased 161 per cent. This enormous increase, which occurred chiefly in the Prince William Sound region, may be regarded as the outstanding feature of the Alaska salmon production during the year. In western Alaska, where red salmon constitute the greater part of the catch, there was a decline of 32 per cent, while in southeastern Alaska the decline was 18 per cent below the figures for 1923.

An important factor in this reduced catch was the putting into effect of regulations by the Secretary of Commerce under authority of the act of June 6, 1924, prohibiting or sharply curtailing fishing in certain specific areas, and imposing restrictions in regard to seasons and character and quantity of apparatus employed. It is yet too early to see the final effect of the regulations, but undoubtedly the situation is well in hand and the future of the industry assured.

CATCH AND APPARATUS

The total number of seines used in the salmon industry of Alaska in 1924 was 437, of which 105 were beach seines and 332 were purse seines. The beach seines aggregated 14,305 fathoms of webbing and the purse seines 57,104 fathoms. The number of gill nets used was 2,916, having a total length of 319,285 fathoms. There were 278 driven traps and 180 floating traps, or a total of 458.

Southeast Alaska is credited with 308 seines, or a total of 51,699 fathoms of webbing, a reduction of 57 seines, or 718 fathoms, from the number used in 1923; also with 201 gill nets, aggregating 17,395 fathoms, a reduction of 31 nets, or 1,771 fathoms less than the quantity used in the previous season; and with 176 driven and 175 floating traps, an increase of 5 and 20, respectively, over the number operated in 1923.

Corresponding figures for central Alaska show 115 seines, or 16,835 fathoms, as compared with 130 seines, or 25,841 fathoms, in 1923; 799 gill nets, or 58,290 fathoms, as against 1,085 gill nets of 63,237 fathoms in 1923, showing a reduction of 288 nets and 4,947 fathoms. The number of traps operated was 97 driven and 5 floating, as compared with 106 and 7, respectively, in 1923.

Western Alaska used 4 seines, or 500 fathoms of webbing, a reduction from the number shown in 1923 of 11 seines, or 375 fathoms of webbing. A total of 1,916 gill nets was used, having an aggregate length of 243,600 fathoms, a reduction of 240 nets or 27,460 fathoms in the quantity of webbing used. Five driven traps were operated, the same number as in 1923.

Seines caught approximately 32 per cent of the salmon taken in 1924, gill nets 17 per cent, and traps 49 per cent, while lines and wheels took the remaining 2 per cent.

Percentage of salmon caught in each Alaska district, by principal forms of apparatus

Apparatus	Southeast Alaska		Central Alaska		Western Alaska	
	1923	1924	1923	1924	1923	1924
Seines	37	38	29	35	2	8
Gill nets	1	3	18	5	93	81
Traps	60	57	52	60	2	2
Wheels					1	8

The total catch of salmon in 1924 was 79,477,600, an increase of 2,055,289, or 2½ per cent, over the number taken in 1923. Central Alaska gained 16,977,707, while southeastern and western Alaska fell off 8,549,621 and 6,372,797, respectively. The catch by species shows that cohos increased 120,066, chums 2,976,153, humpbacks 6,822,304, and kings 112,880. Reds decreased 7,976,114.

Salmon taken in 1924, by apparatus and species, for each geographic section of Alaska

Apparatus and species	Southeast Alaska	Central Alaska	Western Alaska	Total
Seines:				
Coho, or silver	178,667	104,754		283,421
Chum, or keta	4,375,396	467,780	17,739	4,860,915
Humpback, or pink	9,562,136	7,676,977	673,846	17,912,959
King, or spring	9,568	1,470	4,989	16,027
Red, or sockeye	563,005	1,322,973	463,672	2,349,650
Total	14,688,772	9,573,954	1,160,246	25,422,972
Gill nets:				
Coho, or silver	139,340	132,974	40,376	312,690
Chum, or keta	28,273	148,232	447,970	624,475
Humpback, or pink	332,794	174,875	102,978	610,647
King, or spring	79,538	30,892	119,590	230,020
Red, or sockeye	472,798	990,454	10,284,281	11,747,533
Total	1,052,743	1,477,427	10,995,195	13,525,365

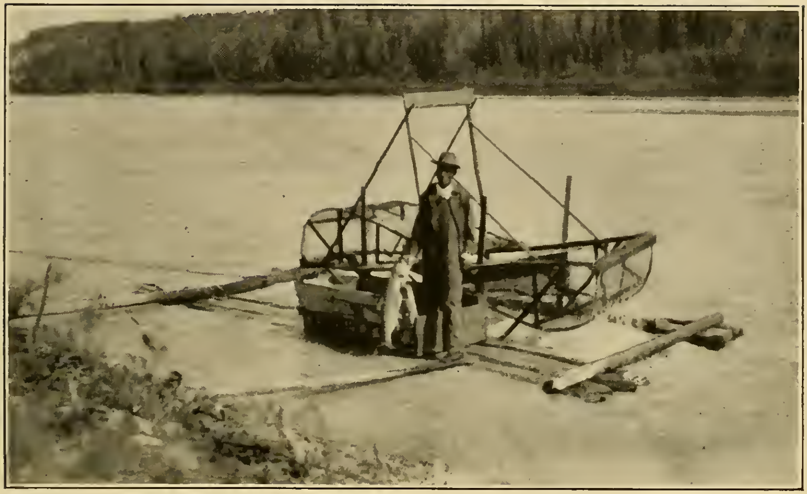

Fig. 7.—Native fish wheel on Copper River, Alaska

Fig. 8.—Drying salmon at native village, western Alaska

Salmon taken in 1924, by apparatus and species, for each geographic section of Alaska—Continued

Apparatus and species	Southeast Alaska	Central Alaska	Western Alaska	Total
Traps:				
Coho, or silver	716, 403	474, 811		1, 191, 214
Chum, or keta	698, 783	1, 363, 923	30, 770	2, 093, 476
Humpback, or pink	19, 231, 628	11, 386, 104		30, 617, 732
King, or spring	24, 058	20, 812	5, 431	50, 301
Red, or sockeye	1, 414, 959	3, 211, 586	238, 806	4, 865, 351
Total	22, 085, 831	16, 457, 236	275, 007	38, 818, 074
Lines:				
Coho, or silver	100, 429			100, 429
Humpback, or pink	5			5
King, or spring	483, 819		1, 500	485, 319
Red, or sockeye	3			3
Total	584, 256		1, 500	585, 756
Wheels:				
Chum, or keta			1, 112, 800	1, 112, 800
King, or spring			12, 633	12, 633
Total			1, 125, 433	1, 125, 433
Total:				
Coho, or silver	1, 134, 839	712, 539	40, 376	1, 887, 754
Chum, or keta	5, 102, 452	1, 979, 935	1, 609, 279	8, 691, 666
Humpback, or pink	29, 126, 563	19, 237, 956	776, 824	49, 141, 343
King, or spring	596, 983	53, 174	144, 143	794, 300
Red, or sockeye	2, 450, 765	5, 525, 013	10, 986, 759	18, 962, 537
Grand total	38, 411, 602	27, 508, 617	13, 557, 381	79, 477, 600

CANNING

CHANGES IN CANNERIES

The A. & P. Products Corporation again operated the plant at Heceta Island, which it leased from the Swift-Arthur-Crosby Co., but did not operate the Ford Arm plant, which was leased the previous year from the Deep Sea Salmon Co. The Alaska Salmon & Herring Packers' plant at Tyee was sold to the Sebastian Stuart Fish Co. Carlson Bros. (Inc.), who leased the plant of the Pavlof Harbor Packing Co. in 1923, did not operate in 1924. The Charles W. Demmert Packing Co. discontinued operation of a floating cannery and built a shore plant at Bayview. P. E. Harris & Co. leased and operated the cannery of the G. W. Hume Co. at Scow Bay. The Northwestern Fisheries Co. opened its Hunter Bay cannery after several years of idleness. The cannery operated by R. J. Peratovich at Bayview is now listed in the name of the Bayview Packing Co. The Point Warde Packing Co. sold its cannery at Point Warde to the Point Warde Fisheries Co., which, after making necessary repairs, operated it during the season. The Pure Food Fish Co. moved to a new location at Ketchikan. The Pyramid Packing Co. took over the Sitka Packing Co. at Sitka and operated the plant as a one-line cannery. It is reported, however, that the Sitka Packing Co. plant is to be dismantled and the machinery installed in the original Pyramid Packing Co. plant at Sitka. The Steamboat Bay Packing Co.'s plant on Noyes Island was purchased by the New England Fish Co. The Stuart Packing Corporation, which operates a salmon cannery at Ketchikan, has changed its name to The Stuart Corporation.

In central Alaska the Alaska Sea Food Co. and the Canoe Pass Packing Co., both owning canneries near Cordova, consolidated and operated the plant of the latter company under the name of the Shepard Point Packing Co. The Alaska Packers Association reopened its plant at Olga Bay, which was not operated in 1923. The Alaska Year-Round Canneries (Inc.) is listed under the name of Alaska Year-Round & Cook Inlet Packing Co., to cover joint operations of the Alaska Year-Round Canneries (Inc.) and a new company, the Cook Inlet Packing Co., at the plant of the former. The Eyak River Packing Co. sold its cannery on Eyak River to the Pioneer Sea Foods Co. Gorman & Co. leased the plant of the Prince Packing Co. at Drier Bay, which was last operated as a salmon cannery in 1920 under the name of the Kenai Packing Co. The King Salmon Fisheries Co. sold its cannery at Unakwik Inlet to the Unakwik Packing Co., which in turn leased it to the Pacific American Fisheries. The Seward cannery of the San Juan Fishing & Packing Co. was moved to Evans Bay, near Latouche.

In western Alaska the Carlisle Packing Co. built a shore plant on the Kvichak River, after having operated a floating cannery on the river near Lockanok. Libby, McNeill & Libby reopened its Egegik River and Lockanok canneries. After making a pack of red salmon on the Ugashik River, the International Packing Co. moved its floating cannery, *Santa Flavia*, to Makushin Bay on Unalaska Island.

NEW CANNERIES

Libby, McNeill & Libby opened a floating cannery at Ketchikan, using the scow operated a few years ago as a salmon cannery by the Mount Baker Packing Co. In central Alaska the Hemrich Packing Co. packed salmon at its clam cannery on Kukak Bay, and Henry J. Emard canned salmon at his plant at Moose Point.

CANNERIES NOT OPERATED

A number of canneries were not operated in 1924, some of them being converted to other uses, while a few were dismantled and abandoned. The cannery of the Marathon Fishing & Packing Co., at Cape Fanshaw, was sold at auction to the Alaska Consolidated Canneries. Several of the smaller buildings were moved to Pybus Bay and the machinery was removed for installation elsewhere. The Baranof Packing Co., at Red Bluff Bay, discontinued salmon canning a few years ago and is now operating its plant as a herring saltery and by-products plant for the production of fish oil and meal. The Dobbins Packing Co., heretofore operating a floating plant at Petersburg as a salmon and crab cannery, moved to Hoonah and engaged in packing crabs exclusively. The plant of the Pioneer Canneries (Inc.), at Snug Harbor, was taken over by the Chisik Island Corporation and packed clams exclusively. The plant of the Southern Alaska Canning Co., at Big Port Walter, was operated in 1924 by Arentsen & Co., who were engaged exclusively in packing Scotch cure herring and manufacturing oil and meal. The small plant of The Trading Union (Inc.), at Petersburg, was used as a crab cannery by Ludeman & Isom Bros. The International Packing Co., which operated the *Santa Flavia* at Waterfall in southeastern Alaska, and at Bering River in central Alaska, in 1923, did not return to either locality in 1924. The floating cannery of the Star Canning Co., which was operated on the Copper River delta by the Copper River Canning Co. in 1923, was not operated in 1924. Gorman & Co. purchased the plant of the Anchorage Packing Co. at Anchorage, but it remained closed during the season. Other idle canneries are as follows:

Southeastern Alaska:	
Alaska Salmon and Herring Packers	Tyee.
Alaska Sanitary Packing Co	Cape Fanshaw.
American Packing Co	Juneau.
Auk Bay Salmon Canning Co	Auk Bay.
John L. Carlson & Co	Do.
Deep Sea Salmon Co	Ford Arm.
Hoonah Packing Co	Hoonah. Gambier Bay.
Northwestern Fisheries Co	Roe Point. Santa Ana.
Pavlof Harbor Packing Co	Pavlof Harbor.
Central Alaska:	
Alaska Packers Association	Kasilof.
Alaska Sea Food Co	Point Whitshed.
Bainbridge Fisheries Co	Flemming Island.
Kamishak Canning Co	Kamishak Bay.
Northwestern Fisheries Co	Seldovia. Orca.
Gorman & Co	Anchorage.
Western Alaska:	
Alaska Packers Association	Nushagak (PHJ).
Alaska Salmon Co	Kvichak Bay.
Fidalgo Island Packing Co	Herendeen Bay.
Nelson Lagoon Packing Co	Nelson Lagoon.
Phoenix Packing Co	Herendeen Bay.

TOTAL CANNERIES OPERATED

There were 130 canneries operated in Alaska in 1924, the number in all districts being the same as in the previous year, namely, southeastern 65, central 37, and western 28.

Companies canning salmon in Alaska, number and location of canneries operated, and number of pound nets owned by each, 1924

[New canneries indicated by (*)]

Company	Canneries		Pound nets		
	Number	Location	Driven	Floating	Total
Southeast Alaska:					
Alaska Consolidated Canneries	7	Pybus Bay	3	5	8
		Chomly	4	3	7
		Tee Harbor	5	4	9
		Boca de Quadra	4	2	6
		Rose Inlet	1	6	7
		Yes Bay	4	5	9
		Tenakee	5	4	9
Alaska Herring & Sardine Co	1	Port Walter	1	3	4
Alaska Packers Association	2	Loring	4		4
		Wrangell	2	5	7
A. & P. Products Corporation	4	Heceta Island		7	7
		Hidden Inlet	1	6	7
		Union Bay		5	5
		Waterfall		5	5
Alaska Sanitary Packing Co	1	Wrangell	1	1	2
Annette Island Packing Co	1	Metlakatla	6		6
Astoria & Puget Sound Canning Co	1	Excursion Inlet	3	1	4
F. C. Barnes Co	1	Lake Bay	1		1
Bayview Packing Co	1	Bayview			
Beauclaire Packing Co	1	Port Beauclerc			
Beegle Packing Co	1	Ketchikan	4		4
Burnett Inlet Packing Co	1	Burnett Inlet		5	5
Deep Sea Salmon Co	1	Port Althorp		19	19
Charles W. Demmert Packing Co	1	Bayview			
Douglas Island Packing Co	1	Douglas			

Companies canning salmon in Alaska, number and location of canneries operated, and number of pound nets owned by each, 1924—Continued

[New canneries indicated by (*)]

Company	Canneries		Pound nets		
	Number	Location	Driven	Floating	Total
Southeast Alaska—Continued.					
Fidalgo Island Packing Co	2	Ketchikan	7	1	8
		Bay of Pillars	9		9
George Inlet Packing Co	1	George Inlet	1	2	3
Haines Packing Co	1	Letnikof Cove			
P. E. Harris & Co	2	Hawk Inlet	3	7	10
		Scow Bay	3		3
Hetta Packing Co	1	Coppermount			
Hidden Inlet Canning Co	1	Hood Bay	2		2
Karheen Packing Co	1	Karheen	5		5
Libby, McNeill & Libby	3	Taku Harbor	13		13
		Yakutat			
		Ketchikan (floating) *			
Mountain Point Packing Co	1	Wrangell Narrows	1		1
Geo. T. Myers & Co	1	Chatham	3		3
New England Fish Co	2	Ketchikan			
		Noyes Island			
North Pacific Trading & Packing Co	1	Klawak	1	2	3
Northwestern Fisheries Co	5	Dundas Bay		5	5
		Shakan		3	3
		Kasaan	5	1	6
		Boca de Quadra	5	1	6
		Hunter Bay		2	2
Pacific American Fisheries	1	Excursion Inlet	10	4	14
Petersburg Packing Co	1	Petersburg	7	5	12
Point Warde Fisheries Co	1	Point Warde		1	1
Pure Food Fish Co	1	Ketchikan	3		3
Pyramid Packing Co	2	Sitka		4	4
Red Salmon Packers Association	1	Dry Bay and Ketchikan (floating).*			
Sanborn Cutting Co	1	Kake		8	8
Sea-Coast Packing Co	1	Craig		5	5
J. L. Smiley & Co	1	Ketchikan	4	2	6
Starr-Collinson Packing Co	1	Moira Sound		4	4
Straits Packing Co	1	Skowl Arm			
The Stuart Corporation	1	Ketchikan (floating)	1		1
Sunny Point Packing Co	1	Ketchikan	7	1	8
Sunrise Packing Co	1	do	2	1	3
Superior Fisheries Co	1	Tenakee	2	2	4
Thlinket Packing Corporation	1	Funter Bay	5	7	12
Ward's Cove Packing Co	1	Ward Cove	2		2
Central Alaska:					
Alaska Packers Association	3	Chignik	3		3
		Karluk	2		2
		Alitak	4	1	5
Alaska Year-Round & Cook Inlet Packing Co.	1	Seldovia	2		2
Alitak Packing Co	1	Lazy Bay	2		2
Arctic Packing Co	1	English Bay			
Carlisle Packing Co	1	Cordova	3		3
Columbia River Packers Association	1	Chignik	2	1	3
Copper River Packing Co	1	McClure Bay	3		3
Henry J. Emard	1	Moose Point *	3		3
Emel Packing Co	1	Valdez	2		2
Fidalgo Island Packing Co	1	Port Graham	5		5
Gorman & Co	1	Drier Bay	1	1	2
P. E. Harris & Co	1	Isanotski Strait	4		4
Hemrich Packing Co	1	Kukak Bay *			
Hoonah Packing Co	1	Bering River			
Kadiak Fisheries Co	1	Kodiak	2		2
Katmai Packing Co	1	Uzinki			
Kodiak Island Fishing & Packing Co	2	Seward			
		Uganik Bay			
Libby, McNeill & Libby	1	Kenai	13		13
Moore Packing Co	1	Orca Inlet	2		2
North Coast Packing Co	1	Ninilchik	1		1
Northern Light Packing Co	1	Mountain Slough			
Northwestern Fisheries Co	3	Chignik	3		3
		Kenai	5		5
		Uyak			
Pacific American Fisheries	3	Ikatan	12		12
		King Cove	11		11
		Unakwik Inlet			
Pajoman & Trout	1	Raspberry Island			
Pioneer Packing Co	1	Cordova			
Pioneer Sea Foods Co	1	Eyak River			
Robinson Packing Corporation	1	Zachar Bay			
San Juan Fishing & Packing Co	1	Evans Bay	7		7
Shepard Point Packing Co	1	Shepard Point		2	2
Shumagin Packing Co	1	Squaw Harbor	4		4

Companies canning salmon in Alaska, number and location of canneries operated, and number of pound nets owned by each, 1924—Continued

[New canneries indicated by (*)]

Company	Canneries		Pound nets		
	Number	Location	Driven	Floating	Total
Western Alaska:					
Alaska Packers Association	8	Kvichak Bay (2)			
		Naknek River (3)			
		Nushagak Bay (NC)			
		Egegik River			
		Ugashik River			
Alaska-Portland Packers Association	2	Naknek River			
		Nushagak Bay			
Alaska Salmon Co	1	Wood River			
Bristol Bay Packing Co	1	Kvichak Bay			
Carlisle Packing Co	1	Kvichak River			
Columbia River Packers Association	1	Nushagak Bay			
Everett Packing Co	1	Herendeen Bay			
International Packing Co	1	Ugashik River and Makushin Bay (floating).			
Libby, McNeill & Libby	6	Egegik River			
		Ekuk			
		Koggiung			
		Libbyville			
		Lockanok			
		Nushagak			
Naknek Packing Co	1	Naknek River			
Northwestern Fisheries Co	2	do			
		Nushagak			
Pacific American Fisheries	1	Port Moller	5		5
Red Salmon Canning Co	2	Naknek River			
		Ugashik River			

LOSSES AND DISASTERS

Two canneries were burned in southeastern Alaska in 1924. The first fire occurred at Wrangell on July 25, and resulted in the partial destruction of the cannery of the Alaska Sanitary Packing Co. Buildings and equipment valued at approximately $31,000 were lost, and business was discontinued for the remainder of the season. On October 1 the Tee Harbor plant of the Alaska Consolidated Canneries, including more than 30,000 cases of salmon, was totally destroyed with a loss of $301,838. The Alaska Herring & Sardine Co., at Port Walter, lost by fire buildings valued at $12,528. The F. C. Barnes Co. also lost by fire its superintendent's residence, valued at $5,000. Other losses of property in this district, chiefly fishing gear and small boats, aggregated $28,218. One transporter and one shoresman were killed accidentally in southeastern Alaska.

In central Alaska small boats, fishing gear, and products valued at $29,837 were lost.

Similar losses in western Alaska totaled $19,346. One fisherman and one shoresman met accidental death in this district.

STATISTICS

As in 1923, 130 canneries were operated in Alaska in 1924. The active investment in the canning industry was $52,677,670, a gain of $2,041,784 over 1923. The increase in southeastern Alaska was $1,658,683, or 7 per cent; in central Alaska the increase was $2,135,965, or approximately 20 per cent, accounted for chiefly by the larger investments in operating capital and wages paid; in western Alaska investments decreased $1,752,864, or slightly more than 10 per cent, there being material reductions in operating capital, wages paid, vessels engaged, and fishing apparatus used.

Employment was given to 20,107 persons, as compared with 19,439 in 1923, an increase of 668, or about 3.4 per cent. White employees increased by 382, natives 15, Chinese 24, Japanese 330, Filipinos 249, Negroes 15, and miscellaneous, including Porto Ricans, 81. Mexicans decreased 428.

The total pack of canned salmon was 5,294,915 cases, valued at $33,007,135. This is an increase in pack over 1923 of 259,218 cases, or approximately 5 per cent, and an advance in value of $134,128, or less than one-half of 1 per cent. The output in southeastern Alaska fell off from 3,007,119 cases to 2,787,789 cases, or a little more than 7 per cent; in western Alaska the decline was from 1,284,938 to 902,019 cases, or approximately 29.9 per cent. In central Alaska the pack increased from 743,640 cases to 1,605,107, or 115.8 per cent, due to the extraordinary run of humpback salmon in some parts of the district. In Alaska as a whole cohos increased from 164,107 cases to 183,601, or about 11.7 per cent; chums from 525,622 cases to 1,028,488, or 95.7 per cent; humpbacks from 2,448,129 cases to 2,601,283, or approximately 6 per cent. Kings decreased from 38,343 cases to 33,648, or about 12 per cent; and reds from 1,859,496 cases to 1,447,895, or 22 per cent.

Persons engaged in the Alaska salmon-canning industry in 1924

Occupation and race	Southeast Alaska	Central Alaska	Western Alaska	Total
Fishermen:				
Whites	1,081	859	2,112	4,052
Natives	1,221	382	161	1,764
Chinese	2			2
Japanese	4			4
Filipinos	15			15
Miscellaneous [1]	2			2
Total	2,325	1,241	2,273	5,839
Shoresmen:				
Whites	2,320	858	1,777	4,955
Natives	1,399	612	192	2,203
Chinese	548	321	456	1,325
Japanese	736	428	207	1,371
Filipinos	1,023	314	322	1,659
Mexicans	41	95	1,184	1,320
Negroes	12	32	131	175
Porto Ricans		3	126	129
Miscellaneous [1]	24	16	34	74
Total	6,103	2,679	4,429	13,211
Transporters:				
Whites	597	233	153	983
Natives	23	23	1	47
Chinese	3		5	8
Japanese	8	3		11
Filipinos	5	1		6
Mexicans	1			1
Miscellaneous [1]	1			1
Total	638	260	159	1,057
Total:				
Whites	3,998	1,950	4,042	9,990
Natives	2,643	1,017	354	4,014
Chinese	553	321	461	1,335
Japanese	748	431	207	1,386
Filipinos	1,043	315	322	1,680
Mexicans	42	95	1,184	1,321
Negroes	12	32	131	175
Porto Ricans		3	126	129
Miscellaneous [1]	27	16	34	77
Grand total	9,066	4,180	6,861	20,107

[1] Kanakas, Koreans, etc.

Investment in the Alaska salmon-canning industry in 1924

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Plants operated	65	$6,531,762	37	$3,154,126	28	$5,614,695	130	$15,300,583
Operating capital		8,629,991		4,519,591		3,446,843		16,596,425
Wages paid		3,917,159		2,294,550		2,986,009		9,197,718
Vessels:								
Power, over 5 tons	294	1,993,418	96	883,893	78	1,296,164	468	4,173,475
Net tonnage	5,894		2,487		14,193		22,574	
Sailing	2	90,000	4	230,000	18	830,000	24	1,150,000
Net tonnage	3,819		7,980		32,340		44,139	
Barges	2	20,000					2	20,000
Net tonnage	2,386						2,386	
Launches	94	130,525	157	154,442	36	81,704	287	366,671
Boats, sail and row	1,040	136,189	693	67,568	1,187	411,001	2,920	614,758
Lighters, scows, and houseboats	389	403,783	182	155,313	180	380,478	751	939,574
Pile drivers	63	447,029	32	180,435	23	71,965	118	699,429
Pile pullers	4	20,600					4	20,600
Apparatus:								
Beach seines	14	6,605	84	44,562	4	2,000	102	53,167
Fathoms	1,320		12,210		500		14,030	
Purse seines	293	219,570	29	27,750	10	11,500	332	258,820
Fathoms	50,329		4,400		2,375		57,104	
Gill nets	193	17,369	763	89,021	1,674	288,724	2,630	395,114
Fathoms	16,170		57,390		231,240		304,800	
Pound nets, driven	176	1,559,895	96	577,341	5	25,000	277	2,162,236
Pound nets, floating	175	707,048	5	22,052			180	729,100
Total		24,830,943		12,400,644		15,446,083		52,677,670

Output and value of canned salmon in Alaska in 1924 [1]

Product	Southeast Alaska		Central Alaska		Western Alaska		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
Coho, or silver:								
½-pound flat	4,939	$50,649	3,120	$28,564			8,059	$79,213
1-pound flat	5,034	45,367	369	2,462			5,403	47,829
1-pound tall	100,016	667,530	65,691	433,070	4,432	$26,909	170,139	1,127,509
Total	109,989	763,546	69,180	464,096	4,432	26,909	183,601	1,254,551
Chum, or keta:								
½-pound flat	346	2,214					346	2,214
1-pound flat	630	2,819					630	2,819
1-pound tall	798,581	3,722,311	192,934	912,255	35,997	172,698	1,027,512	4,807,264
Total	799,557	3,727,344	192,934	912,255	35,997	172,698	1,028,488	4,812,297
Humpback, or pink:								
½-pound flat	21,365	151,507					21,365	151,507
1-pound flat	8,932	51,796	4,163	22,126			13,095	73,922
1-pound tall	1,647,157	8,079,281	888,250	4,390,431	31,416	142,205	2,566,823	12,611,917
Total	1,677,454	8,282,584	892,413	4,412,557	31,416	142,205	2,601,283	12,837,346
King, or spring:								
½-pound flat	995	11,516	506	5,672			1,501	17,188
1-pound flat	4,721	44,622	4,779	54,475			9,500	99,097
1-pound tall	2,566	18,555	5,246	44,871	14,835	119,298	22,647	182,724
Total	8,282	74,693	10,531	105,018	14,835	119,298	33,648	299,009
Red, or sockeye:								
½-pound flat	11,801	156,738	15,827	200,801	4,319	57,736	31,947	415,275
1-pound flat	39,717	415,789	63,201	633,365	7,434	70,794	110,352	1,119,948
1-pound tall	140,989	1,291,148	361,021	3,339,510	803,586	7,638,051	1,305,596	12,268,709
Total	192,507	1,863,675	440,049	4,173,676	815,339	7,766,581	1,447,895	13,803,932
Grand total	2,787,789	14,711,842	1,605,107	10,067,602	902,019	8,227,691	5,294,915	33,007,135

[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 forty-eight 1-pound cans per case.

53896—25†——5

Output of canned salmon in Alaska, in cases, 1919 to 1924 [1]

Product	1919	1920	1921	1922	1923	Average for 5-year period, 1919–1923	1924	Percentage of increase or decrease in 1924, as compared with 5-year average
Coho, or silver:								
½-pound flat	9,719	8,915	4,084	22,237	13,866	11,764	8,059	−31.49
1-pound flat	10,438	10,746	7,918	12,099	10,151	10,270	5,403	−47.39
1-pound tall	212,713	172,424	94,553	141,657	140,090	152,287	170,139	+11.72
Total	232,870	192,085	106,555	175,993	164,107	174,321	183,601	+5.32
Chum, or keta:								
½-pound flat	3,981	53	608	3,698	6,356	2,939	346	−88.23
1-pound flat		46,167		6,185	16	10,474	630	−93.98
1-pound tall	1,361,582	987,297	254,887	556,035	519,250	735,810	1,027,512	+39.64
Total	1,365,563	1,033,517	255,495	565,918	525,622	749,223	1,028,488	+37.27
Humpback, or pink:								
½-pound flat	28,185	18,970	1,292	42,736	29,363	24,109	21,365	−11.38
1-pound flat	7,553	76,017		30,879	9,428	24,775	13,095	−47.14
1-pound tall	1,575,870	1,498,133	422,692	1,584,808	2,409,338	1,498,168	2,566,823	+71.33
Total	1,611,608	1,593,120	423,984	1,658,423	2,448,129	1,547,052	2,601,283	+68.14
King, or spring:								
½-pound flat	7,584	10,196	4,061	3,770	5,466	6,215	1,501	−75.85
1-pound flat	11,532	18,319	19,192	3,967	7,281	12,058	9,500	−21.21
1-pound tall	76,870	81,488	21,741	22,923	25,596	45,724	22,647	−50.47
Total	95,986	110,003	44,994	30,660	38,343	63,997	33,648	−47.42
Red, or sockeye:								
½-pound flat	122,236	101,716	60,831	171,896	121,775	115,691	31,947	−72.39
1-pound flat	110,491	120,147	71,108	121,449	159,271	116,493	110,352	−5.27
1-pound tall	1,044,934	1,278,875	1,633,859	1,777,313	1,578,450	1,462,686	1,305,596	−10.74
Total	1,277,661	1,500,738	1,765,798	2,070,658	1,859,496	1,694,870	1,447,895	−14.57
Grand total	4,583,688	4,429,463	2,596,826	4,501,652	5,035,697	4,229,463	5,294,915	+25.19

[1] The number of cases shown has been put upon the common basis of forty-eight 1-pound cans per case.

Relative importance of each species of canned salmon within each district in 1924

District	Coho	Chum	Humpback	King	Red	Total, all species
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Southeast Alaska	3.9	28.7	60.2	0.3	6.9	100
Central Alaska	4.3	12.0	55.6	.7	27.4	100
Western Alaska	.5	4.0	3.5	1.6	90.4	100
All Alaska	3.5	19.4	49.1	.6	27.4	100

Relative importance of each district in the production of each species of canned salmon in 1924

District	Coho	Chum	Humpback	King	Red	Total, all species
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Southeast Alaska	59.9	77.7	64.5	24.6	13.3	52.7
Central Alaska	37.7	18.8	34.3	31.3	30.4	30.3
Western Alaska	2.4	3.5	1.2	44.1	56.3	17.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

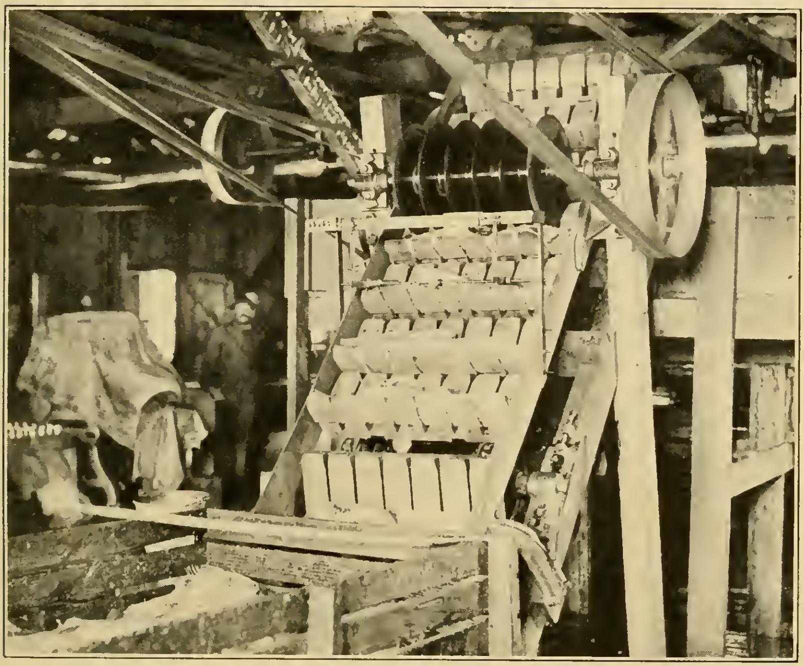

FIG. 9.—Cutting machine in salmon cannery, Alaska

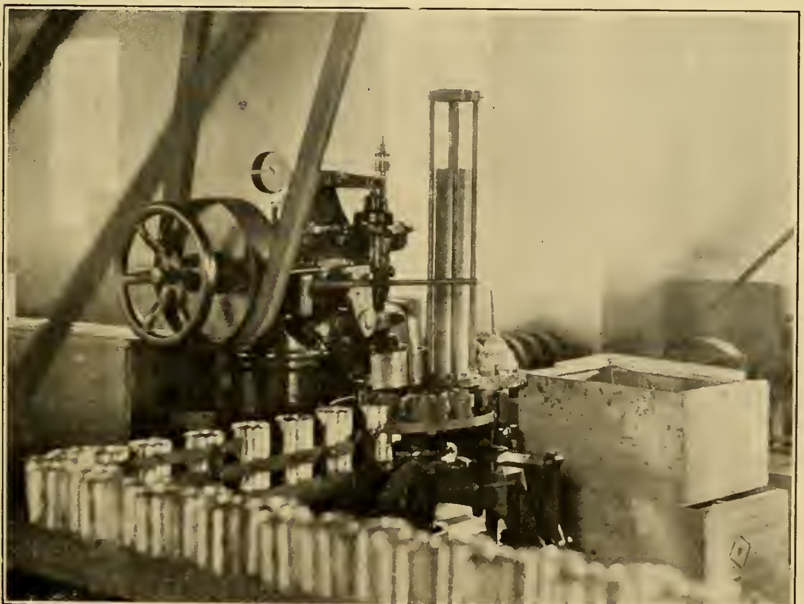

FIG. 10.—Putting tops on cans filled with salmon, Alaska

Average annual price per case of forty-eight 1-pound cans of salmon, 1914 to 1924

Product	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Coho, or silver	$4.39	$4.31	$5.34	$8.76	$9.15	$11.27	$9.13	$5.63	$5.47	$5.74	$6.83
Chum, or keta	3.37	2.59	3.34	6.14	6.27	6.82	4.19	3.68	3.98	4.65	4.68
Humpback, or pink	3.50	2.78	3.64	6.44	6.58	8.35	5.47	4.21	4.34	4.86	4.93
King, or spring	5.01	4.63	5.36	10.40	9.85	13.13	10.97	10.22	8.08	8.56	8.89
Red, or sockeye	5.58	5.82	6.04	9.48	9.44	12.98	13.05	8.96	9.24	9.27	9.53

PACK IN CERTAIN DISTRICTS

Statistics of the salmon pack are again presented for a number of subdivisions of the three main districts of Alaska, and a comparison is made with similar statistics in 1923, the first year in which this was done. These districts are described as follows:

Bristol Bay.—The Bering Sea shore east and north of the Ugashik River.

Port Moller and Herendeen Bay.—Port Moller, Herendeen Bay, and Nelson Lagoon.

Ikatan-Shumagin Islands.—False Pass, Ikatan Bay, King Cove, and the Shumagin Islands.

Chignik.—Three canneries located at Chignik.

Kodiak-Afognak Islands.—Kodiak, Spruce, and Raspberry Islands.

Cook Inlet.—The shores of Cook Inlet.

Prince William Sound.—Extends from Resurrection Bay to Point Whitshed, except that the packs of king and red salmon at canneries eastward from Shepard Point to the end of the district are omitted.

Copper and Bering Rivers.—Extends from Point Whitshed to Bering River and includes the red and king salmon pack at Cordova canneries not credited to Prince William Sound.

Yakutat and Dry Bay.—Extends from Yakutat Bay to and including Dry Bay.

Icy Strait-Lynn Canal.—West coast of Baranof and Chichagof Islands, the shores of Cross Sound, Icy Strait, Lynn Canal, and Stephens Passage south to Taku Harbor. Only part of the pack at Taku Harbor is credited to this district, as some of it originated elsewhere.

Chatham Strait-Frederick Sound.—Includes part of the Taku cannery pack and the Petersburg Packing Co.'s pack, in addition to that of all canneries on both shores of Chatham Strait and its bays from Point Augusta to Cape Ommaney, and through Frederick Sound and its bays northward to Taku Harbor, including Kake.

Sumner Strait-Dixon Entrance.—Extends southward from Petersburg and eastward from Port Beauclerc to Cape Chacon and Dixon Entrance, and includes all canneries on the mainland and intervening islands from the Stikine River to Portland Canal.

West coast, Prince of Wales Island.—Territory west and south of a line from Cape Chacon to Point Baker and Cape Ommaney.

Pack of canned salmon in Alaska in 1924, by districts [1]

District	Coho	Chum	Hump-back	King	Red	Total	Percentage of increase or decrease from 1923
	Cases	*Cases*	*Cases*	*Cases*	*Cases*	*Cases*	
Bristol Bay	4,432	31,168	4,669	12,928	764,663	817,860	−33.21
Port Moller and Herendeen Bay		4,803		1,907	50,286	56,996	−5.56
Ikatan-Shumagin Islands	11,012	127,818	173,964	792	112,154	425,740	+111.38
Chignik	9,405	9,895	51,837	55	81,089	152,281	+117.90
Kodiak-Afognak Islands	12,356	12,721	251,424	84	94,960	371,545	+153.12
Cook Inlet	12,812	2,875	34,183	5,681	68,550	124,101	+37.16
Prince William Sound	12,922	39,121	381,506	51	8,814	442,414	+172.97
Copper and Bering Rivers	10,673	530	26,246	3,868	74,872	116,189	+59.16
Yakutat and Dry Bay	15,522		14,913	3,549	29,127	63,111	−5.73
Icy Strait-Lynn Canal	30,598	126,382	216,899	2,458	67,755	444,092	−3.82
Chatham Strait-Frederick Sound	19,374	157,352	370,658	1,103	16,042	564,529	+12.17
Sumner Strait-Dixon Entrance	34,241	446,174	831,554	1,149	66,814	1,379,932	−14.70
West coast, Prince of Wales Island	10,254	69,649	243,430	23	12,769	336,125	−5.94
Total	183,601	1,028,488	2,601,283	33,648	1,447,895	5,294,915	+5.15

[1] Pack reduced to the basis of forty-eight 1-pound cans per case.

MILD CURING

The salmon mild-cure industry showed a material gain over the production of 1923. During most of the year the market was brisk and fishermen obtained good prices for their catches. As is well known, this industry has reached its greatest development in southeastern Alaska, where the feeding grounds of the salmon are more accessible to the fishermen at all times of the year and improved facilities for marketing their catches are available.

This industry gave employment to 1,766 persons, as compared with 1,831 in 1923, a decrease of 3.5 per cent. Of these, whites numbered 1,648, natives 116, and Filipinos 2.

The total output of mild-cured salmon was 5,187,200 pounds, valued at $1,137,301, as against 3,372,250 pounds, valued at $726,622, produced in 1923, or an increase of 51 per cent in products and 56.5 per cent in value. The pack consisted of 5,115,200 pounds of kings and 72,000 pounds of cohos. This production was divided between the three districts as follows: Southeastern Alaska produced 4,338,400 pounds of kings and 72,000 pounds of cohos, or a total of 4,410,400 pounds; central Alaska produced 97,600 pounds of kings and western Alaska 679,200 pounds of kings. Reduced to tierces of 800 pounds each, the pack was 6,394 tierces of kings and 90 of cohos.

Persons engaged, investment, and products of Alaska salmon mild-curing industry in 1924

Items	Southeastern Alaska		Central Alaska		Western Alaska		Total	
PERSONS ENGAGED								
Fishermen:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Whites	1,515		10		26		1,551	
Natives	35				21		56	
Total	1,550		10		47		1,607	
Shoresmen:								
Whites	61		6		11		78	
Natives	3		6		42		51	
Filipinos	1		1				2	
Total	65		13		53		131	
Transporters:								
Whites	14		1		4		19	
Natives	5		2		2		9	
Total	19		3		6		28	
Grand total	1,634		26		106		1,766	
INVESTMENT								
Plants operated	10	$66,750	1	$1,608	3	$70,500	14	$138,858
Operating capital		361,340		12,978		93,284		467,602
Vessels:								
Power, over 5 tons	13	62,200			3	48,500	16	110,700
Net tonnage	173				573		746	
Barges	1	3,000					1	3,000
Net tonnage	126						126	
Launches, under 5 tons	[1] 804	803,100	2	1,750	11	11,700	817	816,550
Other boats, lighters, scows, etc	11	1,240	9	2,350	39	2,925	59	6,515
Apparatus:								
Gill nets	7	1,300	36	1,500	156	8,200	199	11,000
Fathoms	1,150		900		6,400		8,450	
Traps, driven			1	4,000			1	4,000
Lines	2,042	20,410					2,042	20,410
Wheels					3	600	3	600
Total		1,319,340		24,186		235,709		1,579,235
PRODUCTS (POUNDS)								
Coho, or silver	72,000	8,278					[2] 72,000	8,278
King, or spring	[3] 4,338,400	984,668	[4] 97,600	20,655	[5] 679,200	123,700	[6] 5,115,200	1,129,023
Total	4,410,400	992,946	97,600	20,655	679,200	123,700	5,187,200	1,137,301

[1] Includes 800 trolling launches, valued at $800,000.
[2] 90 tierces.
[3] 5,423 tierces.
[4] 122 tierces.
[5] 849 tierces.
[6] 6,394 tierces.

PICKLING

The salmon-pickling industry of Alaska is practically without separate identity except in the western district, as out of a total investment of $162,239 western Alaska is credited with $156,114 and central Alaska with the remainder of $6,125, while southeastern Alaska has no investment in the business. There was a marked shrinkage in investments, western Alaska declining 79 per cent and central Alaska 91 per cent, and a material decrease in output. In southeastern Alaska production fell off from 42,500 pounds in 1923 to 40,700 pounds in 1924; in central Alaska it increased from 114,744 pounds to 296,952; while in western Alaska there was a decline from 2,175,600 to 1,025,300 pounds. The total production was 1,362,952 pounds, valued at $132,223, as compared with 2,332,844 pounds in 1923, valued at $186,790, a shrinkage of 41 per cent in output and 29 per cent in value of products. The total number of persons employed was 102, or 163 less than in 1923.

Persons engaged, investment, and products of Alaska salmon-pickling industry in 1924

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
PERSONS ENGAGED								
Fishermen:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Whites			6		37		43	
Natives			1		15		16	
Total			7		52		59	
Shoresmen:								
Whites					25		25	
Natives					17		17	
Total					42		42	
Transporters: Whites					1		1	
Grand total			7		95		102	
INVESTMENT								
Plants operated			2	$2, 400	3	$45, 325	5	$47, 725
Operating capital				1, 900		60, 963		62, 863
Vessels:								
Power, over 5 tons					3	13, 600	3	13, 600
Net tonnage					30		30	
Sailing					1	10, 000	1	10, 000
Net tonnage					391		391	
Launches			2	1, 150	2	2, 300	4	3, 450
Gill-net boats					22	11, 250	22	11, 250
Lighters and scows					3	4, 500	3	4, 500
Rowboats and others			6	375	5	600	11	975
Apparatus:								
Beach seines (225 fathoms)			2	300			2	300
Gill nets (5,100 fathoms)					43	7, 576	43	7, 576
Total				6, 125		156, 114		162, 239
PRODUCTS (POUNDS)								
Coho, or silver	18, 300	$1, 129	34, 668	5, 118			52, 968	6, 247
Chum, or keta	600	27	644	75	60, 600	3, 580	61, 844	3, 682
Humpback, or pink	6, 000	268	257, 540	15, 399			263, 540	15, 667
King, or spring	400	40			101, 100	12, 937	101, 500	12, 977
Red, or sockeye	15, 400	1, 723	4, 100	500	863, 600	91, 427	883, 100	93, 650
Total	40, 700	3, 187	296, 952	21, 092	1, 025, 300	107, 944	1, 362, 952	132, 223

FRESH SALMON

The fresh-salmon business of Alaska represents no appreciable independent investment, as it is largely incidental to the mild curing of salmon and freezing of halibut. The bulk of the salmon marketed fresh comes from the trollers of southeastern Alaska, and consists of kings and cohos too small for mild curing. In 1924 there were produced 2,206,944 pounds, valued at $203,624, as compared with 2,926,257 pounds, valued at $244,838, in 1923, or a decline of 24 per cent in quantity and 16 per cent in value. This decline may be accounted for by the fact that most of the fresh fish were used by the canning and mild-curing industries.

Products of the Alaska fresh-salmon industry in 1924

Species	Pounds	Value
Coho, or silver	328,446	$15,531
Chum, or keta	46,044	1,011
Humpback, or pink	4,000	64
King, or spring	1,801,481	184,753
Red, or sockeye	26,973	2,265
Total	2,206,944	203,624

FREEZING

The freezing of salmon in Alaska is regarded as wholly incidental to other fishery activities, as no investment is credited exclusively to this line of business. In 1924 there was an increase in production of 522,377 pounds over that of 1923, the total output being 2,287,666 pounds, valued at $165,809, as compared with 1,765,289 pounds, valued at $132,522, in 1923, or an increase of approximately 29 per cent in products and 25 per cent in value.

Products of the Alaska frozen-salmon industry in 1924

Species	Pounds	Value
Coho, or silver	529,188	$26,932
Chum, or keta	434,307	20,564
Humpback, or pink	250	3
King, or spring	1,320,825	118,146
Red, or sockeye	3,096	164
Total	2,287,666	165,809

DRY-SALTING, DRYING, AND SMOKING

One operator in southeastern Alaska reported the dry-salting of 6,400 pounds of chum salmon valued at $206. Two operators in central Alaska prepared 4,800 pounds of beleke, valued at $400; 27,228 pounds of dried salmon, valued at $1,426; and 4,000 pounds of kippered salmon, valued at $600. These operations were incidental to other lines of business. The Indians of the Yukon and Tanana Valleys prepared a total of 1,591,540 pounds of dried salmon, valued at $79,577. They employed 294 wheels, valued at $29,400, and 860 fathoms of nets, valued at $860, a total investment of $30,260.

Production of dry-salted, dried, and smoked salmon in Alaska in 1924

Product	Pounds	Value
Dry-salted	6,400	$206
Beleke	4,800	400
Kippered	4,000	600
Dried	1,618,768	81,003
Total	1,633,968	82,209

BY-PRODUCTS

Three companies engaged primarily in the salmon by-products business reported an investment of $147,250 and operating capital of $33,421, with 46 persons engaged. In addition three plants in southeast Alaska and two in central Alaska manufactured fertilizer and oil in connection with salmon-canning operations. The total production was 1,759,300 pounds of fertilizer, valued at $43,370, and 49,033 gallons of oil, valued at $21,833. This is an increase of 98 per cent in production of fertilizer and 68 per cent in production of oil over 1923, and is accounted for primarily by the installation of by-products machinery in two canneries in southeast Alaska and one in central Alaska. Also, one new plant located at Ketchikan was devoted solely to this business.

Production of salmon oil and fertilizer in Alaska in 1924

Districts	Oil		Fertilizer	
	Gallons	*Value*	*Pounds*	*Value*
Southeast Alaska	38,803	$16,207	1,397,300	$34,320
Central Alaska	10,230	5,626	362,000	9,050
Total	49,033	21,833	1,759,300	43,370

HERRING

Notwithstanding the very general opinion that the herring is the most abundant food fish in Alaskan waters, and that diminution of the supply by the most intensive fishing is only a remote possibility, there was a marked scarcity of these fish in certain localities, especially in the Prince William Sound region, during 1924. This condition had occurred to some extent in past seasons, and it seemed clear that regulatory measures were necessary to conserve the fisheries and to prevent waste.

In 1924 protection of the herring fisheries by specific regulation of fishing was undertaken for the first time, although in 1923 operations in the Cook Inlet and Afognak-Kodiak districts were carried on under permits issued by the Secretary of Commerce. By virtue of authority conferred in the Alaska fisheries act of June 6, 1924, the Secretary of Commerce issued regulations establishing closed seasons and limitations upon size of mesh, and imposing other restrictions upon herring fishing in various waters of Alaska. These regulations affected operations in the southeastern, Prince William Sound, Cook Inlet, and Afognak-Kodiak sections.

Sixteen companies were interested in herring fishing in southeastern Alaska. Of these the New England Fish Co., at Ketchikan, the Booth Fisheries Co., at Sitka, and the Juneau Cold Storage Co., at Juneau, took herring only for freezing halibut bait. The Puget Sound Reduction Co., using the *Fort Union*, a 4,000-ton converted steamer, as a floating reduction plant, confined its activities solely to the production of oil and fertilizer, locating first at Port Armstrong and later at Klawak. The Douglas Fish Co., at Douglas and Todd, the Alaska Shellfish Co., operating a floating plant near Killisnoo, and A. H. Sonsthagan, at Chatham, packed small quantities of herring for food. The larger producers of herring in this district operated combined salteries and reduction plants owned and located as follows, which, with the exception of the last two, devoted their efforts solely to herring:

Arentsen & Co	Port Walter.
Hamilton Packing Co	Hood Bay.
Chatham Strait Fish Co	Port Walter.
Buchan & Heinen Packing Co	Port Armstrong.
Killisnoo Packing Co	Killisnoo.
Northwestern Herring Co	Port Conclusion.
Alaska Herring & Sardine Co	Little Port Walter.
Baranof Packing Co	Red Bluff Bay.

In central Alaska operations were centered in three localities—Prince William Sound, Lower Cook Inlet, and Afognak-Kodiak waters. In the Prince William Sound district nine companies operated, all except the last named being engaged exclusively in herring operations, as follows:

Lee-Salater Co	Latouche.
Franklin Packing Co	Evans Bay.
W. J. Imlach Packing Co	Do.
Utopian Fisheries	Horseshoe Bay.
Johnson Packing Co	Latouche.
Nildenrich Packing Co	Crab Bay.
Knight Island Packing Co	Drier Bay.
Everett-Pacific Fisheries	Thumb Bay.
San Juan Fishing & Packing Co	Evans Bay.

The bulk of the output of these plants was Scotch-cure herring, but five also produced a considerable quantity of oil, fish meal, and fertilizer.

In the Cook Inlet district 15 producers of herring food products were reported, as follows:

Axel Norstad	Halibut Cove.
H. Sunsby	Do.
Ottar Hofstad	Do.
William J. Babis	Do.
G. E. Meredith	Do.
Sivertsen & Iversen	Do.
Arntsen & Buvick	Do.
Knight Island Packing Co	Do.
Ed Jacobson & Co	Do.
Libby, McNeill & Libby	Do.
Fidalgo Island Packing Co	Port Graham.
Utopian Fisheries	Seldovia.
Herring Bay Packing Co	Do.
McIver & McNab Packing Co	Do.
San Juan Fishing & Packing Co	Tutka Bay.

In the Afognak-Kodiak region five operators were likewise engaged and located as follows:

Kodiak Island Fishing & Packing Co	Uganik Bay.
W. J. Erskine Co	Kodiak.
Karl Armstrong	Three Saints Bay.
W. J. Imlach Packing Co	Uzinki.
Granheim Fishing & Packing Co	Red Fox Bay.

In western Alaska two operators packed a small quantity of herring at Golovin Bay.

STATISTICAL SUMMARY

The herring industry of Alaska employed 1,407 persons in 1924, as compared with 881 in 1923. The number of plants increased from 19 in 1923 to 32 in 1924, and the investment from $2,375,798

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to $3,849,422, or 62 per cent. The products were valued at $2,458,370 as compared with $1,602,571 in 1923, an increase of $855,799, or 53 per cent. Scotch-cure herring increased from 13,047,433 pounds in 1923 to 19,020,650 pounds, or approximately 46 per cent. Herring for bait decreased from 5,234,525 pounds to 3,599,350 pounds. Fertilizer increased 46.6 per cent in quantity and 14.7 per cent in value, and oil 29 per cent in quantity and 38 per cent in value over the production in 1923.

Persons engaged, investment, and products of Alaska herring industry in 1924

Items	Southeast Alaska		Central Alaska		Western Alaska		Total	
PERSONS ENGAGED								
Fishermen:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Whites	103		295		6		404	
Natives	22		14		6		42	
Total	125		309		12		446	
Shoresmen:								
Whites	249		592		3		844	
Natives	22		32				54	
Miscellaneous	23						23	
Total	294		624		3		921	
Transporters:								
Whites	11		18				29	
Natives	5		5				10	
Miscellaneous	1						1	
Total	17		23				40	
Grand total	436		956		15		1, 407	
INVESTMENT								
Plants operated	9	$513, 656	22	$500, 672	1	$150	32	$1, 014, 478
Operating capital		696, 252		1, 417, 121		3, 456		2, 116, 829
Vessels:								
Power, over 5 tons	27	224, 300	55	281, 190			82	505, 490
Net tonnage	825		1, 319				2, 144	
Launches, under 5 tons	1	2, 000	12	22, 350	2	1, 072	15	25, 422
Boats, row and seine	24	3, 000	73	13, 655	11	1, 025	108	17, 680
Scows	7	8, 000	13	10, 920	1	500	21	19, 420
Barges	1	1, 000					1	1, 000
Pile drivers	1	800	2	7, 500			3	8, 300
Apparatus:								
Beach seines	3	7, 000	1	1, 500	2	500	6	9, 000
Fathoms	535		150		250		935	
Purse seines	17	43, 010	34	62, 938	2	321	53	106, 269
Fathoms	2, 750		5, 385		300		8, 435	
Gill nets			102	17, 784	72	650	174	18, 434
Fathoms			5, 130		1, 200		6, 330	
Impounding nets			9	7, 100			9	7, 100
Fathoms			520				520	
Total		1, 499, 018		2, 342, 730		7, 674		3, 849, 422
PRODUCTS (POUNDS)								
Fresh, for bait	150, 000	3, 040	1, 387, 750	13, 877			1, 537, 750	16, 917
Frozen, for bait	2, 061, 600	18, 116					2, 061, 600	18, 116
Pickled, for food, Scotch cure	3, 518, 512	304, 594	15,353,538	1, 342, 517	148, 600	13, 880	19,020,650	1, 660, 991
Pickled, for food, Norwegian cure	7, 200	576			11, 400	1, 250	18, 600	1, 826
Spiced, for food	9, 600	1, 000					9, 600	1, 000
Dry-salted	17, 200	4, 075	75, 250	2, 826			92, 450	6, 901
Bloaters			770, 500	25, 790			770, 500	25, 790
Fertilizer	8, 079, 625	187, 379	1, 280, 000	35, 341			9, 359, 625	222, 720
Oil ... gallons	974, 918	428, 426	169, 754	75, 683			1, 144, 672	504, 109
Total		947, 206		1, 496, 034		15, 130		2, 458, 370

HALIBUT

Halibut fishing was entirely suspended late in 1924 in the North Pacific Ocean by vessels of the United States and Canada, in accordance with legislation enacted by both countries giving effect to the convention of March 2, 1923, between the United States and Great Britain for the protection of the halibut fishery of the North Pacific. This legislation imposed a closed season of three months, beginning November 16, 1924, in which the intentional catching of halibut by American and Canadian vessels is prohibited. Accordingly the halibut fleet discontinued operations on November 15, and for the first time in the history of Alaska this important branch of its fisheries industry was at a standstill. The closed season thus provided is considered necessary for the preservation of this fishery. It has been accepted generally without protest or opposition by the fishermen, practically all of whom seem glad to forego the uncertain profits and hazards of fishing during three months in the winter.

In addition to the closed season imposed by law, practically the entire halibut fleet was idle for three weeks in September on account of the scarcity of bait. This materially reduced the catch, as all vessels lost at least one trip to the fishing grounds. Notwithstanding this suspension of fishing, the total catch landed in Alaska was 15,037,616 pounds, valued at $1,619,443, an increase over 1923 of 2,864,342 pounds, or 23.5 per cent, and in value of $365,492, or 29 per cent. The total investment in the halibut industry in 1924 was $2,316,084, as compared with $2,336,350 in 1923.

Persons engaged, investment, and products of the Alaska halibut fishery in 1924

Items	Southeast Alaska		Central Alaska		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*
PERSONS ENGAGED						
Whites	584		20		604	
Natives	29				29	
Total	613		20		633	
INVESTMENT						
Vessels:						
Steam and gas	122	$1,062,000			122	$1,062,000
Net tonnage	2,281				2,281	
Launches	56	94,400			56	94,400
Apparatus		29,590				29,590
Shore property		343,625		$28,000		371,625
Operating capital		716,677		41,792		758,469
Total		2,246,292		69,792		2,316,084
PRODUCTS (POUNDS)						
Fresh (including local)	4,398,528	528,023			4,398,528	528,023
Frozen	8,334,088	837,870	2,305,000	253,550	10,639,088	1,091,420
Total	12,732,616	1,365,893	2,305,000	253,550	15,037,616	1,619,443

COD

In this statistical review of the cod fishery of Alaska only those vessels landing their catches in the Territory are considered as forming the strictly Alaska cod fleet and included in the investments in this industry. Vessels engaged in cod fishing in Bering Sea and the North Pacific Ocean are shown as the offshore cod fleet.

The Alaska Codfish Co. reduced its fleet of fishing vessels by withdrawing the schooners *Bangor* and *S. N. Castle*, while the Robinson Fisheries Co. sent the schooner *Alice* (220 tons), in addition to the *Wawona*, on a fishing voyage into Alaskan waters. In all, 12 schooners comprised the offshore fleet. The fares of these vessels, consisting of 6,584,819 pounds of dry-salted cod, valued at $366,856, and 94,000 pounds of tongues, valued at $657, were landed at ports in the United States and are not credited to Alaska.

The shore-station fleet consisted of five vessels belonging to the Union Fish Co. and one each to the San Juan Fishing & Packing Co. and the Aleutian Livestock Co. The *Martha*, a sloop of 14 tons owned by the Union Fish Co., was wrecked at the Shumagin Islands during the season and became a total loss.

STATISTICAL SUMMARY

The cod industry of Alaska gave employment to 102 persons in 1924, or 355 less than in 1923. This reduction is accounted for by the exclusion of the fishermen employed with the offshore fleet, who heretofore were included in these statistics. The investment amounted to $310,792, as compared with $967,216 in 1923. This decrease is also explained by the exclusion of all items credited to the offshore fleet operations. Dry-salted cod, stockfish, tongues, and frozen cod aggregating 1,580,026 pounds, valued at $100,777, comprised the products of this fishery. On the basis of previous reports production would have been 8,258,845 pounds, valued at $468,300.

Alaska shore-station cod fleet in 1924

Name	Rig	Net tonnage	Operators
Golden State	Power schooner	223	Union Fish Co., San Francisco, Calif.
Mary G	Power sloop	21	Do.
Pirate	do	30	Do.
Union Flag	do	7	Do.
Martha	Sloop	14	Do.
Daisy	Power vessel	30	Aleutian Livestock Co., Chernofsky, Alaska.
San Jose	do	14	San Juan Fishing & Packing Co., Seattle, Wash.

Offshore cod fleet in 1924

Name	Rig	Net tonnage	Operators
Glendale	Schooner	281	Alaska Codfish Co., San Francisco, Calif.
Maweema	do	392	Do.
City of Papeete	do	370	Do.
Louise	do	223	Union Fish Co., San Francisco, Calif.
Beulah	do	328	Do.
Galilee	do	339	Do.
Progress	do	115	Do.
Alice	do	220	Robinson Fisheries Co., Anacortes, Wash.
Wawona	do	413	Do.
John A	do	235	Pacific Coast Codfish Co., Seattle, Wash.
Charles R. Wilson	do	328	Do.
Fanny Dutard	do	252	J. A. Matheson, Anacortes, Wash.

Persons engaged, investment, and products of Alaska cod industry in 1924

Items	Southwest Alaska		Central Alaska		Western Alaska		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
PERSONS ENGAGED								
Fishermen: Whites			75		8		83	
Shoremen: Whites			10				10	
Transporters: Whites			9				9	
Total			94		8		102	
INVESTMENT								
Shore stations			3	$105,983			3	$105,983
Operating capital				20,476		$7,633		28,109
Wages paid				67,867		6,971		74,838
Vessels:								
Power, over 5 tons			4	63,300	2	12,500	6	75,800
Net tonnage			281		44		325	
Sailing			1	2,600			1	2,600
Net tonnage			14				14	
Launches			23	18,500			23	18,500
Dories			11	3,520	13	174	24	3,694
Apparatus: Lines			210	493	50	775	260	1,268
Total				232,739		28,053		310,792
PRODUCTS (POUNDS)								
Dry-salted cod			1,250,750	85,233	280,000	13,800	1,530,750	99,033
Stockfish			2,000	300			2,000	300
Tongues			1,325	66			1,325	66
Frozen cod	45,951	$1,378					45,951	1,378
Total	45,951	1,378	1,254,075	85,599	280,000	13,800	1,580,026	100,777

WHALES

In the whaling industry of Alaska in 1924, employment was given to 117 whites and 17 natives. The investment, covering value of plant, vessels, wages, and other operating charges, was $460,311. Operations, which began somewhat later than in the previous year, were carried on in the North Pacific Ocean and Bering Sea upon approximately the same scale as heretofore. The total catch amounted to 148 finbacks, 71 humpbacks, 46 sulphur bottoms, 17 sperm, and 1 right whale. The total catch in the previous season was 355. Products were 554,500 gallons of body oil, valued at $305,000; 78,700 gallons of sperm oil, valued at $31,480; 2,189,120 pounds of fertilizer, valued at $47,551; 1,500 pounds of whalebone, valued at $1,500; and 200,000 pounds of pickled whale tails, valued at $6,250. The latter product is understood to have been prepared particularly for the oriental trade. The total value of products in 1924 was $391,781, as compared with $388,681 in 1923, an increase of $3,100. The North Pacific Sea Products Co. operated throughout the season at Akutan in western Alaska.

CLAMS

Dr. F. W. Weymouth, of Stanford University, assisted by H. C. McMillin, continued his investigation of the clam beds of Alaska, which was undertaken in 1923, and a special report on the work has been published (Bureau of Fisheries Doc. No. 984). Careful study was made of the beds in the vicinty of Cordova and at Snug Harbor, Cook Inlet, and Kukak Bay on the Alaska Peninsula.

The beds at Cordova show the effects of the intensive digging carried on since 1916 in the small average size of the clams taken and the large proportion of undersized clams. It was shown that in the cold waters of central Alaska the production of clams is much smaller than on the Washington beds, and also that the rate of growth is slower. By taking undersized and immature clams the industry has to a dangerous degree been reducing its capital.

The age of a clam is determined from markings on the shell, like rings of a tree, and comparative studies revealed that on the Copalis (Wash.) beds clams reached a length of 4½ inches in three years, while at Cordova the period required is six years. The restoration of the depleted Alaska clam beds will therefore require many years. The imposition of a minimum size limit will, it is hoped, be helpful in this restoration, as it will make operations unprofitable and cause their cessation on beds where a large percentage of undersized clams is taken.

During the season of 1924 the regulations established a minimum size of 4½ inches in total length of shell, and permitted not more than 5 per cent of the clams taken to be under that size. The new regulations issued December 2, 1924, reduced this percentage to not more than 3 per cent in number of the clams taken.

STATISTICAL SUMMARY

Eleven firms packed clams in central Alaska and two in southeastern. Investment in the industry was $707,970, all of which was in the central district. Operations centered at Cordova. The number of persons engaged was 729, of which 557 were whites, 153 natives, 14 Chinese, 3 Mexicans, and 1 each Filipino and Negro. The investment in 1923 was $476,747, and 338 persons were employed. The output in 1924 was 83,161 cases, containing 2,340,644 pounds, valued at $629,412, an increase of 6 per cent in quantity and 16 per cent in value over the previous year, when 77,283 cases, valued at $541,139, were packed.

Products of the Alaska clam industry in 1924

Items	Cases	Pounds	Value
Minced:			
½-pound cans (48 to case)	52,131	1,251,144	$354,961
10-ounce cans (48 to case)	21,074	632,220	185,456
1-pound cans (48 to case)	645	30,960	5,172
10-pound cans (6 to case)	26	1,560	273
Whole:			
1-pound cans (48 to case)	8,020	384,960	75,315
5-pound cans (6 to case)	1,200	36,000	7,650
10-pound cans (6 to case)	65	3,800	585
Total	83,161	2,340,644	629,412

SHRIMP

Preliminary investigations concerning the condition and needs of the shrimp fishery in southeastern Alaska were made under the direction of Assistant Agent E. M. Ball in 1924. Reports and comments in regard to the Wrangell and Petersburg districts were secured from the masters of the bureau's patrol boats *Murre* and *Auklet* and from the chief packers of shrimp in these districts. A considerable diversity of opinion was apparent as to the time of the spawning period and the general movements and location of the schools of shrimp. On account of the diminution of the supply in some localities it has been generally conceded that a closed season is desirable to afford protection during the spawning period. The present regulations prohibit commercial fishing for shrimp between March 15 and April 30 of each year throughout southeastern Alaska.

The great need of the industry appears to be the development of more efficient apparatus for catching shrimp on the known grounds, and especially the invention of gear which can be used on the rough and rocky bottoms where beam and otter trawls can not operate successfully.

The investment in the shrimp industry in 1924 was $326,683, as compared with $268,656 in 1923. Of this total $25,500 represents the value of the two plants, $128,259 the cost of operations exclusive of labor, $113,739 wages paid, and $59,185 the value of boats and apparatus. Employment was given to 173 persons, of whom 45 were whites, 75 natives, 2 Chinese, 27 Japanese, 16 Filipinos, 3 Koreans, and 5 Mexicans. Products consisted of 528,432 pounds of shrimp meat, valued at $227,979, as compared with 460,560 pounds, valued at $178,474, produced in 1923, or an increase of approximately 15 per cent in quantity and 28 per cent in value.

CRABS

Five concerns in southeastern Alaska packed crabs in 1924. The Dobbins Packing Co., at Hoonah, and Ludeman & Isom Bros., at Petersburg, were the chief operators. The total investment was $56,196, and 22 persons were engaged. The output consisted of 2,241 cases of ½-pound cans, valued at $22,410; 66,630 pounds of cold-packed crab meat, valued at $25,981; and 160 dozen whole crabs, valued at $336. The total value of crab products in 1924 was $48,727, as compared with $14,590 in 1923, a gain of 233 per cent.

TROUT

The production of trout in Alaska in 1924 was wholly incidental to other fishery business. The products were Dolly Vardens, 45,428 pounds fresh, valued at $5,627, and 1,222 pounds frozen, valued at $122; and steelheads, 11,217 pounds fresh, valued at $693, and 3,395 pounds frozen, valued at $299, a total production of 61,262 pounds, valued at $6,741. No trout were canned. The total production of trout in 1923 was 44,024 pounds, valued at $4,122.

MISCELLANEOUS FISHERY PRODUCTS

Minor species of fish are taken in small quantities, chiefly in connection with the halibut fishery. In 1924 such products were as follows: Sablefish, 23,006 pounds fresh, valued at $831, and 204,344 pounds frozen, valued at $8,977; smelt, 1,233 pounds fresh, valued at $113, and 23,251 pounds frozen, valued at $2,235; flounders, 6,993 pounds frozen, valued at $349; red cod, 115 pounds fresh, valued at $3, and 1,060 pounds frozen, valued at $31.

FUR-SEAL INDUSTRY

PRIBILOF ISLANDS

GENERAL ADMINISTRATIVE WORK

In the calendar year 1924, 17,219 fur-seal skins were taken on the Pribilof Islands, of which 13,453 were taken on St. Paul Island and 3,766 on St. George Island. The blubbering of sealskins taken on St. Paul Island was continued. The development of more improved methods of handling and feeding the blue foxes of the Pribilofs, begun in 1923, was continued throughout 1924. The by-products plant on St. Paul Island was operated for about one month, seal oil and meal being manufactured for use as fox food or for sale.

Progress was made on both islands in the installation of improved water-supply systems, that on St. George being nearly completed. In addition to work on other buildings, a new warehouse was constructed on St. Paul Island.

Practically all of the general supplies were transported from Seattle to the Pribilofs by the U. S. S. *Gold Star*, although small quantities were transported by other vessels. The bureau's power vessel *Eider* rendered valuable assistance in transporting passengers, mail, and freight between the islands and Unalaska.

Vessels of the United States Coast Guard maintained an efficient patrol of Bering Sea and the North Pacific Ocean for the protection of the Pribilof Islands fur-seal herd. The bureau is under obligation to that service for its cooperation and assistance in connection with the Pribilof Islands work.

PURCHASE AND TRANSPORTATION OF SUPPLIES

In accordance with the custom adopted in 1923, competitive bids were secured by the issuance of separate schedules of various commodities required. Through the courtesy of the Navy Department shipment of the supplies was made from Seattle, Wash., on the U. S. S. *Gold Star* on May 20, 1924. The vessel arrived at St. Paul Island May 29, and the work of discharging cargo there was completed June 5. On June 6 the *Gold Star* left for St. George Island, where the discharge of cargo was completed on June 11.

On October 17 approximately 83 tons of foodstuffs and emergency supplies were shipped from Seattle on the steamship *Cordova* to Unalaska. Transportation to the Pribilofs was subsequently effected by the *Eider*.

POWER SCHOONER "EIDER"

The *Eider* played an important part in connection with the round-the-world flight of Army airplanes in May, 1924. Under the command of J. A. Beck, the *Eider* afforded transportation for advance officers and supplies from Unalaska to Attu, Alaska, and to Nikolski, on the Commander Islands off the Siberian coast. The vessel

FIG. 11.—Hauling coal through sand with a 10-ton Holt caterpillar tractor, St. Paul Island, Alaska

received the airplanes successively at Nazar Bay, on Atka Island; Chichagof, on Attu Island, Alaska; and at Nikolski, on Bering Island, Siberia. Quarters and subsistence on board were furnished to the aviators at each of these places. Important meteorological data also were furnished and other valuable assistance rendered.

The *Eider* rendered valuable service in the fur-seal work in 1924, making nine round trips between Unalaska and the Pribilof Islands. During the summer transportation was provided for employees on fishery inspection work along the Alaska Peninsula and as far east as Seward. A trip was made to Seattle in November for the installation of radio telephone equipment and the making of certain repairs. The vessel was still at Seattle at the end of the calendar year.

ELECTRIC LIGHTING PLANT

St. Paul Island.—A motor formerly used at the bureau's central station at Washington was rewound as a generator and shipped to St. Paul Island, where it was connected with the 20-horsepower semi-Diesel engine used for pumping water for washing sealskins. A set of Edison storage batteries was also supplied. The entire village was wired, and the new plant was put in operation in September.

CONSTRUCTION WORK

St. Paul Island.—Two of the houses for the use of white employees, begun in 1923, were completed and it was expected that the third would be finished in the winter of 1924–25. A building 28 by 48 feet, to be used as a dwelling and dispensary by the resident physician, was begun.

A two-story warehouse, 48 by 100 feet, was built at West Landing at the village on St. Paul Island. The building replaced an old and smaller warehouse built many years before on the same site. The old wharf leading up to the warehouse was enlarged to provide more space for handling cargo.

St. George Island.—Concrete walls were poured for an additional house for white employees, and plans were made for completing the building in the winter of 1924–25.

WATERWORKS

St. Paul Island.—The work of making available the water of Ice House Lake as the village water supply was continued in 1924. As soon as the sealing season was over, the digging of ditches and the laying of the 4-inch wood pipe line was resumed and continued until September 27. In this period 4,427 feet of pipe were laid and one valve with indicator post was installed. Approximately 1,150 feet remain to be laid.

St. George Island.—The installation of the water system connecting Upper Lake with the village was carried well along toward completion. A filter and tank house have been built at the lake and wood pipe laid to the village. The laying of pipe for distributing the water through the village and the installation of nonfreezable hydrants remain to be done.

BY-PRODUCTS PLANT

The by-products plant on St. Paul Island was operated from July 8 to August 10, during which time there were manufactured 5,340 gallons of No. 1 oil, 1,430 gallons of No. 2 oil, and 100 gallons of foots, a total of 6,870 gallons. There were also prepared 13,360 pounds of meal from seal carcasses and 5,654 pounds of meal from seal blubber, a total of 19,014 pounds.

With the exception of 50 gallons of No. 1 oil shipped to Seattle, the season's product was stored at the island, to be used as fox feed or for future shipment.

During the year 493 gallons of oil prepared at the plant in previous years were sold at 50 cents per gallon. From the proceeds, $246.50, expenses in connection with the sale, amounting to $36.14, were deducted, and the balance, $210.36, was transferred to the general fund of the Treasury.

NATIVES

CENSUS

The annual census, taken as of December 31, 1924, showed that there were 179 natives residing on St. Paul Island and 144 on St. George Island, a total of 323. Three of those on St. George Island were temporary visitors from St. Paul Island. During the year there were 7 births and 5 deaths on St. Paul Island, 12 arrivals, and 16 departures.

On St. George Island there were 6 births, 3 deaths, 5 arrivals, and 1 departure.

In addition to the foregoing, 11 natives who should be accredited to St. Paul Island were in attendance at the Salem Indian Training School at Chemawa, Oreg., at the end of the year.

HEALTH CONDITIONS

Improvements in medical facilities and equipment are being made gradually on the Pribilof Islands. A physician was on duty on each island throughout the year, and training in nursing and care of the sick was given to some of the more intelligent of the younger natives. Special attention was given to improving sanitary conditions in the villages and raising the standard of living among the natives by means of better housing facilities. When the new combined dispensary and physician's residence is completed in 1925 it will be much easier to accomplish this.

SCHOOLS

St. Paul Island.—The school year began on September 19, 1923, and closed May 16, 1924, both junior and senior schools being maintained as heretofore. The term consisted of 154½ school days. The enrollment in the junior school was 37 and in the senior school 27, a total of 64.

St. George Island.—The school year opened on September 10, 1923, and closed May 16, 1924, school being in session 148½ days. Thirty-eight pupils were enrolled at the beginning of the term.

ATTENDANCE AT SALEM INDIAN TRAINING SCHOOL, CHEMAWA, OREG.

On January 1, 1924, 9 natives from St. Paul Island were in attendance at the Salem Indian Training School, Chemawa, Oreg. One of these died in the latter part of the year, and 3 additional natives from St. Paul Island entered the school in the year, making 11 in attendance on December 31, 1924. No children from St. George Island attended during the year.

SAVINGS ACCOUNTS

Certain of the Pribilof Islands natives have personal funds in the custody of the United States Commissioner of Fisheries. Through the year 1924 these funds were kept on deposit with the Washington Loan & Trust Co., Washington, D. C., and interest was paid at the rate of 3 per cent per annum, calculated on monthly balances. Two accounts were opened during the year. A summary of the accounts as a whole for the year 1924 is shown in the statement that follows:

Balance on hand, Jan. 1, 1924	$11, 788. 51
Interest earned from Jan. 1, to Dec. 31, 1924	348. 15
Deposited by natives in 1924	61. 28
	12, 197. 94
Withdrawn by natives in 1924	678. 48
Balance on hand, Dec. 31, 1924	11, 519. 46

An itemized statement of the account, showing the individual balances of the natives, follows:

Pribilof Islands natives' savings accounts in custody of United States Commissioner of Fisheries, as trustee, December 31, 1924

Borenien, Zoya [1]	$265. 71	Melovidov, Iosef	$48. 49
Bourdukofsky, Martha [2]	101. 74	Merculieff, Dosofey [3]	43. 45
Bourdukofsky, Peter	. 90	Merculieff, Makary	43. 45
Fratis, Agrippina [3]	104. 54	Merculieff, Mariamna [3]	72. 45
Fratis, Akalina [3]	506. 65	Merculief, Agrippina	20. 57
Fratis, Martha [3]	104. 52	Merculief, Joseph	37. 91
Fratis, Iuliania [3]	104. 52	Merculief, Polyxenia	20. 87
Galanin, Mary	37. 69	Merculief, Stefanida [1]	4, 334. 05
Gromoff, Iuliania	286. 65	Pankoff, Agrippina	265. 34
Kochutin, Alexandra	4, 489. 56	Pankoff, Maria M(elovidov)	48. 50
Krukoff, Ekaterina	134. 25	Sedick, Lavrenty	53. 92
Krukoff, John [2]	35. 40	Sedick, Leonty	53. 92
Lestenkof, Michael	147. 10	Sedick, Marina	. 38
Mandregan, Alexandra M	11. 46	Shane, Michael	43. 94
Melovidov, Alfey	48. 49	Tetoff, Vikenty M(elovidov)	48. 49
Melovidov, Anton	4. 10	Zacharof, Emanuel	. 45

[1] Deceased.
[2] New account.
[3] Not living on islands in 1924.

PAYMENTS FOR TAKING SEALSKINS

A small force of temporary assistants was employed to aid in sealing operations at the Pribilofs. A number of Aleutian workmen from Unalaska and vicinity also were employed for a brief period.

The natives of the Pribilof Islands received 75 cents for each sealskin taken in 1924. The take of skins was 17,219 and payments amounted to $13,114.25, including $200 paid as additional compensation to 4 native foremen. Ten St. George Island natives, employed at St. Paul during the active sealing season, received $50 each, and $105.99 was paid to St. Paul Island natives for special services. The earnings in 1924 were as follows:

Salaries of sealing assistants	$12, 862. 66
Wages of temporary Aleutian workmen	7, 467. 50
Native workmen of St. Paul Island	10, 295. 74
Native workmen of St. George Island	3, 424. 50
Total	34, 050. 40

St. Paul Island.—For the 13,453 sealskins taken on St. Paul Island in the calendar year 1924 the resident natives received 75 cents per skin, and in addition two native foremen received $50 each for special services. The natives were divided into classes according to their ability and work, and payments were made as follows:

Payments to St. Paul Island natives for taking sealskins, calendar year 1924

Classification	Number of men	Share of each	Total
First class	29	$254. 25	$7, 373. 25
Second class	5	204. 00	1, 020. 00
Third class	3	165. 00	495. 00
Fourth class	5	127. 50	637. 50
Fifth class	4	103. 50	414. 00
Boys' class	2	75. 00	150. 00
Foremen (additional compensation to 2)			100. 00
Total	48		10, 189. 75

St. George Island.—For the 3,766 sealskins taken on St. George Island in the calendar year 1924 the resident natives received 75 cents per skin, and in addition one native foreman received $55 and one $45 for special services. Payments for taking these skins were made as follows:

Payments to St. George Island natives for taking sealskins, calendar year 1924

Classification	Number of men	Share of each	Total
First class	9	$96. 00	$864. 00
Do	8	95. 25	762. 00
Second class	6	76. 50	459. 00
Do	4	75. 75	303. 00
Third class	6	63. 00	378. 00
Fourth class (boys)	6	9. 75	58. 50
Foreman (additional compensation)			55. 00
Do			45. 00
Total	39		2, 924. 50

PAYMENTS FOR TAKING FOX SKINS

A payment of $5 is made by the Government for each fox skin taken and prepared for shipment by the native residents on the Pribilof Islands. In the season of 1923–24 the natives on St. Paul Island received $300 for the 60 pelts taken, and for the 742 taken on St.

Fig. 12.—Blue foxes on St. George Island, Alaska

George Island in that season $3,710 were paid. On St. Paul Island payments were made to individuals on the basis of number of skins taken by each, whereas on St. George Island the work was collective in character and distribution of the total amount due was in accordance with what was considered an equitable apportionment.

FUR-SEAL HERD

QUOTA FOR KILLING

On May 1, 1924, the Acting Secretary of Commerce approved the bureau's recommendation in regard to the killing of seals in 1924. It was provided that killings should be limited to 3-year-old males, except for the comparatively few seals of other age classes that might incidentally and unavoidably be killed during the course of sealing operations. A reserve of 7,000 3-year-old males was to be created, and, as far as practicable, this number was to be marked and released before regular operations began. With the exception of the reserved animals, as many of the 3-year-old males as could be found were to be killed. Later instructions authorized increasing the reserve to 10,000 if it appeared advisable to do so in order to maintain the herd in a healthy condition.

KILLINGS OF SEALS

The total number of seals killed on both islands in 1924 (including a few seals found dead, from which the skins were preserved for commercial purposes) was 17,219, of which 16,411 were 3-year-old males. A detailed classification of these seals is given on page 149.

Seal killings on Pribilof Islands in 1924

ST. PAUL ISLAND

Date	Serial No. of drive	Hauling ground	Skins secured
May 22	1	Sea Lion Rock	63
June 4		Seal killed for food	1
June 17		Seal found dead	1
Do	2	Reef and Gorbatch	61
Do		From seal dying as a result of shearing operations.	1
Do		Seals killed for food	4
June 23		From seal dying as result of shearing operations.	1
June 25		do	1
June 27		do	2
June 30		Seal killed for food	1
Do	3	Zapadni	74
July 1	4	Tolstoi	80
July 2	5	Polovina and Little Polovina.	104
Do		From seal dying as result of shearing operations.	1
July 3	6	Reef and Gorbatch	1,042
Do		From seal dying after shearing operations.	1
July 4	7	Zapadni	343
July 5		Seal killed for food	1
Do	8	Tolstoi	83
Do	9	Kitovi	37
July 6		Seals killed for food	2
Do		From seal dying as result of shearing operations.	1
Do	10	Polovina	162
July 7	11	Gorbatch	671
July 8	12	Zapadni	140
July 9		Seals killed for food	2
Do	13	Polovina	68
Do	14	Tolstoi	117
July 10	15	Reef and Gorbatch	708
July 11	16	Zapadni	376
July 13	17	Tolstoi	164
Do	18	Lukanin	171
July 14	19	Polovina	183
July 15	20	Reef and Gorbatch	1,405
Do		Seals killed for food	2
Do		From seal found dead	1
July 16	21	Zapadni	159
July 17	22	Tolstoi	184
Do	23	Vostochni (vicinities of rocks 41, 47, and 53) and Morjovi (vicinity rock 37).	370
Do	24	Lukanin and Kitovi	156
July 18	25	Polovina	85
Do	26	Vostochni (vicinities of rocks 64 and 70).	180
July 19	27	Reef and Gorbatch	1,224
July 20	28	Zapadni	260
Do	29	Vostochni (vicinities of rocks 47 and 53) and Morjovi (vicinity of rock 37).	176

Seal killings on Pribilof Islands in 1924—Continued

ST. PAUL ISLAND—Continued

Date	Serial No. of drive	Hauling ground	Skins secured	Date	Serial No. of drive	Hauling ground	Skins secured
July 21	30	Lukanin and Kitovi	53	July 27	------	From seals dying after rejection from Reef-Gorbatch killing, July 27.	5
Do	31	Vostochni (vicinities of rocks 64 and 70).	179	July 28	43	Zapadni	150
July 22	32	Polovina and Little Polovina.	133	July 29	44	Tolstoi	107
July 23	33	Reef and Gorbatch	557	Do	45	Vostochni (vicinities of rocks 41 and 47).	68
Do	34	Vostochni (vicinities of rocks 41, 47, and 53) and Morjovi (vicinity of rock 37).	183	Do	46	Lukanin and Kitovi	64
July 24	35	Zapadni	250	July 30	47	Polovina and Little Polovina.	124
Do	36	Vostochni (vicinities of rocks 64 and 70).	271	Do	48	Vostochni (vicinities of rocks 64 and 70).	224
July 25	37	Tolstoi	243	July 31	49	Reef and Gorbatch	368
Do	38	Lukanin and Kitovi	148	Aug. 1	------	From seal found dead	1
July 26	39	Polovina and Polovina Cliffs.	134	Oct. 20	50	Lukanin and Kitovi	76
Do	40	Vostochni (vicinities of rocks 47 and 53) and Morjovi (vicinity of rock 37).	37	Oct. 28	51	Tolstoi and Lukanin	70
				Nov. 8	52	Reef and Gorbatch	32
				Nov. 13	53	Gorbatch	26
				Nov. 18	------	Seals killed for food	2
				Nov. 26	54	Vostochni	45
July 27	41	Reef and Gorbatch	743				
Do	42	Vostochni (vicinities of rocks 64 and 70).	291			Total	13,453

ST. GEORGE ISLAND

Date	Serial No. of drive	Hauling ground	Skins secured	Date	Serial No. of drive	Hauling ground	Skins secured
June 12	1	North	21	July 28	------	Seal found dead	1
June 14	2	East Cliffs	29	July 29	13	Zapadni	61
June 25	3	North	38	July 30	14	East Cliffs	322
June 30	------	Wounded seal killed	1	July 31	15	North and Staraya Artil	317
July 7	4	East Cliffs	110	Oct. 20	16	North	18
July 10	5	North	301	Oct. 25	17	North, East Reef, and East Cliffs.	33
Do	------	Wounded seals killed	2				
July 14	6	North and Staraya Artil	407	Nov. 3	18	Zapadni	7
July 15	7	East Cliffs and East Reef	104	Nov. 4	19	North	5
July 18	8	North and Staraya Artil	645	Nov. 20	20	Staraya Artil	25
July 21	9	East Cliffs and East Reef	201	Nov. 28	21	North	21
July 22	10	North and Staraya Artil	484	Do	22	Staraya Artil	27
July 25	11	East Cliffs	284				
July 26	12	North and Staraya Artil	302			Total	3,766

AGE CLASSES OF SEALS

The method by which the sizes of male seals of the various age classes have been determined has been described in previous reports. For convenience of reference the limits of these age classes are shown in the following table:

Age standards of body lengths of male seals, Pribilof Islands

Age	Length of summer seals	Length of fall seals	Age	Length of summer seals	Length 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 1924

Age	Summer (Jan. 1 to Aug. 5)			Fall (Aug. 6 to Dec. 31)			Total for year		
	St. Paul	St. George	Total	St. Paul	St. George	Total	St. Paul	St. George	Total
Yearlings	7		7	1		1	8		8
2-year-olds	309	15	324	37	8	45	346	23	369
3-year-olds	12, 525	3, 558	16, 083	201	127	328	12, 726	3, 685	16, 411
4-year-olds	222	30	252	10		10	232	30	262
5-year-olds	1		1				1		1
6-year-olds		1	1					1	1
7-year-olds and over		1	1					1	1
Cows [1]	138	25	163	2	1	3	140	26	166
Total	13, 202	3, 630	16, 832	251	136	387	13, 453	3, 766	17, 219

[1] Cows unavoidably and accidentally killed and found dead.

RESERVING OPERATIONS

During the season 6,826 3-year-old male seals were reserved for breeding purposes on St. Paul Island and 1,746 on St. George Island, a total of 8,572. The reserved seals were marked by shearing a patch of fur from the top of the head, thereby establishing their identity as reserved animals.

On St. Paul Island reserving operations began June 16 and were concluded August 2, when 6,826 animals had been marked. Of the animals marked by shearing, 1,000 were further marked by clipping off the tips of both ears.

On St. George Island operations began on June 12 and were concluded on August 5, with 1,746 animals marked.

Simultaneously with the marking of 3-year-old males, 3,718 4-year-old males present in the drives also were marked by shearing—2,891 on St. Paul Island and 827 on St. George. Separate record was kept of the 4-year-olds that bore the iron brand used for marking a portion of the 3-year-olds reserved in 1923.

The season's reserving operations are shown in the following tabulation:

Branded 3-year-old and 4-year-old male seals forming part of breeding reserve, 1924

Island	3-year-old males marked by shearing	4-year-old males marked by shearing		
		Iron branded in 1923	Others	Total
St. Paul	6, 826	1, 275	1, 616	2, 891
St. George	1, 746	458	369	827
Total	8, 572	1, 733	1, 985	3, 718

WASHING AND BLUBBERING SEALSKINS

Almost all the sealskins taken on St. Paul Island in 1924 were washed and blubbered before being cured in salt. Through the active sealing period 11 employees of the Fouke Fur Co. were present for carrying on the work, and a number of Pribilof Islands natives were instructed in the actual work of blubbering.

CENSUS

In 1924 the census of the Pribilof Islands fur-seal herd was taken by Edward C. Johnston, who has done this work for a number of years. His report is printed on pages 164 to 169. The following is a comparative statement of the numerical strength of the various elements of the herd in the years 1913 to 1924, inclusive.

General comparison of recent censuses of the seal herd on the Pribilof Islands

Classes	1913	1914	1915	1916	1917	1918
Harem bulls	1,403	1,559	2,151	3,500	4,850	5,344
Breeding cows	92,269	93,250	103,527	116,977	128,024	142,915
Surplus bulls					8,977	17,110
Idle bulls	105	172	673	2,632	2,706	2,444
Young bulls (chiefly 5-year-olds)	259	1,658				
6-year-old males				11,167	15,397	13,755
5-year-old males			11,271	15,494	14,813	11,941
4-year-old males	2,000	9,939	15,848	15,427	16,631	7,114
3-year-old males	10,000	13,880	18,282	19,402	19,507	9,117
2-year-old males	15,000	17,422	23,990	24,169	26,815	30,159
Yearling males	20,000	23,068	30,307	33,645	38,013	41,595
2-year-old cows	15,000	17,422	23,990	24,245	26,917	30,415
Yearling cows	20,000	23,067	30,306	33,646	38,018	41,608
Pups	92,269	93,250	103,527	116,977	128,024	142,915
Total	268,305	294,687	363,872	417,281	468,692	496,432

Classes	1919	1920	1921	1922	1923	1924
Harem bulls	5,158	4,066	3,909	3,562	3,412	3,516
Breeding cows	157,172	167,527	176,655	185,914	197,659	208,396
Surplus bulls	9,619	6,115	3,301	2,346	1,891	2,043
Idle bulls	2,239	1,161	747	508	312	390
6-year-old males	8,991	4,153	3,991	3,771	4,863	8,489
5-year-old males	5,282	5,007	4,729	6,080	10,612	5,132
4-year-old males	5,747	5,667	6,780	11,807	5,710	18,670
3-year-old males	13,596	10,749	14,668	7,459	22,786	21,551
2-year-old males	33,081	39,111	41,893	40,920	43,112	45,685
Yearling males	46,444	51,074	50,249	52,988	55,769	59,291
2-year-old cows	33,287	39,480	43,419	46,280	48,801	51,359
Yearling cows	46,447	51,081	54,447	57,413	60,422	64,240
Pups	157,172	167,527	176,655	185,914	197,659	208,396
Total	524,235	552,718	581,443	604,962	653,008	697,158

DEVELOPMENT OF FOX HERDS ON PRIBILOF ISLANDS

The work of developing the fox herds of the Pribilof Islands, inaugurated in 1923, was continued in 1924 under the immediate supervision of Dr. H. L. Van Volkenberg, an expert specially secured for that duty.

ST. PAUL ISLAND

As it appeared that a scarcity of food during certain seasons of the year was the probable reason why St. Paul Island had not produced larger numbers of foxes, attention was devoted primarily to providing an adequate food supply for them. Accordingly cookers and ovens were purchased for baking biscuits and preparing cooked foods to be put out at intervals in places where foxes might congregate. These ovens were very satisfactory. The biscuits contained oat groats, corn meal, rice, calf meal, seal meal, and seal oil or lard.

The calf meal (a mixture of several grains) consisted of cracked wheat or groats and rice mixed with seal oil.

Fox feeding was begun on October 25. A wire cage trap, similar to that used on St. George Island, was constructed adjacent to the village near the by-products plant, but the foxes could not be induced to enter it and feeding was successful only on the seal-killing fields.

Thirteen small box traps for feeding and trapping were constructed—3 at Tolstoi, 2 at Lukanin, 1 near East Landing, 2 on Village Reef, 2 at Zapadni, 2 at Halfway Point, and 1 at Northeast Point. They were about 4 feet long, 2½ feet wide, and 2½ feet high, provided with a detachable cover and having at one end a small door for the fox to enter. The food was placed in a removable trough. For trapping purposes a catch on the drop door was released by a string running from the catch to a loose board which the fox stepped on while eating the food. The foxes entered these very slowly at first, but in a short time all the food fed was placed in them. The advantage of these traps is that sea gulls do not consume any of the food, as they will not enter the boxes.

During the fall two new fox houses were constructed—one at Zapadni and one at Halfway Point. They were one-story structures, the main part being 12 by 14 feet, with living quarters for men engaged in winter fox feeding and trapping.

Fox trapping for the breeding reserve was begun at the village on December 13, and the animals caught were marked by clipping the hair at the base of the tail. Blue foxes were released, but all white foxes caught were killed, as an effort is being made to eliminate the white strain. The usual trapping with steel traps began on December 17 and continued to December 24. The places covered were Northeast Point, Marunich, Tsammana, and Southwest Point, 29 trappers being engaged.

The winter was quite mild, and the natural food washed up on the beaches was so much preferred by the animals that the food in the traps and at the feeding places did not tempt them, in consequence of which fewer were caught. It was noted that the foxes traveled widely over the island during the mild weather. At each of the three reserving stations marking was done in a characteristic manner, and quite frequently a fox that had been marked at one place was recaught in one of the other districts.

ST. GEORGE ISLAND

On St. George Island both seal carcasses and baked biscuits were used as fox food, the foxes showing a decided preference for the latter.

On December 29 a 50-foot whale was found 20 feet above the water line, half buried in the sand at Garden Cove. Tracks showed that a large number of foxes were resorting there for food. A trap 10 by 12 feet was at once built near by and baited with whale meat, and 21 blue skins were secured.

Weather conditions were not favorable for fox trapping on St. George Island. It was exceptionally mild and at the same time stormy. From December 12 through the end of the month the temperature was not below 38° F., and it rained practically every day. All snow disappeared.

FOX TRAPPING SEASON OF 1924–25

The season's take of fox pelts on St. Paul and St. George Islands consisted of 681 blue and 28 white pelts, a total of 709.

On St. Paul Island the regular trapping season began December 17 and ended December 24, 1924. In this period 81 blue and 10 white pelts were secured. In an effort to eliminate the strain of white foxes from the St. Paul Island herd 16 white foxes were killed during January, February, and March, 1925, thereby bringing the take on this island in the season to 81 blue and 26 white pelts, a total of 107. There were marked and released on this island for breeding purposes 167 blue foxes, 103 males and 64 females.

On St. George Island the killing of foxes began on December 5, 1924, and was continued until February 27, 1925. Six hundred blue and two white pelts were taken, a total of 602. During the season 541 blue foxes (272 males and 269 females) were marked and released for breeding purposes.

REINDEER

The reindeer herds on the Pribilof Islands provide a valuable source of fresh meat for both white and native residents. Consideration is being given to the feasibility of introducing new blood into the herds for the reason that, due to inbreeding, they have not done as well as anticipated since their introduction in 1911.

By the end of 1924 the St. Paul Island herd numbered approximately 200 animals and that of St. George Island approximately 150 animals. During the year 13 reindeer were killed for food on St. Paul Island and 18 on St. George Island.

FUR-SEAL SKINS

SHIPMENTS

In the calendar year 1924 two shipments of fur-seal skins, aggregating 18,713 commercial skins, were made from the Pribilof Islands. On June 5 there were placed aboard the U. S. S. *Gold Star* at St. Paul Island 28 barrels containing 1,121 sealskins, representing the balance left on that island from the take of the calendar year 1923. On June 11 there were shipped from St. George Island on the same vessel 18 barrels containing 760 sealskins, the balance left on that island from the take of the calendar year 1923. These 1,881 sealskins were delivered at Bremerton, Wash., on July 28, and were shipped from there by freight on August 2, consigned to the Fouke Fur Co., St. Louis, Mo., arriving there on August 12. Shipment was made via the Puget Sound Navigation Co., Great Northern, and Chicago, Burlington & Quincy.

Seventy-eight barrels of sealskins were shipped from St. Paul Island on September 19 and 75 barrels on September 30, the two lots containing a total of 13,202 skins, and on the 15th of September 69 barrels containing 3,630 sealskins were shipped from St. George Island, all taken in the calendar year 1924. The skins were transported on the *Eider* and the Coast Guard cutter *Haida* to Unalaska, and were delivered by the *Boxer* at Seattle on November 20, from whence they were shipped by freight on the same date via Oregon-Washington Railroad & Navigation Co., Union Pacific, and Wabash to the Fouke Fur Co. at St. Louis, delivery being made on December 1.

SALES

In 1924 two public auction sales of Pribilof Islands fur-seal skins were held, and in addition 287 skins were disposed of at private sales. The first public auction sale was held at New York City on March 24 and the second at St. Louis, Mo., on October 15. The tables below show details of these sales.

March 24, 1924.—At this sale 19,804 dressed, dyed, and machined Pribilof skins sold for $514,512.50; 11 miscellaneous skins from the Pribilof Islands sold for $5.50; 3 skins from seals shipped to the Steinhart Aquarium at San Francisco sold for $1.50; 33 skins received from the Japanese Government under treaty provisions sold for $561; and 35 confiscated skins sold for $45.50; a grand total of $515,126. All of the dressed, dyed, and machined skins were prepared with the standard black dye.

October 15, 1924.—On this date there were sold 14,136 standard black-dyed sealskins for $367,016, 1,845 brown-dyed (Chataigne d'Or) for $95,430.50, 1,010 raw salted for $7,983, and 17 miscellaneous for $17.65, all taken at the Pribilof Islands, and 4 confiscated skins for $16.50—a grand total of $470,463.65.

The brown-dyed skins were an innovation to the trade, and keen competition for them was shown. A comparative study of the prices received for the three kinds is of interest. The 1,010 raw salted skins brought an average price of $7.90 each, the 14,136 black-dyed skins an average of $25.96, and the 1,845 brown-dyed (Chataigne d'Or) skins an average of $51.72 per skin. The cost of dressing, dyeing, and machining the black-dyed and the brown-dyed skins ranged from $14.50 to $15.50 per skin. It will be noted that the black-dyed skins commanded a good margin in price over the raw salted skins, after making allowance for the cost of dressing, dyeing, and machining, and that the average price for brown-dyed skins was within a few cents of double that obtained for the black-dyed skins.

Private sales.—In the interim between the sale of October 15 and the end of the year 287 Pribilof fur-seal skins were disposed of at private sales, all of which were authorized by the Secretary of Commerce.

On November 1, 1924, 195 Chataigne d'Or skins were sold to various dealers for the purpose of increasing the interest of the trade in the new brown-dyed skins. The price received was the average bid for similarly dyed skins, grade for grade, at the sale on October 15.

On December 24, 1924, 75 Chataigne d'Or seal skins were disposed of at private sale by the Fouke Fur Co. to purchasers of similarly dyed skins at the October 15 sale, at the price paid by them at that sale for lots of the same grade of skins. Also, on December 24, 17 black-dyed skins were sold for exhibition purposes. These were of the 1921 and 1922 takes, and the price was determined by the average which skins of those years brought at previous auction sales.

Sale of fur-seal skins at New York City, March 24, 1924

SALE OF 19,804 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BLACK

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
1	60	Extra extra large	$58.00	$3,480.00
2	60	do	53.00	3,180.00
4	60	do	54.00	3,240.00
6	38	5 wigs, 33 extra extra large	47.00	1,786.00
8	70	Extra large	44.00	3,080.00
9	70	do	45.00	3,150.00
10	70	do	44.00	3,080.00
11	70	do	44.00	3,080.00
12	70	do	43.00	3,010.00
13	70	do	43.00	3,010.00
14	70	do	43.00	3,010.00
15	70	do	42.00	2,940.00
16	70	do	40.00	2,800.00
17	70	do	41.00	2,870.00
18	70	do	41.00	2,870.00
19	70	do	42.00	2,940.00
20	70	do	40.50	2,835.00
21	70	do	41.00	2,870.00
22	70	do	40.00	2,800.00
23	70	do	40.00	2,800.00
24	70	do	39.50	2,765.00
25	70	do	39.00	2,730.00
26	70	do	40.00	2,800.00
27	70	do	39.00	2,730.00
28	59	do	40.00	2,360.00
29	70	Extra large; scarred, blemished, etc	26.50	1,855.00
30	70	do	26.50	1,855.00
31	70	do	26.00	1,820.00
32	66	do	26.50	1,749.00
33	80	Large	29.00	2,320.00
34	80	do	30.00	2,400.00
35	80	do	31.50	2,520.00
36	80	do	30.50	2,440.00
38	80	do	32.00	2,560.00
39	80	do	31.50	2,520.00
40	80	do	30.00	2,400.00
41	80	do	31.00	2,480.00
42	80	do	32.00	2,560.00
43	80	do	30.50	2,440.00
46	80	do	30.50	2,440.00
47	80	do	29.00	2,320.00
48	80	do	30.50	2,440.00
49	80	do	28.50	2,280.00
50	80	do	30.50	2,440.00
51	80	do	31.00	2,480.00
52	80	do	30.50	2,440.00
53	80	do	30.50	2,440.00
54	80	do	30.00	2,400.00
55	80	do	31.00	2,480.00
56	80	do	29.50	2,360.00
57	80	do	29.00	2,320.00
58	80	do	28.00	2,240.00
59	80	do	29.00	2,320.00
60	80	do	30.00	2,400.00
61	80	do	29.00	2,320.00
62	80	do	27.50	2,200.00
63	80	do	27.00	2,160.00
64	80	do	26.00	2,080.00
65	80	do	26.50	2,120.00
66	80	do	25.00	2,000.00
67	80	do	26.00	2,080.00
68	80	do	27.50	2,200.00
69	80	do	26.00	2,080.00
70	80	do	26.00	2,080.00
71	80	do	25.50	2,040.00
72	80	do	26.00	2,080.00
73	80	do	25.50	2,040.00
74	80	do	26.00	2,080.00
75	80	do	26.50	2,120.00
76	68	do	25.50	1,734.00
78	80	Large; scarred, blemished, etc	19.00	1,520.00
80	80	do	22.50	1,800.00
81	80	do	17.50	1,400.00
82	80	do	18.50	1,480.00
83	80	do	18.50	1,480.00
84	80	Large; scarred, blemished, etc	$19.00	$1,520.00
85	80	do	19.00	1,520.00
86	80	do	19.50	1,560.00
91	90	Medium	24.00	2,160.00
93	90	do	25.00	2,250.00
94	90	do	26.50	2,385.00
96	90	do	25.00	2,250.00
97	90	do	25.00	2,250.00
99	90	do	25.00	2,250.00
101	90	do	26.50	2,385.00
102	90	do	25.00	2,250.00
103	90	do	26.00	2,340.00
104	90	do	26.00	2,340.00
105	90	do	26.00	2,340.00
106	90	do	26.00	2,340.00
107	90	do	26.50	2,385.00
108	77	do	26.00	2,002.00
115	65	Small medium	23.50	1,527.50
120	60	2 wigs, 58 extra extra large	39.50	2,370.00
122	40	1 wig, 39 extra extra large; scarred, blemished, etc	25.00	1,000.00
123	70	Extra large	33.00	2,310.00
124	70	do	31.50	2,205.00
125	70	do	31.50	2,205.00
126	70	do	31.50	2,205.00
127	70	do	31.00	2,170.00
128	70	do	30.50	2,135.00
129	70	do	30.00	2,100.00
130	26	do	34.50	897.00
131	70	Extra large; scarred, blemished, etc	20.50	1,435.00
132	70	do	17.50	1,225.00
133	70	do	17.50	1,225.00
134	70	do	18.00	1,260.00
135	70	do	19.50	1,365.00
136	55	do	19.00	1,045.00
137	80	Large	24.00	1,920.00
138	80	do	23.00	1,840.00
139	80	do	23.00	1,840.00
140	80	do	22.50	1,800.00
141	80	do	22.50	1,800.00
142	80	do	24.00	1,920.00
143	80	do	22.50	1,800.00
144	80	do	23.00	1,840.00
145	80	do	23.50	1,880.00
146	80	do	23.25	1,860.00
147	80	do	22.50	1,800.00
148	80	do	22.50	1,800.00
149	80	do	23.00	1,840.00
150	45	do	23.50	1,057.50
151	44	do	23.50	1,034.00
152	80	Large; scarred, blemished, etc	16.50	1,320.00
153	80	do	16.50	1,320.00
154	80	do	17.00	1,360.00
155	80	do	17.00	1,360.00
156	80	do	18.00	1,440.00
157	80	do	17.00	1,360.00
158	80	do	17.50	1,400.00
159	80	do	17.50	1,400.00
160	80	do	17.50	1,400.00
161	37	do	18.50	684.50
162	90	Medium	20.50	1,845.00
163	90	do	20.00	1,800.00
164	90	do	20.50	1,845.00
165	90	do	20.50	1,845.00
166	90	do	20.50	1,845.00
167	90	do	20.50	1,845.00
168	90	do	20.00	1,800.00
169	90	do	20.50	1,845.00
170	90	do	21.50	1,935.00
171	90	do	20.50	1,845.00
172	90	do	21.00	1,890.00

Sale of fur-seal skins at New York City, March 24, 1924—Continued

SALE OF 19,804 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BLACK—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
173	90	Medium	$21.50	$1,935.00
174	90	do	21.00	1,890.00
176	90	Medium; scarred, blemished, etc	15.00	1,350.00
177	90	do	15.50	1,395.00
179	90	do	16.00	1,440.00
184	90	do	16.50	1,485.00
187	90	Small medium	22.50	2,025.00
188	78	do	21.50	1,677.00
189	90	Small medium; scarred, blemished, etc	13.50	1,215.00
191	46	do	14.50	667.00
193	52	III, large	10.50	546.00
194	54	III, 37 medium, 17 small medium	9.00	486.00
200	27	Extra extra large	52.00	1,404.00
201	70	Extra large	45.50	3,185.00
202	70	do	42.50	2,975.00
203	70	do	43.00	3,010.00
204	70	do	43.50	3,045.00
205	29	do	43.00	1,247.00
206	38	3 extra extra large, 35 extra large; scarred, blemished, etc	34.50	1,311.00
207	38	2 extra extra large, 36 extra large; scarred, blemished, etc	31.00	1,178.00
208	80	Large	30.50	2,440.00
209	80	do	30.50	2,440.00
210	80	do	31.00	2,480.00
211	80	do	32.50	2,600.00
212	80	do	31.00	2,480.00
213	80	do	30.00	2,400.00
214	80	do	31.50	2,520.00
215	80	do	31.50	2,520.00
216	80	do	30.50	2,440.00
217	80	do	30.00	2,400.00
218	80	do	30.00	2,400.00
219	80	do	30.50	2,440.00
220	80	do	30.00	2,400.00
221	80	do	31.00	2,480.00
222	80	do	30.50	2,440.00
223	80	do	30.00	2,400.00
224	80	do	31.00	2,480.00
225	40	do	30.00	1,200.00
226	40	do	31.00	1,240.00
227	40	do	32.00	1,280.00
228	40	do	30.50	1,220.00
229	40	do	29.00	1,160.00
230	40	do	30.00	1,200.00
231	40	do	31.00	1,240.00
232	40	do	31.00	1,240.00
233	40	do	30.50	1,220.00
234	40	do	31.00	1,240.00
235	50	do	30.00	1,500.00
236	80	Large; scarred, blemished, etc	19.00	1,520.00
237	80	do	19.75	1,580.00
238	80	do	19.50	1,560.00
239	80	do	20.00	1,600.00
240	40	do	20.50	820.00
241	40	do	21.00	840.00
242	47	do	21.50	1,010.50
243	90	Medium	23.00	2,070.00
244	90	do	23.50	2,115.00
245	90	do	24.50	2,205.00
246	90	do	23.50	2,115.00
247	90	do	23.50	2,115.00
248	90	do	23.50	2,115.00
249	90	Medium	$24.00	$2,160.00
250	90	do	24.00	2,160.00
251	90	do	24.00	2,160.00
252	90	do	23.50	2,115.00
253	90	do	23.50	2,115.00
254	90	do	23.50	2,115.00
255	90	do	23.50	2,115.00
256	90	do	24.00	2,160.00
257	90	do	23.50	2,115.00
258	90	do	24.00	2,160.00
259	90	do	23.00	2,070.00
260	90	do	23.50	2,115.00
261	90	do	23.50	2,115.00
262	90	do	23.00	2,070.00
263	90	do	23.50	2,115.00
264	90	do	23.00	2,070.00
265	90	do	22.50	2,025.00
266	90	do	23.00	2,070.00
267	90	do	22.50	2,025.00
268	90	do	22.50	2,025.00
269	45	do	22.00	990.00
270	45	do	23.00	1,035.00
271	45	do	23.00	1,035.00
272	45	do	23.00	1,035.00
273	45	do	22.50	1,012.50
274	45	do	23.00	1,035.00
275	45	do	22.75	1,023.75
276	45	do	22.75	1,023.75
277	45	do	23.00	1,035.00
278	45	do	22.50	1,012.50
279	45	do	24.00	1,080.00
280	45	do	23.00	1,035.00
281	45	do	23.00	1,035.00
282	45	do	22.50	1,012.50
283	45	do	23.50	1,057.50
284	45	do	23.00	1,035.00
285	48	do	22.50	1,080.00
286	48	do	22.50	1,080.00
287	90	Medium; scarred, blemished, etc	17.50	1,575.00
288	90	do	18.00	1,620.00
289	90	do	18.00	1,620.00
290	90	do	18.50	1,665.00
291	90	do	19.00	1,710.00
292	90	do	19.50	1,755.00
293	90	do	20.00	1,800.00
294	90	do	19.00	1,710.00
295	48	do	20.00	960.00
296	48	do	20.50	984.00
297	47	do	20.00	940.00
298	90	Small medium	21.00	1,890.00
299	90	do	20.50	1,845.00
300	90	do	21.50	1,935.00
301	90	do	20.50	1,845.00
302	90	do	21.00	1,890.00
303	90	do	20.50	1,845.00
304	90	do	21.00	1,890.00
305	45	do	22.50	1,012.50
306	45	do	22.50	1,012.50
307	34	do	23.00	782.00
308	90	Small medium; scarred, blemished, etc	15.50	1,395.00
309	90	do	15.50	1,395.00
310	34	do	16.50	561.00
311	34	do	17.00	578.00
312	20	III, 1 wig, 4 extra large, 15 large	17.25	345.00
313	52	III, medium	13.25	689.00
314	22	III, small medium	11.50	253.00
	19,804			514,512.50

Sale of fur-seal skins at New York City, March 24, 1924—Continued

SALE OF 11 MISCELLANEOUS SKINS TAKEN ON PRIBILOF ISLANDS

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
320	11	Washed and dried	$0.50	$5.50

SALE OF 3 SKINS TAKEN FROM PRIBILOF ISLANDS SEALS SHIPPED TO STEINHART AQUARIUM

321	3	Raw salted	$0.50	$1.50

SALE OF 33 SKINS RECEIVED FROM JAPANESE GOVERNMENT UNDER TREATY PROVISIONS

328	33	5 extra extra large, 13 extra large, 15 large	$17.00	$561.00

SALE OF 35 CONFISCATED SKINS

322	3	Dressed, dyed, and machined	$8.00	$24.00
323	21	Unhaired and dressed	.50	10.50
324	11	do	1.00	11.00
	35			45.50

Sale of fur-seal skins at St. Louis, Mo., October 15, 1924

SALE OF 14,136 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BLACK

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
1	70	12 extra extra large, 58 extra large	$56.00	$3,920.00
2	70	Extra large	50.50	3,535.00
3	71	do	53.00	3,763.00
4	27	Extra large; scarred, blemished, etc	32.00	864.00
5	80	Large	35.50	2,840.00
6	80	do	34.50	2,760.00
7	80	do	36.00	2,880.00
8	80	do	37.00	2,960.00
9	80	do	37.50	3,000.00
10	80	do	37.00	2,960.00
11	80	do	37.00	2,960.00
12	80	do	39.00	3,120.00
13	80	do	37.50	3,000.00
14	80	do	37.75	3,020.00
15	80	do	36.00	2,880.00
16	80	do	38.00	3,040.00
17	80	do	37.00	2,960.00
18	80	do	37.50	3,000.00
19	80	do	38.00	3,040.00
20	80	do	38.00	3,040.00
21	80	do	39.00	3,120.00
22	80	do	38.50	3,080.00
23	80	do	38.00	3,040.00
24	80	do	38.50	3,080.00
25	80	do	38.00	3,040.00
26	43	do	40.00	1,720.00
27	80	Large; scarred, blemished, etc	25.50	2,040.00
28	80	do	25.50	2,040.00
29	80	do	26.00	2,080.00
30	84	do	27.00	2,268.00
31	90	Medium	26.50	2,385.00
32	90	do	26.00	2,340.00
33	90	Medium	$25.00	$2,250.00
34	90	do	26.50	2,385.00
35	90	do	26.50	2,385.00
36	90	do	26.50	2,385.00
37	90	do	27.50	2,475.00
38	90	do	25.50	2,295.00
39	90	do	28.00	2,520.00
40	90	do	28.00	2,520.00
41	90	do	26.00	2,340.00
42	90	do	27.50	2,475.00
43	90	do	26.50	2,385.00
44	90	do	28.50	2,565.00
45	90	do	27.00	2,430.00
46	90	do	27.00	2,430.00
47	90	do	26.50	2,385.00
48	90	do	26.75	2,407.50
49	90	do	26.50	2,385.00
50	90	do	27.50	2,475.00
51	90	do	27.25	2,452.50
52	90	do	27.00	2,430.00
53	90	do	27.50	2,475.00
54	90	do	27.50	2,475.00
55	90	do	26.50	2,385.00
56	90	do	26.00	2,340.00
57	90	do	27.00	2,430.00
58	90	do	27.00	2,430.00
59	90	do	27.25	2,452.50
60	90	do	27.00	2,430.00
61	90	do	27.00	2,430.00
62	90	do	26.50	2,385.00
63	90	do	27.00	2,430.00
64	90	do	27.50	2,475.00
65	90	do	28.50	2,565.00
66	90	do	27.00	2,430.00
67	90	do	28.00	2,520.00
68	90	do	27.75	2,497.50

Sale of fur-seal skins at St. Louis, Mo., October 15, 1924—Continued

SALE OF 14,136 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BLACK—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot	Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
69	90	Medium	$27.75	$2,497.50	119	90	Small medium	$24.50	$2,205.00
70	90	do	26.50	2,385.00	120	90	do	23.50	2,115.00
71	90	do	27.00	2,430.00	121	90	do	24.50	2,205.00
72	90	do	27.00	2,430.00	122	90	do	23.00	2,070.00
73	90	do	28.00	2,520.00	123	90	do	24.25	2,182.50
74	90	do	28.75	2,587.50	124	90	do	24.50	2,205.00
75	90	do	27.50	2,475.00	125	90	do	24.00	2,160.00
76	90	do	28.00	2,520.00	126	90	do	24.50	2,205.00
77	90	do	27.50	2,475.00	127	90	do	25.00	2,250.00
78	90	do	27.00	2,430.00	128	90	do	23.75	2,137.50
79	90	do	27.50	2,475.00	129	90	do	24.50	2,205.00
80	90	do	27.50	2,475.00	130	90	do	24.00	2,160.00
81	90	do	27.75	2,497.50	131	90	do	24.25	2,182.50
82	90	do	27.00	2,430.00	132	90	do	24.00	2,160.00
83	90	do	27.75	2,497.50	133	90	do	24.00	2,160.00
84	90	do	27.75	2,497.50	134	90	do	24.50	2,205.00
85	90	do	27.00	2,430.00	135	90	do	24.00	2,160.00
86	90	do	27.75	2,497.50	136	90	do	24.25	2,182.50
87	90	do	27.50	2,475.00	137	90	do	23.75	2,137.50
88	90	do	28.25	2,542.50	138	90	do	23.75	2,137.50
89	90	do	27.50	2,475.00	139	90	do	23.75	2,137.50
90	90	do	28.25	2,542.50	140	90	do	23.50	2,115.00
91	90	do	28.25	2,542.50	141	90	do	23.75	2,137.50
92	90	do	27.50	2,475.00	142	90	do	23.75	2,137.50
93	82	do	28.50	2,337.00	143	90	do	24.75	2,227.50
94	90	Medium; scarred, blemished, etc	18.50	1,665.00	144	90	do	24.50	2,205.00
95	90	do	16.75	1,507.50	145	81	do	24.25	1,964.25
96	90	do	17.75	1,597.50	146	90	Small medium; scarred, blemished, etc	15.50	1,395.00
97	90	do	18.25	1,642.50	147	90	do	16.00	1,440.00
98	90	do	18.00	1,620.00	148	90	do	16.25	1,462.50
99	90	do	18.25	1,642.50	149	90	do	16.25	1,462.50
100	90	do	18.00	1,620.00	150	90	do	16.50	1,485.00
101	90	do	18.50	1,665.00	151	90	do	16.50	1,485.00
102	90	do	19.00	1,710.00	152	90	do	15.75	1,417.50
103	90	do	19.00	1,710.00	153	90	do	16.50	1,485.00
104	90	do	19.00	1,710.00	154	90	do	16.50	1,485.00
105	90	do	18.25	1,642.50	155	90	do	16.25	1,462.50
106	90	do	19.25	1,732.50	156	90	do	16.50	1,485.00
107	90	do	20.25	1,822.50	157	90	do	16.50	1,485.00
108	90	do	21.00	1,890.00	158	90	do	16.50	1,485.00
109	90	do	19.75	1,777.50	159	90	do	16.50	1,485.00
110	55	do	20.25	1,113.75	160	70	do	17.50	1,225.00
111	90	Small medium	24.75	2,227.50	161	50	III, 2 extra large, 9 large, 39 medium	12.00	600.00
112	90	do	23.50	2,115.00	162	49	III, medium	13.00	637.00
113	90	do	24.00	2,160.00	163	62	III, small medium	9.50	589.00
114	90	do	24.00	2,160.00	164	62	do	10.00	620.00
115	90	do	24.00	2,160.00					
116	90	do	23.50	2,115.00					
117	90	do	24.00	2,160.00					
118	90	do	23.00	2,070.00		14,136			367,016.00

SALE OF 1,845 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BROWN

170	25	18 extra large, 7 large	$56.00	$1,400.00	187	45	Medium	$54.50	$2,452.50
171	40	Large	64.00	2,560.00	188	29	do	59.00	1,711.00
172	40	do	63.00	2,520.00	189	45	do	58.00	2,610.00
173	40	do	65.00	2,600.00	190	45	do	58.50	2,632.50
174	40	do	66.00	2,640.00	191	45	do	58.50	2,632.50
175	25	do	68.00	1,700.00	192	16	do	61.00	976.00
176	14	Large; scarred, blemished, etc	47.50	665.00	193	48	do	67.00	3,216.00
177	45	Medium	57.00	2,565.00	194	30	9 large, 21 medium	60.00	1,800.00
178	45	do	54.00	2,430.00	195	29	18 medium, 11 small medium	53.00	1,537.00
179	45	do	55.00	2,475.00	196	24	10 large, 8 medium, 6 small medium	55.00	1,320.00
180	45	do	56.00	2,520.00	197	50	5 large, 35 medium, 10 small medium	55.00	2,750.00
181	45	do	55.00	2,475.00	198	50	Medium; scarred, blemished, etc	46.00	2,300.00
182	45	do	53.50	2,407.50	199	49	do	47.00	2,303.00
183	45	do	56.00	2,520.00	200	26	do	48.50	1,261.00
184	45	do	54.00	2,430.00	201	25	do	51.50	1,287.50
185	45	do	56.00	2,520.00					
186	45	do	56.50	2,542.50					

Sale of fur-seal skins at St. Louis, Mo., October 15, 1924—Continued

SALE OF 1,845 DRESSED, DYED, AND MACHINED SKINS TAKEN ON PRIBILOF ISLANDS, DYED BROWN—Continued

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot	Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
202	19	11 large, 8 medium; scarred, blemished, etc	$53.00	$1,007.00	212	34	Small medium	$40.00	$1,360.00
					213	39	do	45.50	1,774.50
					214	29	do	44.50	1,290.50
203	15	3 large, 10 medium, 2 small medium; scarred, blemished, etc	40.00	600.00	215	45	Small medium; scarred, blemished, etc	34.00	1,530.00
204	45	Small medium	41.00	1,845.00	216	30	do	36.00	1,080.00
205	45	do	44.50	2,002.50	217	36	do	38.00	1,368.00
206	45	do	42.00	1,890.00	218	15	do	42.50	637.50
207	45	do	43.00	1,935.00	219	12	do	42.00	504.00
208	45	do	43.00	1,935.00	220	10	III, 4 medium, 6 small medium	30.00	300.00
209	16	do	45.00	720.00					
210	45	do	44.00	1,980.00		1,845			95,430.50
211	45	do	42.50	1,912.50					

SALE OF 1,010 RAW SALTED SKINS TAKEN ON PRIBILOF ISLANDS

270	64	5 extra extra large, 59 extra large	$9.00	$576.00	281	33	Medium	$9.50	$313.50
271	70	Extra large	10.00	700.00	282	54	Small	7.50	405.00
272	80	Large	6.25	500.00	283	11	Extra large; low and faulty	1.75	19.25
273	80	do	6.50	520.00	284	31	Large; low and faulty	3.00	93.00
274	80	do	6.75	540.00	285	20	Medium; low and faulty	3.00	60.00
275	80	do	7.75	620.00	286	8	Small; low and faulty	1.25	10.00
276	80	do	8.75	700.00					
277	49	do	8.75	428.75					
278	90	Medium	8.75	787.50					
279	90	do	9.25	832.50					
280	90	do	9.75	877.50		1,010			7,983.00

SALE OF 17 MISCELLANEOUS SKINS TAKEN ON PRIBILOF ISLANDS

165	2	Raw salted	$0.50	$1.00	168	1	Dyed	$1.25	$1.25
166	7	Washed and dried	.60	4.20					
167	7	Dressed	1.60	11.20		17			17.65

SALE OF 4 CONFISCATED SKINS

169	1	Large; dressed, dyed, machined, and finished	$11.00	$11.00	169B	1	Raw salted	$0.50	$0.50
169A	2	Black pups; dressed only	2.50	5.00		4			16.50

Private sales of Pribilof sealskins at St. Louis, Mo., in 1924

Date	Number of skins	Description	Price per skin	Total	Date	Number of skins	Description	Price per skin	Total
Nov. 1	24	Chataigne d'Or, large	$63.78	$1,530.72	Dec. 24	45	Chataigne d'Or, small medium	$44.00	$1,980.00
Do	133	Chataigne d'Or, medium	56.76	7,549.08	Do	13	Black dyed, 1922 take	25.93	337.09
Do	38	Chataigne d'Or, small medium	43.71	1,660.98	Do	4	Black dyed, 1921 take	21.13	84.52
Dec. 24	30	Chataigne d'Or, small medium; scarred, blemished, etc	36.00	1,080.00		287			14,222.39

Comparative values, by sizes and grades, with percentages each size, of Pribilof sealskins sold at public auction in 1924

Classes and sales	Grade	Number	High	Low	Average	Total	Total number	Average price	Total price	Percentage
BLACK DYED										
Wigs:										
Mar. 24	I and II	7	$47.00	$39.50	$44.86	$314.00	9	$39.38	$356.25	0.04
	Scarred, blemished, etc.	1	25.00	25.00	25.00	25.00				
	III	1	17.25	17.25	17.25	17.25				
Extra extra large:										
Mar. 24	I and II	298	58.00	39.50	50.83	15,146.00	342	47.62	16,286.50	1.73
	Scarred, blemished, etc.	44	34.50	25.00	25.92	1,140.50				
Oct. 15	I and II	12	56.00	56.00	56.00	672.00	12	56.00	672.00	.09
Extra large:										
Mar. 24	I and II	2,284	45.50	30.00	39.50	90,219.00	3,040	35.34	107,445.50	15.35
	Scarred, blemished, etc.	752	34.50	17.50	22.82	17,157.50				
	III	4	17.25	17.25	17.25	69.00				
Oct. 15	I and II	199	56.00	50.50	52.99	10,546.00	228	50.15	11,434.00	1.61
	Scarred, blemished, etc.	27	32.00	32.00	32.00	864.00				
	III	2	12.00	12.00	12.00	24.00				
Large:										
Mar. 24	I and II	6,207	32.50	22.50	28.26	175,385.50	8,118	25.92	210,445.25	40.99
	Scarred, blemished, etc.	1,844	22.50	16.50	18.58	34,255.00				
	III	67	17.25	10.50	12.01	804.75				
Oct. 15	I and II	1,723	40.00	34.50	37.25	64,540.00	2,056	35.54	73,076.00	14.54
	Scarred, blemished, etc.	324	27.00	25.50	26.01	8,428.00				
	III	9	12.00	12.00	12.00	108.00				
Medium:										
Mar. 24	I and II	5,573	26.50	20.00	23.25	129,554.50	6,885	22.16	152,585.50	34.77
	Scarred, blemished, etc.	1,223	20.50	15.00	18.00	22,009.00				
	III	89	13.25	9.00	11.48	1,022.00				
Oct. 15	I and II	5,662	28.75	25.00	27.23	154,189.50	7,245	25.31	183,363.25	51.25
	Scarred, blemished, etc.	1,495	21.00	16.75	18.78	28,068.75				
	III	88	13.00	12.00	44.20	1,105.00				
Small medium:										
Mar. 24	I and II	987	23.50	21.00	21.46	21,176.50	1,410	19.43	27,393.50	7.12
	Scarred, blemished, etc.	384	17.00	13.50	15.13	5,811.00				
	III	39	11.50	9.00	10.41	406.00				
Oct. 15	I and II	3,141	25.00	23.00	24.04	75,516.75	4,595	21.43	98,470.75	32.51
	Scarred, blemished, etc.	1,330	17.50	15.50	16.35	21,745.00				
	III	124	10.00	9.50	9.75	1,209.00				
All classes:										
Mar. 24							19,804	25.98	514,512.50	100.00
Oct. 15							14,136	25.96	367,016.00	100.00
BROWN DYED										
Extra large:										
Oct. 15	I and II	18	56.00	56.00	56.00	1,008.00	18	56.00	1,008.00	.98
Large:										
Oct. 15	I and II	216	68.00	55.00	63.78	13,777.00	244	62.07	15,145.00	13.22
	Scarred, blemished, etc.	28	53.00	40.00	48.86	1,368.00				
Medium:										
Oct. 15	I and II	805	67.00	53.00	56.76	45,694.50	977	55.06	53,790.00	52.95
	Scarred, blemished, etc.	168	53.00	40.00	47.47	7,975.50				
	III	4	30.00	30.00	30.00	120.00				
Small medium:										
Oct. 15	I and II	460	55.00	40.00	43.71	20,108.00	606	42.06	25,487.50	32.85
	Scarred, blemished, etc.	140	42.50	34.00	37.14	5,199.50				
	III	6	30.00	30.00	30.00	180.00				
All classes							1,845	51.72	95,430.50	100.00

Comparative values, by sizes and grades, with percentages each size, of Pribilof sealskins sold at public auction in 1924—Continued

Classes and sales	Grade	Number	High	Low	Average	Total	Total number	Average price	Total price	Percentage
RAW SALTED										
Extra extra large: Oct. 15	I and II	5	$9.00	$9.00	$9.00	$45.00	5	$9.00	$45.00	.50
Extra large: Oct. 15	I and II	129	10.00	9.00	9.54	1,231.00	140	8.93	1,250.25	13.86
	Low and faulty	11	1.75	1.75	1.75	19.25				
Large: Oct. 15	I and II	449	8.75	6.25	7.37	3,308.75	480	7.09	3,401.75	47.52
	Low and faulty	31	3.00	3.00	3.00	93.00				
Medium: Oct. 15	I and II	303	9.75	8.75	9.28	2,811.00	323	8.89	2,871.00	31.98
	Low and faulty	20	3.00	3.00	3.00	60.00				
Small: Oct. 15	I and II	54	7.50	7.50	7.50	405.00	62	6.69	415.00	6.14
	Low and faulty	8	1.25	1.25	1.25	10.00				
All classes							1,010	7.90	7,983.00	100.00
MISCELLANEOUS	*Description*									
Mar. 24	Washed and dried.	11	.50	.50	.50	5.50	11	.50	5.50	100.00
Oct. 15	Raw salted	2	.50	.50	.50	1.00	17	1.04	17.65	100.00
	Washed and dried.	7	.60	.60	.60	4.20				
	Dressed	7	1.60	1.60	1.60	11.20				
	Dyed	1	1.25	1.25	1.25	1.25				
Total miscellaneous:										
Mar. 24							11	.50	5.50	100.00
Oct. 15							17	1.04	17.65	100.00

DISPOSITION OF FUR-SEAL SKINS TAKEN AT PRIBILOF ISLANDS

The grand total of all fur-seal skins taken at the Pribilof Islands on hand on January 1, 1924, was 49,912. Of these 1,881 were at the Pribilof Islands, 48,024 were at St. Louis, and 7 at Washington. In 1924 a total of 17,219 was secured at the islands and 37,110 were sold, leaving a balance on hand on December 31, 1924, of 30,021. The 30,021 sealskins taken on the Pribilof Islands on hand on December 31, 1924, comprised 387 at the islands, 29,625 at St. Louis, and 9 at Washington. The following two tables show further details in regard to Pribilof Islands sealskins at those islands and at St. Louis as well as details in regard to other Government-owned sealskins at St. Louis.

Summary of all fur-seal skins handled on Pribilof Islands, calendar year 1924

Island	Balance on hand Jan. 1	Number taken	Total handled	Number shipped	Balance on hand Dec. 31
St. Paul	1,121	13,453	14,574	14,323	251
St. George	760	3,766	4,526	4,390	136
Total	1,881	17,219	19,100	18,713	[1] 387

[1] All taken in calendar year 1924.

Summary of United States Government-owned fur-seal skins in custody of Fouke Fur Co., St. Louis, Mo., calendar year 1924

Description	On hand Jan. 1	Receipts in 1924	Disposed of in 1924	On hand Dec. 31
Taken on Pribilof Islands:				
Calendar year 1920	1		[1] 1	
Calendar year 1921	4,861		[1] 4,861	
Calendar year 1922	29,123		[1] 29,123	
Calendar year 1923	14,039	1,881	[2] 3,127	12,793
Calendar year 1924		16,832		16,832
Skins from Pribilof seals shipped Steinhart Aquarium	3	4	[1] 3	4
United States share of Japanese sealskins:				
Season of 1922	33		[1] 33	
Season of 1923		82		82
Confiscated skins	37	10	[3] 47	
Total	48,097	18,809	37,195	29,711

[1] Sold.
[2] 3,125 sold, 2 delivered to Bureau of Fisheries.
[3] 39 sold, 8 destroyed as worthless.

FOX SKINS

SHIPMENT AND SALE

The 46 blue and 14 white fox skins taken on St. Paul Island in the season of 1923–24 were placed aboard the U. S. S. *Gold Star* for shipment on June 5, and 741 blue and 1 white fox skins from St. George Island, taken in the same season, were shipped on the same vessel on June 11. These 802 skins were delivered at Bremerton, Wash., on July 28, 1924, and were forwarded from that place by American Railway Express to St. Louis, Mo., where they were received August 2.

The skins were sold by the Fouke Fur Co. at public auction at St. Louis on October 15, 1924. The 787 blue skins sold for $49,755.50, an average of $63.22 per skin, the maximum price obtained for a single skin being $130. The 15 white skins sold for $630, an average of $42 per skin. The average prices received at the last preceding sale (October 8, 1923) for similar skins were $102.91 for the blue and $46 for the white.

Sale of 787 blue and 15 white fox skins at St. Louis, Mo., October 15, 1924

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
		BLUE FOX SKINS		
305	1	Extra extra fine	$130.00	$130.00
306	4	Fine dark	120.00	480.00
307	6	do	92.00	552.00
308	8	I and II blue	81.00	648.00
309	6	II	60.00	360.00
310	8	Fine	119.00	952.00
311	7	I and II dark	76.50	535.50
312	6	I and II	76.00	456.00
313	4	Extra extra fine	101.00	404.00
314	4	Extra fine, extra large	98.00	392.00
315	4	Extra fine	95.00	380.00
316	6	Fine dark	75.00	450.00
317	6	Extra dark	83.00	498.00
318	8	I dark, extra large	65.00	520.00
319	10	I dark	96.00	960.00
320	10	do	73.00	730.00
321	10	II dark, extra large	63.00	630.00
322	12	II dark	52.00	624.00
		BLUE FOX SKINS—Continued		
323	14	II dark	$56.00	$784.00
324	10	I blue	75.00	750.00
325	16	II blue	45.00	720.00
326	16	II low	36.00	576.00
327	12	I and II	50.00	600.00
328	4	Extra extra fine	112.00	448.00
329	4	Extra fine, extra large	83.00	332.00
330	4	Extra fine	81.00	324.00
331	6	Fine dark	78.00	468.00
332	6	Fine silvery	121.00	726.00
333	8	I dark, extra large	74.00	592.00
334	10	I dark	91.00	910.00
335	12	do	71.00	852.00
336	12	II dark, extra large	51.00	612.00
337	14	II dark	58.00	812.00
338	14	do	62.00	868.00
339	12	I blue	68.00	816.00

Sale of 787 blue and 15 white fox skins at St. Louis, Mo., October 15, 1924—Con.

Lot No.	Number of skins	Trade classification	Price per skin	Total for lot
		BLUE FOX SKINS—Continued		
340	16	II blue	$46.00	$736.00
341	18	II low	29.00	522.00
342	18	III	19.00	342.00
343	12	I	53.00	636.00
344	14	II	30.00	420.00
345	4	Extra extra fine	115.00	460.00
346	4	Extra fine, extra large	92.00	368.00
347	6	Extra fine	114.00	684.00
348	6	Fine dark	91.00	546.00
349	7	I dark silvery	106.00	742.00
350	8	I dark, extra large	83.00	664.00
351	12	I dark	71.00	852.00
352	12	do	70.00	840.00
353	14	do	78.00	1,092.00
354	14	II dark	56.00	784.00
355	16	do	50.00	800.00
356	8	I blue	71.00	568.00
357	16	II blue	45.00	720.00
358	18	II low	23.00	414.00
359	20	III and IV	6.00	120.00
360	4	Extra extra fine	110.00	440.00
361	6	Extra fine	87.00	522.00
362	4	Fine	110.00	440.00
363	6	Fine dark	87.00	522.00
364	10	Silvery	77.00	770.00
365	6	I dark, extra large	72.00	432.00
366	10	I dark	55.00	550.00
		BLUE FOX SKINS—Continued		
367	10	I dark	$53.00	$530.00
368	12	do	72.00	864.00
369	14	II dark	64.00	896.00
370	16	do	46.00	736.00
371	10	I blue	62.00	620.00
372	18	II blue	42.00	756.00
373	8	II low	30.00	240.00
374	4	Extra extra fine	121.00	484.00
375	4	Extra fine	115.00	460.00
376	10	I dark	86.00	860.00
377	12	do	67.00	804.00
378	16	II dark	45.00	720.00
379	10	I blue	79.00	790.00
380	4	Extra extra fine	125.00	500.00
381	4	Extra fine	98.00	392.00
382	10	I dark	72.00	720.00
383	10	do	88.00	880.00
384	14	II dark	66.00	924.00
385	4	I and II	36.00	144.00
386	6	II	49.00	294.00
387	8	Skins	33.00	264.00
	787			49,755.50
		WHITE FOX SKINS		
388	15	I and II, white fox	42.00	630.00
	802			50,385.50

FUR-SEAL PATROL

A patrol for the protection of the American fur-seal herd on its annual migration to the Pribilof Islands was carried on by seven vessels of the United States Coast Guard in the spring of 1924. The waters covered extended from California along the coasts of Oregon, Washington, British Columbia, southeastern Alaska, and across the Gulf of Alaska. Particular attention was given to the region of the Aleutian Islands and Bering Sea, three of the cutters remaining in those waters until the close of the sealing season.

An Executive order of April 11, 1924, directed a special patrol by vessels of the Bureau of Fisheries in Alaskan waters for the protection of the American fur-seal herd, and authorized the search and seizure of any vessels of the United States suspected of engaging in illegal sealing. Under the general direction of Warden M. J. O'Connor the *Murre* and *Petrel* maintained a patrol during April and May in the vicinity of Sitka, where the Indians usually carry on pelagic sealing. On account of the stormy weather that prevailed during the migration, and also the low price offered for sealskins, practically no sealing was done, only eight skins being secured.

One fur-seal skin taken on halibut gear was turned over to a representative of the bureau at Sitka by the master of the halibut schooner *Brothers*. The commander of the Coast Guard patrol force reported the seizure at Unalaska on May 14 of the gas boat *Halleys* with four sealskins and one sea-otter skin on board.

Canadian authorities have advised that 34 fur-seal skins were confiscated at Prince Rupert for which satisfactory evidence was not produced as to their having been lawfully taken. These were considered as of the 1924 take.

SEALING PRIVILEGES ACCORDED ABORIGINES

A total of 1,037 fur-seal skins were authenticated as having been lawfully taken in 1924 by Indians in the waters off the coasts of Washington and southeast Alaska. The details are as follows:

Washington.—One thousand and twenty-nine skins were authenticated, of which 606 were from male seals and 423 from females. A part of the skins were taken from unborn pups. The skins were authenticated by Dr. Carl B. Boyd, superintendent Neah Bay Indian Agency, Neah Bay, Wash.

Southeast Alaska.—Eight skins were authenticated, all of which were from male seals. This small take, in comparison with takes of previous years, was attributed in part to weather conditions unfavorable to sealing operations.

An official report received by the bureau stated that 2,248 sealskins were taken by the natives of British Columbia in 1924.

JAPANESE SEALSKINS DELIVERED TO THE UNITED STATES

The North Pacific Sealing Convention of July 7, 1911, provides that 10 per cent of the sealskins taken by the Japanese Government within the areas defined by the convention shall be turned over to the United States Government, unless the number of seals frequenting the Japanese islands falls below 6,500, enumerated by official count.

The first Japanese skins to be allotted to the United States were taken in 1918, and additional skins have accrued to the United States from the take of each year since. These skins are sold at public auction for the account of the United States, and details in regard to them have been published in the corresponding reports for previous years.

At the beginning of the year 1924 there remained on hand 33 skins taken in 1922. These were sold at public auction in New York City on March 24, 1924.

The United States Government's share of Japanese sealskins taken in 1923 was 82 skins, which reached St. Louis, Mo., on September 15, 1924, and remained unsold at the end of the year. The share of those taken in 1924 was 94 skins, but these had not been received in the United States at the end of the year.

SALE OF CONFISCATED SEA-OTTER SKINS

There were sold at public auction at St. Louis, Mo., on October 15, 1924, four sea-otter skins seized from J. W. McCord. The skins brought $1,020, or an average of $255 per skin. Details are shown in the following tabulation:

Sale of four sea-otter skins at St. Louis, Mo., October 15, 1924

Lot No.	Number of skins	Sale price	Lot No.	Number of skins	Sale price
389	1	$295	392	1	$155
390	1	270			
391	1	300		4	1,020

FUR-SEAL CENSUS, PRIBILOF ISLANDS, 1924

By Edward C. Johnston

In 1924 the annual count of fur-seal harems was made from July 15 to 17 on St. Paul Island and on July 22 and 23 on St. George Island, weather conditions preventing an earlier count. On St. George Island pups were actually counted on East Reef on July 28 and on Zapadni and South rookeries on July 29, and estimates were made of the pups present on all other rookeries. On St. Paul Island actual counts of pups were made as follows: Lagoon and Zapadni Reef rookeries on July 31, Polovina and Polovina Cliffs rookeries on August 1, and Morjovi rookery on August 2, while the pups on the remaining rookeries were estimated.

Superintendent Christoffers and Dr. H. L. Van Volkenberg aided in the pup count on St. Paul Island, and all possible assistance was given by Agent and Caretaker Hungerford. Storekeeper Culbertson participated in the count on St. George Island.

The taking of the seal census was made possible by the cooperation of the Coast Guard Service in transporting the enumerator from one island to the other. Three trips were made on the Coast Guard cutter *Mojave* and one on the cutter *Algonquin*.

PUPS

The pup count was made on the rookeries that were counted in the years 1917 to 1921, inclusive. These rookeries can be counted with greater accuracy than the others and are fairly representative of all the rookeries. The method for estimating the total number of pups has been to determine the average harem in which the pups have been counted and apply the figure obtained to the other rookeries, making allowance for considerable variation due to the character of the harem areas. The complete pup count of 1922 showed that the estimates based upon the above method were conservative.

The outstanding fact brought to light by the count was that pups had greatly increased on St. George Island and the rookeries on the southwest side of St. Paul Island, while on the north and east sides of St. Paul Island they had decreased. This may have been caused by the drift ice, which remained around St. Paul Island very late in the spring and compelled many seals to haul out as far south as possible on account of the low temperature of the water.

Distribution of pups on the Pribilof Islands, August 10, 1924, and comparison with distribution in 1923

Rookery	1924				1923	1924	
	Living	Dead	Total	Per cent dead pups	Total pups	Increase (+) or decrease (−)	Per cent increase (+) or decrease (−)
St. Paul Island:							
Kitovi	6,011	74	6,085	1.22	5,248	+837	+15.95
Lukanin	3,386	94	3,480	2.69	3,458	+22	+.64
Gorbatch	16,186	456	16,642	2.74	14,597	+2,045	+14.01
Ardiguen	1,344	20	1,364	1.44	1,049	+315	+30.03
Reef	29,601	759	30,360	2.50	26,508	+3,852	+14.53
Sivutch	9,910	112	10,022	1.12	8,603	+1,419	+16.49
Lagoon	175	3	[1] 178	1.69	263	−85	−32.32
Tolstoi	19,661	451	20,112	2.24	18,060	+2,052	+11.36
Zapadni	18,724	429	19,153	2.24	17,049	+2,104	+12.34
Little Zapadni	9,854	226	10,080	2.24	8,947	+1,133	+12.66
Zapadni Reef	412	13	[1] 425	3.06	316	+109	+34.49
Polovina	7,319	205	[1] 7,524	2.72	10,096	−2,572	−25.48
Polovina Cliffs	4,111	94	[1] 4,205	2.24	4,731	−526	−11.12
Little Polovina	1,739	22	1,761	1.23	2,029	−268	−13.21
Morjovi	3,156	69	[1] 3,225	2.14	3,971	−746	−18.79
Vostochni	36,585	1,327	37,912	3.50	44,438	−6,526	−14.69
Total	168,174	4,354	172,528	2.52	169,363	+3,165	+1.90
St. George Island:							
North	12,487	254	12,741	1.99	10,734	+2,007	+18.70
Staraya Artil	10,180	287	10,467	2.74	8,191	+2,276	+27.79
Zapadni	1,528	16	[1] 1,544	1.04	1,312	+232	+17.68
South	297		[1] 297		320	−23	−7.19
East Reef	2,493	32	[1] 2,525	1.27	1,938	+587	+30.29
East Cliffs	8,128	166	8,294	2.00	5,801	+2,493	+42.98
Total	35,113	755	35,868	2.10	28,296	+7,572	+26.76
Total (both islands)	203,287	5,109	208,396	2.45	197,659	+10,737	+5.43

[1] Actual count.

As shown in the above table, the pups on St. George Island increased 26.76 per cent while the number on St. Paul Island increased only 1.9 per cent. The rookeries on the north and east sides of St. Paul Island actually showed a decrease. The only rookery on St. George Island to show a decrease was South rookery, which had 23 pups less than was estimated for it in 1923. As the number of dead pups found during the count was approximately the same as in 1921, the same percentage was assigned to the other rookeries.

COWS

Since the number of cows, for census purposes, is the same as the total number of pups, the figures above will apply to the adult females. On St. George Island there were 35,868 cows and on St. Paul Island 172,528, a total of 208,396.

No cows bearing the single bar or brand across the back were seen in 1924. If any are alive the number is probably small. They were branded in 1902 and 1903.

Twelve dead cows were found on the rookeries where pups were counted. This is 0.06 per cent dead, and, applied to the whole herd, the number would be 125, or about the number normally found.

BULLS

The harem and idle bulls were counted on all rookeries except Sivutch, weather conditions preventing a count there. Sivutch rookery is situated on Sea Lion Rock, a short distance from St. Paul Island, and on a clear day the general condition of the rookery can be seen. There is no doubt but that it is increasing in the same proportion as the other rookeries.

As the bull count was made on the various rookeries shortly after killing drives had been made from the hauling grounds, the surplus bulls were not counted. In most cases they were driven in with the bachelors or driven into the water as a result of the drive. The idle bulls counted were those around the margin of the harem area actively watching for an opportunity to secure cows.

Harem and idle bulls and percentage of idle bulls to harem bulls compared to average harem, 1924

Rookery	Date	Harem bulls	Idle bulls	Total	Per cent idle to harem bulls	Average harem
St. Paul Island:						
Kitovi	July 15	135	27	162	20.00	45.08
Lukanin	do	82	3	85	3.66	42.44
Gorbatch	do	218	13	231	5.96	76.34
Ardiguen	do	32	2	34	6.24	42.62
Reef	do	429	59	488	13.75	70.77
Sivutch [1]		171	23	194	13.45	58.61
Lagoon	July 15	6		6		29.67
Tolstoi	do	308	30	338	9.74	65.30
Zapadni	July 16	297	33	330	11.11	64.49
Little Zapadni	do	162	12	174	7.41	62.22
Zapadni Reef	do	12	1	13	8.33	35.42
Polovina	do	172	63	235	36.63	43.74
Polovina Cliffs	do	102	9	111	8.82	41.23
Little Polovina	do	48	10	58	20.83	36.70
Morjovi	July 17	97	13	110	13.40	33.25
Vostochni	do	856	77	933	9.00	44.29
Total		3,127	375	3,502	11.99	55.17
St. George Island:						
North	July 22	127	2	129	1.57	100.32
Staraya Artil	do	98	5	103	5.10	106.81
Zapadni	July 23	29	1	30	3.45	53.24
South	do	9		9		33.00
East Reef	July 22	35	4	39	11.43	72.14
East Cliffs	do	91	3	94	3.30	91.14
Total		389	15	404	3.86	92.21
Total (both islands)		3,516	390	3,906	11.09	59.27

[1] Estimated.

AVERAGE HAREM

The number of harems on St. Paul Island increased from 3,051 in 1923 to 3,127 in 1924, and on St. George Island from 361 in 1923 to 389 in 1924. On Ardiguen rookery, St. Paul Island, there was an increase in harem bulls amounting to nearly 30 per cent. The idle bulls showed a corresponding increase. The total harems on the two islands was 3,516.

The percentage of idle to harem bulls on St. Paul Island was 9.93 in 1923 and 11.99 in 1924; on St. George Island it was 2.50 in 1923 and 3.86 in 1924. For both islands the percentage increased from

9.14 to 11.09. About 20 per cent idle to harem bulls would be the ratio to produce the best results.

Four dead bulls were seen during the harem count.

Average harems in 1923 and 1924 for all fur-seal rookeries on the Pribilof Islands

Rookery	Breeding cows in 1924	Harem bulls in 1924	Average harem 1924	Average harem 1923
St. Paul Island:				
Kitovi	6,085	135	45.08	41.32
Lukanin	3,480	82	42.44	40.68
Gorbatch	16,642	218	76.34	69.84
Ardiguen	1,364	32	42.62	45.59
Reef	30,360	429	70.77	66.27
Sivutch	10,022	171	58.61	54.11
Lagoon	178	6	29.67	37.54
Tolstoi	20,112	308	65.30	59.80
Zapadni	19,153	297	64.49	57.99
Little Zapadni	10,080	162	62.22	57.72
Zapadni Reef	425	12	35.42	31.59
Polovina	7,524	172	43.74	55.78
Polovina Cliffs	4,205	102	41.23	42.62
Little Polovina	1,761	48	36.70	39.02
Morjovi	3,225	97	33.25	41.80
Vostochni	37,912	856	44.29	52.84
Total	172,528	3,127	55.17	55.51
St. George Island:				
North	12,741	127	100.32	84.52
Staraya Artil	10,467	98	106.81	91.01
Zapadni	1,544	29	53.24	48.59
South	297	9	33.00	64.00
East Reef	2,525	35	72.14	55.36
East Cliffs	8,294	91	91.14	75.34
Total	35,868	389	92.21	78.38
Total (both islands)	208,396	3,516	59.27	57.93

The average harem on various rookeries shows a great variation in size. It ranges from 29.67 on Lagoon rookery to 106.81 on Staraya Artil. The largest average harem on rookeries where pups were counted was 72.14 on East Reef. On this rookery the average harem increased from 55.36 in 1923 to 72.14 in 1924, while Polovina rookery decreased from 55.78 in 1923 to 43.74 in 1924. The average harem on St. Paul Island dropped from 55.51 in 1923 to 55.17 in 1924, but that on St. George Island increased from 78.38 in 1923 to 92.21 in 1924. For the whole herd the average harem increased from 57.93 in 1923 to 59.27 in 1924.

COMPLETE CENSUS

The following shows in summarized form the method of arriving at the complete census for 1924 and gives a recapitulation of the herd. It will be noted that the increase in the total number of seals in 1924 over 1923 was 44,150, or 6.76 per cent. The increase in 1923 over 1922 was 48,046, or 7.94 per cent.

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Complete census of fur seals, Pribilof Islands, as of August 10, 1924

Class	St. Paul	St. George	Total
Pups, estimated	172,528	35,868	208,396
Breeding cows, 3 years old and over, by inference	172,528	35,868	208,396
Harem bulls, counted	3,127	389	3,516
Idle bulls, counted	375	15	390
Yearlings, male and female, estimated:			
Females born in 1923	84,682	14,148	98,830
Natural mortality, 35 per cent	29,639	4,951	34,590
Yearling females, Aug. 10, 1924	55,043	9,197	64,240
Males born in 1923	84,681	14,148	98,829
Natural mortality, 40 per cent	33,872	5,659	39,531
Yearling males beginning 1924	50,809	8,489	59,298
Yearling males killed 1924	7	0	7
Yearling males, Aug. 10, 1924	50,802	8,489	59,291
2-year-olds, male and female, estimated:			
Yearling females, Aug. 10, 1923	51,638	8,784	60,422
Natural mortality, 15 per cent	7,746	1,317	9,063
2-year-old females, Aug. 10, 1924	43,892	7,467	51,359
Yearling males, Aug. 10, 1923	47,661	8,108	55,769
Natural mortality, 17½ per cent	8,341	1,419	9,760
2-year-old males beginning 1924	39,320	6,689	46,009
2-year-old males killed 1924	309	15	324
2-year-old males, Aug. 10, 1924	39,011	6,674	45,685
3-year-old males, estimated:			
2-year-old males, Aug. 10, 1923	36,484	6,628	43,112
2-year-old males killed fall 1923	97	5	102
2-year-old males end of 1923	36,387	6,623	43,010
Natural mortality, 12½ per cent	4,548	828	5,376
3-year-old males beginning 1924	31,839	5,795	37,634
3-year-old males killed 1924	12,525	3,558	16,083
3-year-old males, Aug. 10, 1924	19,314	2,237	21,551
4-year-old males, estimated:			
3-year-old males, Aug. 10, 1923	19,845	2,941	22,786
3-year-old males killed fall 1923	1,009	752	1,761
3-year-old males end of 1923	18,836	2,189	21,025
Natural mortality, 10 per cent	1,884	219	2,103
4-year-old males beginning 1924	16,952	1,970	18,922
4-year-old males killed 1924	222	30	252
4-year-old males, Aug. 10, 1924	16,730	1,940	18,670
5-year-old males, estimated:			
4-year-old males, Aug. 10, 1923	5,342	368	5,710
4-year-old males killed fall 1923	7	0	7
4-year-old males end of 1923	5,335	368	5,703
Natural mortality, 10 per cent	533	37	570
5-year-olds beginning 1924	4,802	331	5,133
5-year-olds killed 1924	1	0	1
5-year-old males, Aug. 10, 1924	4,801	331	5,132
6-year-old males, estimated:			
5-year-old males, Aug. 10, 1923	9,850	762	10,612
5-year-old males killed fall 1923	0	0	0
5-year-old males end of 1923	9,850	762	10,612
Natural mortality, 20 per cent	1,970	152	2,122
6-year-old males beginning 1924	7,880	610	8,490
6-year-old males killed 1924	0	1	1
6-year-old males, Aug. 10, 1924	7,880	609	8,489

Complete census of fur seals, Pribilof Islands, as of August 10, 1924—Continued

Class	St. Paul	St. George	Total
Surplus bulls, 7 years old and over, estimated:			
6-year-old males, Aug. 10, 1923	4,603	260	4,863
6-year-old males killed fall 1923	0	0	0
6-year-old males end of 1923	4,603	260	4,863
Natural mortality, 20 per cent	921	52	973
7-year-old males beginning 1924	3,682	208	3,890
7-year-old males killed 1924	0	1	1
7-year-old males, Aug. 10, 1924	3,682	207	3,889
Surplus bulls, Aug. 10, 1923	1,606	285	1,891
Natural mortality, 30 per cent	482	85	567
Remaining surplus for 1924	1,124	200	1,324
Breeding bulls of 1923	3,051	361	3,412
Natural mortality, 30 per cent	915	108	1,023
1923 bulls remaining 1924	2,136	253	2,389
Breeding bulls, 1924	3,127	389	3,516
1923 bulls remaining, deducted	2,136	253	2,389
Increment of new bulls in 1924	991	136	1,127
7-year-old males computed for 1924	3,682	207	3,889
Surplus bulls computed for 1924	1,124	200	1,324
Total theoretical surplus bull stock, 1924	4,806	407	5,213
New increment of breeding bulls deducted	991	136	1,127
Surplus bulls in 1924	3,815	271	4,086
50 per cent deducted for losses due to fighting, natural causes, and errors in loss percentage in previous years	1,907	136	2,043
Surplus bulls, Aug. 10, 1924	1,908	135	2,043
Pups	172,528	35,868	208,396
Cows	172,528	35,868	208,396
Harem bulls	3,127	389	3,516
Idle bulls	375	15	390
Yearling females	55,043	9,197	64,240
Yearling males	50,802	8,489	59,291
2-year-old females	43,892	7,467	51,359
2-year-old males	39,011	6,674	45,685
3-year-old males	19,314	2,237	21,551
4-year-old males	16,730	1,940	18,670
5-year-old males	4,801	331	5,132
6-year-old males	7,880	609	8,489
Surplus bulls	1,908	135	2,043
Total, 1924	587,939	109,219	697,158
Total, 1923			653,008
Numerical increase, 1924			44,150
Per cent increase, 1924			6.76

EFFECT OF OIL POLLUTION ON MARINE AND WILD LIFE[1]

By

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CONTENTS

INTRODUCTION

During the latter part of 1922 and the early part of 1923 the Bureau of Mines, then in the Department of the Interior, in cooperation with the American Petroleum Institute and the American Steamship Owners Association, conducted an investigation of the pollution by oil of the coastal waters of the United States. Although the investigation was essentially of a technical character, so many complaints and reports were received relative to the deleterious effect of oil pollution on marine and wild life that it became necessary to devote particular attention to this phase of the subject. With the aid of specialists in that line of endeavor the authors have attempted to summarize the situation with respect to the effect of oil pollution on marine and wild life.

The authors wish to acknowledge their indebtedness to the officials of the organizations that cooperated in the investigation as a whole, to the Bureau of Fisheries, and in particular to Dr. H. F. Moore, formerly Deputy Commissioner of Fisheries. They are also indebted to Dr. Thurlow C. Nelson, of Rutgers College, New Brunswick, N. J., and to Dr. David L. Belding, biologist in the department of conservation of the State of Massachusetts. Appreciation is also expressed to other Government departments that aided in the preparation of this phase of the subject.

[1] Appendix V to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. No. 995. Published by permission of the Director of the Bureau of Mines, Department of Commerce.

Attention is called to the fact that this paper deals only with oil pollution as it occurs on the Atlantic and Gulf coasts. No attempt has been made to deal with other forms of pollution or to investigate effects of oil contamination in inland waters.

GENERAL DISCUSSION

The effect of oil pollution on marine and wild life has received much attention, due to numerous and widespread reports that the fishing industry, particularly the oyster industry, has been adversely affected, and that large numbers of wild fowl have been killed as a result of oil pollution. In the course of the present investigation the authors endeavored to secure additional information on the subject by means of interviews, inspections, and correspondence.

ECONOMIC IMPORTANCE OF COASTAL AQUATIC LIFE

The total value to the fishermen of the fishery products of the United States approximates $90,000,000 annually. The oyster industry alone produces over $14,000,000 worth of food every year, estimated to be the equivalent in food value of 254,000 dressed steers. The most important aspect of the situation, however, lies in the vital importance of aquatic life as a source of food and the possible effect which oil pollution may have upon this source. It is stated that the nitrates and other salts essential for plant growth, which are produced in the decomposition of sewage, and those which are brought to the streams by the leaching action of ground water ultimately pass out to sea and are lost unless utilized in coastal waters as a factor in the growth of marine plants and animals.

EFFECT OF OIL POLLUTION IN DRIVING FISH FROM DOMESTIC WATERS

It has been asserted that practically all of our badly polluted waters, where no signs of fish are now to be found, were good fishing waters before the development of present-day congested manufacturing and shipping conditions. The increasing use of oil fuel is said to be largely responsible for the marked decline of the fisheries in many localities. As indicating that the reduction and control of pollution will be followed by a return of former fishing activities, it has been stated that during the great depression in industrial activities some two or three years ago the closing of entire industrial communities was accompanied by a reduction in pollution of the streams, and consequently fish were again found in quantity in many of their former habitats.

TOXIC PROPERTIES OF OILY DISCHARGES

Experiments made by the Massachusetts department of conservation on the effect of industrial wastes on fish life indicated that a mixture of 1 part crude petroleum to 1,000 parts of water did not immediately affect brook trout.[2] On the other hand, tarry matter

[2] Pub. Doc. No. 25, Commonwealth of Massachusetts, Annual Report of the Division of Fisheries and Game for the Year Ended Nov. 30, 1922.

from gas wastes with a concentration of 1 part in 400,000 killed yellow perch in 12 days.[3] It may be pointed out that the chemical nature of this tarry matter probably differs from the waste oil from oil-burning steamers.

There is considerable difference of opinion among investigators regarding the toxic effect of oily discharges. One states[4] that the amounts of petroleum and certain other oils that are sufficient to cause any deleterious effects upon oysters, other than oyster larvae, are surprisingly large. On the other hand, Dr. Thurlow C. Nelson, an authority on the culture of oysters, maintains that oil, gallon for gallon as thrown out, is the most destructive to aquatic life of all foreign substances now entering our coastal waters.[5]

EFFECTS OF OIL ON FISH, SHELLFISH, AND FOWL

Fish, shellfish, and fowl are affected quite differently by oil. So far as the fish are concerned, pollution by oil not only imparts an obnoxious taste, unfitting them for the market, but the gear used in the fishing industry is befouled and injured. One investigator doubts that there is any real proof that oil directly destroys adult fish. He states that the effect of oil on fish may be twofold[4]—(1) the direct effect on the fish themselves and (2) the indirect effect as shown by changes in environment, food, and migratory habits. He suggests that with regard to migratory fish the presence of oil may deflect them from the coastal waters, and thus affect both the spawning and the fishing industry. As just pointed out, the indirect effect is believed to be brought about largely through the changes that take place in their environment affecting spawning grounds, food, and migratory habits. Unsuitable environment, such as would result from oil waste, may be the direct cause of driving these fish to other waters; or the same effect may be produced indirectly because the smaller fish and the aquatic organisms that serve as their food supply have either been destroyed or driven away.

In connection with the direct effect on fish, the authors desire to state that at least in one instance fish were found struggling in an inclosed body of water badly polluted with oil, apparently suffocating and unable to right themselves and swim away. The harbor master at Bridgeport, Conn., has seen bluefish and mackerel dead in large numbers on the inner side of the inner breakwater, and he can account for this only by the fish coming in contact with the polluted river waters. He stated that boats coming into Bridgeport with large numbers of live cod on board now close the tank holes before entering the harbor. Ordinarily the holes would be left open to insure a free circulation of water for the fish. It was found, however, that when Bridgeport harbor was entered with these holes open over two-thirds of the cod died. It is probable, however, that other industrial wastes besides oil are responsible for much of the damage done.

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[3] Marsh, United States Geological Survey, Water Supply Papers 186–192, 1907, p. 337.
[4] Personal communication to the authors.
[5] Personal communication to the authors. Doctor Nelson's more complete statement is given later in this paper.

The effect of oil wastes on shellfish can be more accurately described.[4] During the first part of its existence, before it sets, the young mollusk is a free-swimming larva in the water. During this stage it is especially susceptible to the slightest change in environment. The presence of oil waste would cause the destruction of these larval forms, which swim immediately beneath the water surface. He believes that oil would kill adult shellfish only when present in considerable amounts. He explained that the process of setting of oysters may be prevented by any slimy material, and the presence of oil would undoubtedly have a deleterious effect in this respect.

Tests have shown that adult oysters can be placed in an appreciable amount of water-gas tar without immediately perishing. Apparently no actual deaths of mollusks from oil wastes have been noted by the Massachusetts division of fish and game, but clams have been rendered unpalatable and unfit for food where oil has contaminated the flats.

The destructive action of oil pollution on fowl was officially reported in California in 1917 and along the eastern coast in 1920 and 1921. It is stated that the birds, either in walking on the flats or resting on the oil-covered water of tide pools, come in direct contact with the material, which tenaciously sticks to their legs, wings, and on the sides of their bodies. As the bird endeavors to remove this material, its neck, head, and beak become more or less contaminated with it. The feathers are matted together, and it is stated that when this occurs with the wings the birds become helpless. Apparently they find it impossible to fly, or at least to fly in the normal manner, and they can only walk or roll over the flats. The oil not only causes matting of the feathers, but is reported to penetrate to the skin, causing irritation. It is said that a bird thus disabled will inevitably perish. Death is stated to be due to the inability to (1) navigate normally, (2) obtain food, and (3) maintain their normal body temperature.

The vice president of the American Game Protective and Propagation Association of New York stated that if birds get only a small spot of oil on them death seems to be just as certain though it comes slowly. He has seen many ducks dead with only a small spot of oil on them, and other birds that had only a small patch of feathers matted with oil.

PRESENT STATUS OF OIL POLLUTION

It would appear, therefore, that oil pollution has considerable effect upon the edible qualities of aquatic animals and may affect the migratory habits of fish; it is detrimental to shellfish by reason of destroying the larval forms and rendering the adult mollusks unfit for food. With regard to water fowl, it appears to be a cause of considerable destruction, rendering the birds helpless through its mechanical action on the feathers. It has been stated that when birds are not actually killed as a result of contact with the oil they are rendered unfit for food due to the oil taint.

A survey of the situation along the Atlantic and Gulf coasts indicates that adverse conditions due to oil pollution, as affecting marine and wild life, were widespread, practically every important

[4] Personal communication to the authors.

coastal water being affected to some extent. Conditions, in general, were at their worst during and immediately following the war, when pollution was undoubtedly at its height. The authors are led to believe that, on the whole, conditions during 1922 were somewhat better than in the preceding year.

While it is possible that considerable destruction of wild bird life may be chargeable to pollution of waters by heavy oil and tarlike deposits, the authors are of the belief that oil pollution is only partly responsible for the losses in the fish and shellfish industries. In the waters adjacent to the important industrial centers it is believed that these losses will be found to be due as much to other industrial wastes as to oil.

OIL POLLUTION AND CONSERVATION OF FOOD RESOURCES

An excellent picture of the effect of pollution on all forms of aquatic life in coastal waters is contained in a paper [6] by Dr. Thurlow C. Nelson, of Rutgers College, New Brunswick, N. J., read before the laboratory section of the American Public Health Association at San Franscisco, Calif., on September 13, 1920.

Doctor Nelson states that the effects of human wastes and of trade effluents upon a body of water are entirely different. Domestic sewage usually contains little or nothing that is toxic to aquatic organisms. Putrefactive and other bacteria, aided by a host of animal forms, decompose the sewage and render it available as plant food. The resulting stimulation of plant growth is followed by an increase in numbers and often in size of the animals that feed upon them. Shellfish growing in waters contaminated with human wastes are therefore usually very fat, owing to the presence of great numbers of food organisms which in turn are deriving their nutriment from the products of decomposition of the sewage.

The wastes from factories and manufacturing plants of all kinds present an entirely different problem. Here we are dealing with effluents which, in general, are highly toxic to aquatic organisms. For convenience these wastes may be divided into four classes: (1) Acid or alkaline, (2) oil and oil waste, (3) various chemical substances in solution, and (4) precipitates held in suspension. Doctor Nelson goes on to point out that oil, by spreading a film over the surface of the water or by coating animals and plants with an impenetrable layer, ultimately kills them, either by direct contact or by preventing free interchange of oxygen and carbon dioxide. It is stated that a film of oil on the surface of the water will kill molluscan larvæ within a few hours, owing largely to the habit of these organisms of swimming close to the surface. In the opinion of this writer the disposal of industrial wastes in such a way as to render the effluents harmless when emptied into a stream and still not impose an undue tax upon the industries concerned is a problem that will require the best efforts of chemists and engineers for years to come.

REPORTS ON OIL POLLUTION FROM VARIOUS SOURCES

During the course of this investigation, which was conducted along the coast from Boston, Mass., to Galveston, Tex., the authors held a large number of interviews and received many communications.

[6] "Some aspects of pollution as affecting oyster propagation."

Only a very brief account of the more important of these is given herein.

The Bureau of Fisheries wrote to the Director of the Bureau of Mines as follows:

> * * *. It is the opinion of the bureau that oil pollutions are detrimental to the coastal fisheries, not only from their destructive and repellant effects on fishes and economic invertebrates but in affecting the products of the fisheries with obnoxious tastes, unfitting them for the market, and in fouling and injuring the gear used in the fishing industry.

A biologist of the division of fish and game, Massachusetts State department of conservation, expressed the opinion that oil will kill adult shellfish only when it is present in considerable amounts. On the other hand, the young larvæ would probably be killed by any appreciable quantities of oil. He explained that the process of setting of oysters may be prevented by any slimy material, and oil would undoubtedly have a deleterious effect in this respect. This authority referred to some experimental work on the discharge of wastes from certain gas works into waters at Providence, R. I. The results of this work seem to indicate that under certain conditions shellfish stand a surprising amount of this type of pollution without injury to themselves.

At Providence, R. I., the investigators were told by oystermen that the effect of oil pollution on oysters in that locality is very pronounced. It is questionable just how far the oysters, growing at a considerable distance below the surface of the water, are affected by oil on the surface. In this connection the authors' attention was called to the case against a local petroleum company about three years ago. At the trial a well-known authority presented evidence to show the deleterious effect of oil on oysters, but the defendant had one of the piles pulled up in one of the badly polluted locations and oysters were found growing on the lower portion of it.

At Bridgeport, Conn., officials of an oyster company informed the authors that the last general oyster set in Long Island Sound was in 1914, so that there may be some connection between the disappearance of the oysters in this locality and the introduction of oil as fuel. One of these officials was of the opinion that just as much damage is done by wastes from chemical and other industrial plants as by oil.

A former Connecticut State inspector of oyster beds pointed out that conditions in the waters in the neighborhood of Bridgeport, Conn., are very bad. He believes, however, that these conditions are due as much to sewage and other industrial wastes as to oil. He pointed out that oysters can not be matured in the neighborhood of Bridgeport and therefore the locality is now used merely as a planting ground or seeding area, and when the oysters are partially grown they are transplanted to other localities.

The harbor master at Bridgeport has seen bluefish and mackerel dead in large numbers on the inner side of the inner breakwater, and he can account for this only by the fish coming in contact with the polluted river water.

The manager of an oyster-farm company in Milford, Conn., wrote the authors as follows:

> We are not affected as much by oil pollution as we are by the combined wastes from factories, municipalities, and oils.

He goes on to state that his immediate vicinity has the average number of wild fowl found in emaciated condition and sometimes dead with their feathers saturated with heavy oils. His observations regarding the effects of oil on fish and shellfish coincide closely with the views already given on this subject.

The supervisor of New York Harbor, who has direct administration of the laws relative to the throwing of waste material into the harbor, informed the authors that he had reports that certain fish were now caught in the harbor for the first time in four years.

One investigator writes as follows:[4]

> * * *. I made some rather extended investigations relative to this matter, but my work was all directed to the study of the effect of certain oils upon shellfish, chiefly oysters.
>
> My results can be summarized briefly by saying that the amounts of petroleum and certain other oils that are sufficient to cause any deleterious effects upon oysters, other than oyster larvæ, are suprisingly large. These amounts are far in excess of any quantities that could possibly be held in sand or mud on the bottoms of rivers or bays.

According to a report prepared for the authors by E. F. Moran, of New York, fishing in the harbor and adjacent waters had become insignificant by 1921; while an officer of Coast Guard station No. 92 (Rockaway Beach, Long Island), reported that ducks and birds are made helpless when in oil. He had had personal experience with wild fowl unable to fly on account of oil-covered feathers. The vice president of the American Game Protective and Propagation Association, New York, has seen many wild ducks that have come in contact with floating oil, both along the seaboard and in the interior. In his opinion this menace to wild water fowl kills thousands of ducks every year. Once the feathers of the bird become coated with oil he is doomed, due to loss of the power of flight and consequent inability to obtain food.

The commissioner of fisheries of the Commonwealth of Pennsylvania wrote as follows:

> * * *. This department is very much interested in the subject of oil pollution, not only of navigable waters but of inland waters as well, and our surveys show that in the oil-producing regions very much harm has been done by the wastes from the wells and refineries. This waste not only causes a thin film of oil to float on the surface of the streams, which, of course, is death to the tiny fishes, but it also creates a condition on the bottom of the stream that is detrimental and destructive so far as the natural propagation of the fish is concerned.
>
> The surveys made by this department along the Delaware River in the tidal section lead us to believe that the oil and sludge from refineries and oil-carrying vessels has done more to destroy fishing in that portion of the river than has any other single cause. It has become so serious during the last few years that this department has been unable to collect any of the spawn of the shad, whereas in former years, before we had this to contend with, we were able to collect anywhere from 25,000,000 to 75,000,000 eggs during a season, and shad fishing was worth while.

The president of the New Jersey State fish and game commission stated that he was not in a position to furnish authentic data regarding the condition that existed on the New Jersey coast. He has been more concerned with the pollution of inland streams, which affects the planting of fish by his department. He did state, however, that due to industrial and oil pollution from ships the Hacken-

[4] Personal communication to the authors.

sack and Passaic Rivers and Newark Bay are in such condition that absolutely no fish life of any kind is in them at the present time, whereas 20 years ago these waters were the habitat of all species of edible fish that were native to this coast.

The director of the department of conservation and development of New Jersey stated that while his department has a general knowledge of existing oil pollution in some of the waters bordering the State it has no specific information that would be of value to the present investigation.

Dr. Thurlow C. Nelson, an authority on the culture of oysters, has submitted to the authors a very complete statement. The following is taken from Doctor Nelson's letter:

* * *. The following observations include only those in which it is definitely known that no foreign substances other than oil were present:

1. Oil is, gallon for gallon as thrown out, the most destructive to aquatic life of all the foreign substances now entering our coastal waters. By reason of its physical nature the factor of dilution, which is so important in reducing the harmful effects of other foreign substances, is largely eliminated. Whereas most wastes other than oil are quite uniformly distributed throughout the water, oil is concentrated at two points—on the surface film and at the bottom. Its passage from the surface to the bottom, difficult of comprehension by the layman, is relatively rapid and is accomplished by absorption on the surface of the particles of dirt, sand, and detritus present in the water. Large amounts of suspended matter are stirred up by winds and currents, and these sink during periods of calm and slack tidal water, carrying down to the bottom a load of oil.

Biologically, the surface and the bottom of our coastal waters are the regions of greatest activity. At the surface free interchange of oxygen and of other gases occurs, and here, at some time in their development are found the eggs or larval stages, or both, of many of the common fish, shellfish, and the plant and animal organisms upon which the young and adults feed. Oil, though it be present in only the thinnest film, is thus brought into contact with the living organisms and kills them either through direct contact or through reducing free oxidation, or through being taken in with the food. Such larvæ of shellfish as escape the oil at the surface will, when the time comes to attach to the bottom, find this unsuitable on account of the oil which is accumulated there, and will therefore perish.

2. Laboratory experiments have shown that a film of crude oil just sufficient to cover the surface will within an hour cause the death of clam and oyster larvæ at a temperature of 75° F. This apparently is due to the habit of these organisms of feeding for short periods at a time with the cilia of the velum lashing through the surface film. Feeding experiments show that oyster larvæ will take into the gullet any particles of sufficient fineness, regardless of their nature.

To check these experiments we have the following field observations: Great Bay, N. J., just below the town of Tuckerton, receives the waters of the Mullica River, the largest stream within the State. Situated as they are in the cedar swamps and barren regions of southern New Jersey, neither the Mullica River nor Great Bay receives any sewage or industrial wastes. Aside from an occasional oysterman's shack, there are no settlements on the banks of either, save only a few small settlements near the headwaters of the river many miles above the oyster beds. A large menhaden-oil plant is located on Seven Islands in the eastern part of Great Bay about 2 miles west of New Inlet (Little Egg Harbor Inlet). Until the war this plant was operated in such a manner as to cause no effect on the surrounding waters. From time to time excellent sets of oysters occurred within a short distance of the factory, and sets in the channel below Seven Islands were frequent.

Following the outbreak of the war, late in 1917, this plant began to receive garbage from Atlantic City, which was towed there on great scows. These were anchored alongside the factory sometimes for days, during which, in warm weather especially, large quantities of oil and grease flowed overboard. At times the surface of Great Bay was covered by so heavy a film of oil that oystermen and clammers had difficulty in holding the stales of their tongs, they were so slippery. Since this plant has been rendering garbage, the only sets of oysters have been in the upper Mullica River some 10 miles from the plant. The former great natural oyster bed at the Gravelling, at the mouth of the river, has not received any set of consequence during this same period, though formerly it was one of the most productive in the State.

We have been studying the Great Bay region since 1900, and during this time there has been no apparent change in conditions there other than the change from fish rendering to garbage salvage, as indicated. It is perhaps significant that great numbers of mussel larvæ are found in late April or early May, when the weather is as yet not warm enough to cause much loss of grease from the garbage scows.

3. Regarding the effects of oil upon adult oysters let me cite experiments which I performed in 1920 in preparation for testimony in the case against an oil company at Providence, R. I., in May, 1921. The oysters were kept in two tanks of bay water of known purity; one tank served as control, the other was kept covered by a film of oil. The water in both tanks was frequently agitated to simulate wave action, and at no time did the oxygen saturation fall below 80 per cent. (It has been shown that oysters do not suffer until the saturation falls below about 30 per cent.) After 15 days the oysters from the two tanks were opened and compared. Those from the oil-covered tank showed marked contraction of the mantle, the blood vessels revealed many bluish nodules characteristic of oysters living under unfavorable conditions, and the bodies of the oysters were distinctly thinner and poorer than those of the controls. Preserved samples of each lot show the difference clearly even now.

Mitchell[7] failed to find effect of water-gas tar upon oysters. These experiments are open to the objection that clear running water was used and that practically all of the tar was soon deposited on the sides of the aquarium. If turbid water such as that found on most oyster beds had been used, and if this had been kept in agitation as is the case in wave action, then he would, I am sure, have obtained a different result.

4. Damage to adult oysters from oil is of two kinds—(*a*) a direct result of ingestion of oil along with the minute particles of detritus which form so large a part of the oyster's food, and (*b*) an indirect result of oil upon the plant and animal organisms that live upon the oyster's shell and which are most important sources of nutriment. Eventually, as more and more oil is carried down to the bottom, the shells of the oysters and the surrounding bottom become so thoroughly impregnated with the oil that the organisms used as food by the oyster can not live and multiply.

5. The vast oyster industry of Maurice River Cove, Delaware Bay, which did a $7,000,000 business last year, is threatened by oil and by oil alone. This region is so far removed from industrial centers as to be practically free from trade wastes, but oil pumped overboard by tankers unloading water ballast and from oil-burning steamships floats in large fields across these valuable beds, and its presence is already demonstrable on the bottom. If the condition continues, the industry in Delaware Bay is bound to follow that in New England and elsewhere.

6. A most striking example of the effects of oil may be seen at low tide on the shores of Staten Island. On a warm day, with consequent increased oxidation, soft clams (Mya) may be seen coming up to the surface of the flats by the thousands, dying soon after reaching the top. The surface of the flats is covered by a heavy film of oil, while the bodies of the animals reek with it. This region, however, receives industrial wastes, and hence is open to more than one interpretation, although there is no doubt in my own mind that oil is the chief cause of the destruction evident.

At Baltimore the writers were given the impression that harbor conditions were formerly so bad that the fishing industry was very badly handicapped. Now, however, the trouble is not so serious. Even at the present time it is necessary to go a considerable distance down the bay before it is possible to catch fish and other sea food in large quantities.

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[7] Mitchell, P. H.: The Effect of Water-Gas Tar on Oysters. Bull., U. S. Bur. of Fish., Vol. XXXII, 1912 (1914), pp. 199–206. B. F. Doc. No. 786. Washington.

The conservation commission of Maryland, in reporting upon the pollution of navigable waters and the effect on fishes of Chesapeake Bay, states in part:

The effect of oil pollution in Chesapeake Bay, if allowed to continue as it has in some of the northern waters, would destroy our valuable fishery industries entirely as well as kill and drive away the wild fowl.

A most interesting condition was found at Brunswick, Ga., where a terrapin farm is located on a small creek not far distant from the plant of a large oil refining company. The situation of the terrapin farm is such that if any oil is spilled at the dock of the refinery it is very likely to be washed up into the terrapin farm at high tide through one or more of the small creeks emptying into Turtle River. On the day of the writers' visit a hardly perceptible trace of oil was visible in the water of the terrapin farm, but no indications of oil whatever were noticed on any of the wooden structures or on the turtles themselves. The investigators were informed that no fault could be found with present conditions in this location so far as the breeding of turtles is concerned. There appeared to have been no recent complaints from oystermen, and oysters grow freely in all the waters near Brunswick.

At Pensacola it was reported that the fishing industry and oyster beds have been harmed by oil pollution, and at Mobile complaints have been received from duck hunters. These complaints from wild game associations were to the effect that the fowl were covered with oil and unable to fly and at times many of the birds were found dead. The fishing industry of New Orleans has complained to the municipal authorities regarding oil pollution. In the Houston ship channel the absence of marine life is undoubtedly due not merely to the presence of large quantities of oil but also to the fact that the water in this stream is unusually warm. This results from the conditions prevailing in the industrial plants of this locality.

A carefully prepared report was submitted to the authors by Dr. David L. Belding, biologist of the division of fisheries and game, Massachusetts State department of conservation. Certain parts of the report have been used in the preceding pages of this paper Other portions are given here:

During the past two years numerous complaints of oil-waste pollution along our shores, particularly as to its damaging effect upon wild fowl, have been received. Observations by this department have disclosed not only a marked increase in this type of pollution but also a widespread destruction of water fowl, especially during the cold weather. * * *.

Our attention was first called to the destructive action of this material on birds by the distressing plight of the swans on the Charles River in the winter of 1920–21, which was mentioned in last year's annual report. The metropolitan park commission requested the privelege of killing these swans, which had become so covered with black tarry oil that they had become helpless and starving in the cold weather. A post-mortem examinat on was made on two of these birds in an effort to determine the effect of the oil

In response to a request of this division that all birds found dead under these circumstances be forwarded to the laboratory, pathological examinations were made on murres, auklets, grebes, and ducks during the winter. In spite of the fact that certain specimens were so completely covered with o l as to make examination impossible, and in others post-mortem changes rendered examination difficult, enough information was obtained to warrant certain conclusions as to the action of the oil wastes.

The birds, either in walking on the flats or resting on the oil-covered waters or tide pools, come into direct contact with the material, which tenaciously sticks to their legs, wings, and the undersides of the body. As the bird endeavors to remove the clinging material its neck, head, and beak become more or less contaminated with the tarry material. The feathers are matted together, and when th s occurs with the wings the bird becomes helpless. Even by the time the material has to any extent covered the feathers of the birds they have more or less reached this state. They find it impossible to fly, or at least fly in a normal manner, and can only walk or roll over the flats.

At the autopsy practically all the birds showed a similar condition, and a composite description of the findings may suffice for all.

Externally the birds are covered to a greater or less extent with a black, sticky, tarry oil, apparently a closely related product to crude petroleum. The material is incrusted upon legs, feet, and wings, and the feathers on the undersurface of the body are usually completely covered and matted together with the oil, while patches of the same material are present on the neck and back; as a rule the head and beak are also covered through the attempts of the bird to preen itself. The oil not only causes an adhesion of the feathers but penetrates to the skin at times, evidently causing a slight irritation. * * * .

The matting of the wing feathers gives an effect similar to slipping, thus preventing normal flight dependent upon the extent of the involvement. With a tumbling, irregular flight the bird is more likely to become more extensively contaminated with the oil.

Associated with the question of flight and movement is that of obtaining food. In most of the birds examined the stomachs were empty, and in a few instances there was evidence of starvation, indicating that the birds were unable to obtain the food necessary for existence. However, it would seem that death occurred before or during the early stages of starvation, and that lack of food was probably only a contributing factor.

The internal organs were unaffected by disease and showed post-mortem changes. No evidence of pneumonia was found in any specimen.

The temperature of birds is slightly higher than that of man and is maintained through the air sacs and feathers. The latter are especially valuable in conserving body heat, and birds, if deprived of this covering, would be unable to maintain a normal body temperature in cold weather. The matting together of the feathers deprives them to some extent of their heat-protecting function and makes the birds more readily susceptible to severe weather.

No distinction was noted between the species of water fowl which frequent the oil-covered flats and shores. All seemed to be equally incapacitated. Small birds, however, are more likely to receive a relatively greater covering of oil and therefore may perish sooner than the larger ones.

CONCLUSION

Marine life and aquatic birds along the Atlantic and Gulf coasts have suffered seriously from pollution of waters by petroleum oil, but other industrial wastes are undoubtedly responsible for much of the damage done. This is a serious problem, primarily because of the vital importance of aquatic life as a source of food. Oil pollution is detrimental to shellfish by destroying the larval forms and rendering the adult mollusks and finny fish unfit for food. It causes considerable destruction of fowl, rendering the birds helpless through its mechanical action on the feathers.

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FIG. 1.—Fulton Fish Market, looking north on South Street

WHOLESALE TRADE IN FRESH AND FROZEN FISHERY PRODUCTS AND RELATED MARKETING CONSIDERATIONS IN NEW YORK CITY.[1]

By R. H. Fiedler, *Agent, U. S. Bureau of Fisheries*, and J. H. Matthews, *Production Manager, Atlantic Coast Fisheries Co.*

CONTENTS

INTRODUCTION

The present survey is the seventh of a series of trade investigations made by the Bureau of Fisheries, the cities previously canvassed being Louisville, Ky., Pittsburgh, Pa., Chicago, Ill., Minneapolis and St. Paul, Minn., Seattle, Wash., and Boston, Mass. The following report is based on conditions existing during the calendar year 1924.

The authors wish to express their appreciation to the wholesale fish trade, the American Railway Express Co., and officials of various railway companies, all of New York City, for their interest, enthusiastic cooperation, and the many courtesies extended while the information for this survey was being collected. Thanks are especially due to Capt. Frederick William Wallace, editor of the Fishing Gazette; Joseph Weber, traffic manager of the Chesebro Bros. & Robbins Co.; and Sol Broome, manager of the Lakeside Fish Co., all of New York City, for supplying valuable data which have contributed largely to the success of this undertaking.

[1] Appendix VI to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 996.

FULTON MARKET

The wholesale fresh and frozen fishery trade in New York City is conducted almost exclusively in the several blocks adjacent to the foot of Fulton Street in the area known as the Fulton Fish Market. This market occupies the foremost position among the wholesale

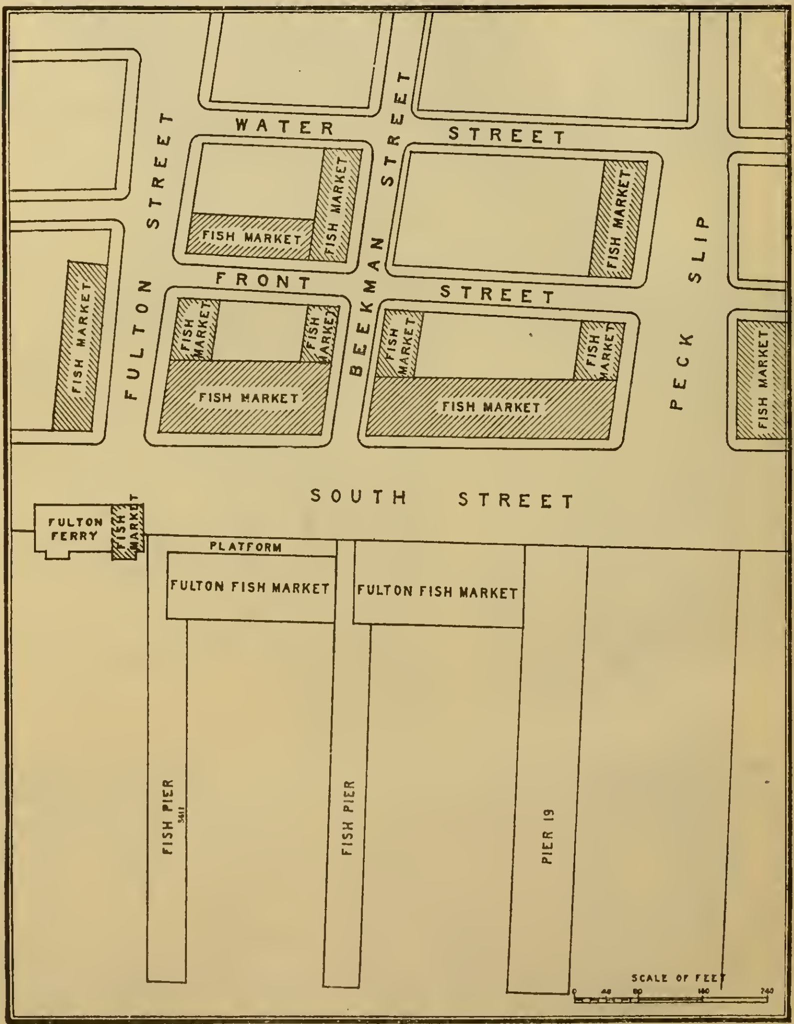

FIG. 2.—Wholesale fish-market area in New York City, showing Fulton and Peck Slip markets

fresh-fish markets of the United States, and whatever may be done to better conditions there and to handle the trade more efficiently will be reflected over the entire country. Nearly every shipper of fish has at one time or another sent his product to this market, which serves approximately one-fifth the population of the United States.

Fulton Market was established at its present location a little over 100 years ago, at a time when the population of New York City centered at the lower end of Manhattan Island, when there were no railroads, and when fishery products arrived entirely by boat. It catered to both the retail and the wholesale trade and was strategically located at the foot of Fulton Street, which at that time was the main artery through New York City to Fulton Ferry, the important means of travel to Brooklyn.

Since the building of Brooklyn Bridge traffic has been diverted to it and to other bridges built subsequently. The withdrawal of the transient trade and the vast growth of the city's population caused the retailers to follow the trade and to seek more advantageous sections, leaving the wholesale trade concentrated in its present location.

As New York City increased in size new firms engaged in the fish business, new buildings were erected, old buildings were remodeled to suit the needs of a fishery business, and Fulton Fish Market developed into the greatest fish-distributing center in the United States, constituting one of the largest industries in the metropolitan district.

In 1924 there were 87 wholesale establishments engaged in handling 394,000,000 pounds, or more than 19,000 carloads, of fresh and frozen fishery products of 106 varieties, with a wholesale value of approximately $30,000,000. The total investment amounted to $2,577,484, and the cash or working capital to $592,900. There were 1,163 persons engaged in this trade, receiving $2,250,705 in wages.

The present greatly enlarged wholesale-market area is still located in its original position on the East River water front at the foot of Fulton Street, Beekman Street, and Peck Slip. It has no direct rail communication with any freight or express terminals, but for the accommodation of fishing smacks and steam trawlers there are two piers extending into the East River from the rear of the market.

SOURCES OF SUPPLY OF FISHERY PRODUCTS

The bulk of the fresh and frozen salt-water fish received at the market is taken on the offshore banks and in the shore fisheries of the Atlantic seaboard from Newfoundland to Key West. Large quantities are also received from the waters of the North Pacific, being reshipped through the ports of Seattle, Wash., and Prince Rupert, B. C. Smaller quantities are received from the waters of the Gulf of Mexico and California.

Most of the oysters are received from Long Island points; the bulk of the clams come from points along the Atlantic seaboard; shrimp are sent from the South Atlantic coast and the Gulf of Mexico; and scallops are shipped in from waters adjacent to Massachusetts, Long Island, and North Carolina.

The bulk of the fresh and frozen fresh-water fishery products received in the market is taken from the Great Lakes and Canadian lakes territory, though large quantities are also received from the Mississippi River and its tributaries. Lesser quantities originate in nearly every producing area for fresh-water fish in the United States.

METROPOLITAN RECEIVING POINTS

FREIGHT AND EXPRESS SHIPMENTS

Although most of the fresh and frozen fishery products for delivery in New York City are received at various freight, express, and steamship terminals in the metropolitan district, Fulton Fish Market has no direct rail communication with any of these terminals.

TABLE 1.—*Fishery products received at Fulton Fish Market, New York City*

Terminals	Terminal number	Quantity received [1]	Distance from terminal to Fulton Market
Express shipments:		*Pounds*	*Miles*
Long Island City	15	6,900,000	5.70
Weehawken	6	900,000	5.10
Manhattan—			
Forty-ninth Street and Lexington Avenue	14	43,400,000	3.80
Thirty-third Street and Tenth Avenue	13	78,200,000	3.80
Hoboken	5	2,600,000	2.70
Jersey City—			
Communipaw	2	6,900,000	1.70
Pier D and Erie terminals	3	34,700,000	1.70
Total		173,600,000	
Freight shipments:			
Bronx, One hundred thirty-second and Lincoln Streets	16	31,700,000	8.10
Jersey City—			
Pennsylvania Railroad, Henderson Street	4	12,200,000	2.30
Central Railroad of New Jersey, Communipaw	1	12,100,000	1.70
Manhattan—			
New London Line, Pier 40, North River	11	9,200,000	1.90
Pennsylvania Railroad, Pier 29, North River	10	10,700,000	1.50
New York Central Railroad, Laight and Varick Streets	12	40,600,000	1.30
Old Dominion Line, Pier 25, North River	9	7,000,000	1.30
Fall River Line, Pier 14, North River	8	21,800,000	.80
Hartford-New York Line, Pier 19, East River	7	3,100,000	.09
Total		148,400,000	
Shipments by fishing vessels: Fulton Market		50,000,000	
Shipments by motor truck: Fulton Market		22,000,000	
Grand total		[2] 394,000,000	

[1] Includes weight of oysters and clams in the shell.
[2] The net weight of these fishery products, exclusive of oyster and clam shells, is about 346,000,000 pounds, consisting of 280,000,000 pounds of salt-water fish, 60,000,000 pounds of fresh-water fish, and 6,000,000 pounds of shellfish.

Except for 2 express and 1 freight terminal on Manhattan Island, the majority of the railroads terminate at Jersey City, Hoboken, or Weehawken. During 1924 approximately 322,000,000 pounds or 82 per cent of the total tonnage of fresh and frozen fishery products received in New York City arrived by freight and express in 16 terminals of 7 districts. Of the total receipts in New York City, 31 per cent arrived at express terminals on the lower center of Manhattan Island, 23 per cent at freight terminals along the North River on the southwestern portion of Manhattan Island, 17 per cent at freight and express terminals of Jersey City and Hoboken along the North River, 8 per cent at freight terminals in the Bronx, 2 per cent at express terminals in Long Island City, two-tenths of 1 per cent at express terminals in Weehawken, and eight-tenths of 1 per cent at a pier about one block from Fulton Market.

The transportation charge for shipments arriving by express in less-than-carload lots includes delivery by the express company from the terminal to the consignees' door. When shipments are received in express carload lots and nondelivery from terminals to consignees' door is specified, a charge is made by the express company for such delivery. All freight carload and less-than-carload shipments are

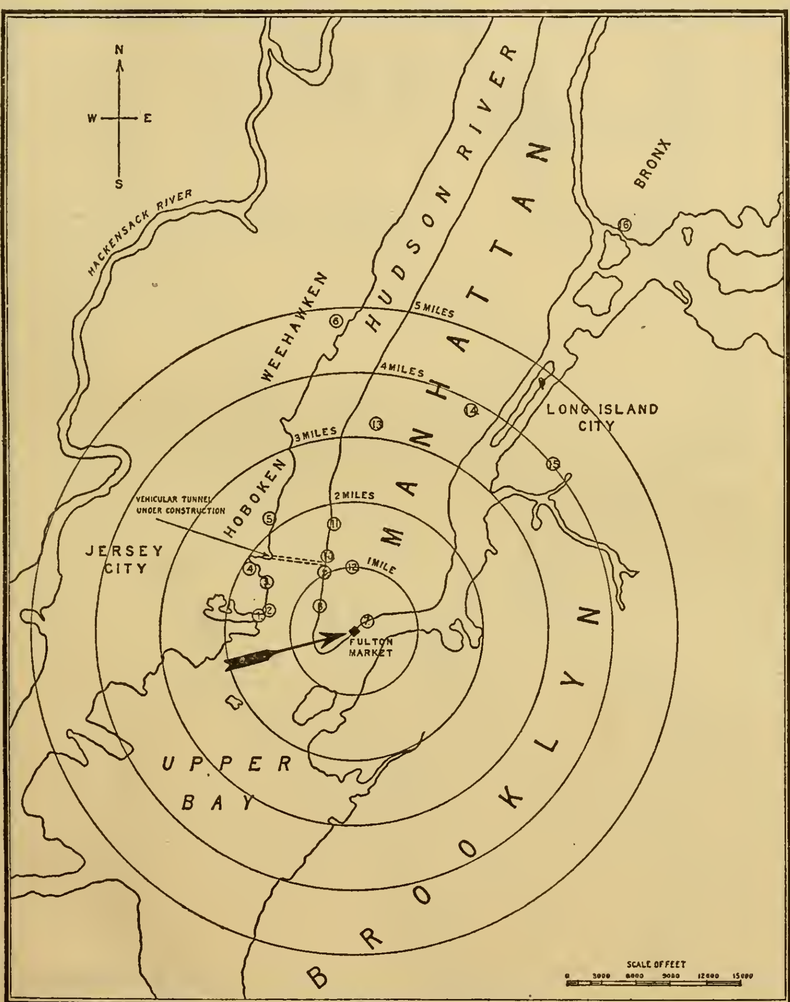

FIG. 3.—Relation of fish-receiving terminals in the metropolitan area to Fulton Fish Market. (See table, p. 186, for amount of fish received at each terminal.)

privately trucked from the various freight terminals to Fulton Fish Market. In this latter case the extra transportation charge is about 20 cents per 100 pounds.

Based on this transportation charge of 20 cents per 100 pounds, about $644,000, or about 2 per cent of the wholesale value of the fishery products sold in 1924, was expended in haulage charges for transfer of freight and express goods from the various terminals to Fulton Fish Market. Of this amount the wholesalers paid $296,800 on freight shipments, while the cost to the express company was $347,200.

The final burden of this intracity transportation cost is placed upon the fisherman shipping his products on consignment, as all charges incidental to getting his product to the market are deducted

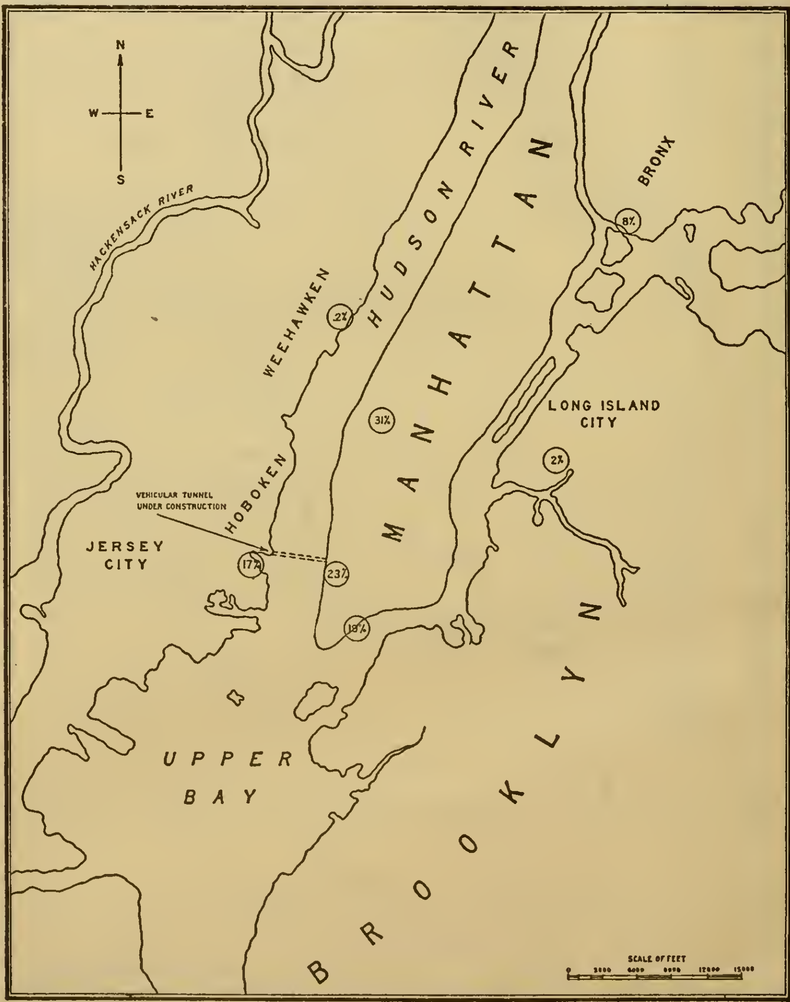

FIG. 4.—Percentage of arrivals of fishery products at each fish-receiving district of the metropolitan area

from the selling price. This expense contributes to making it unprofitable, as a rule, for fishermen to ship certain inexpensive and plentiful varieties of fishery products to Fulton Market. A notable instance is the whiting, which usually sells for a low price, the profit on a barrel oftentimes being not more than sufficient to pay the intracity transportation charges.

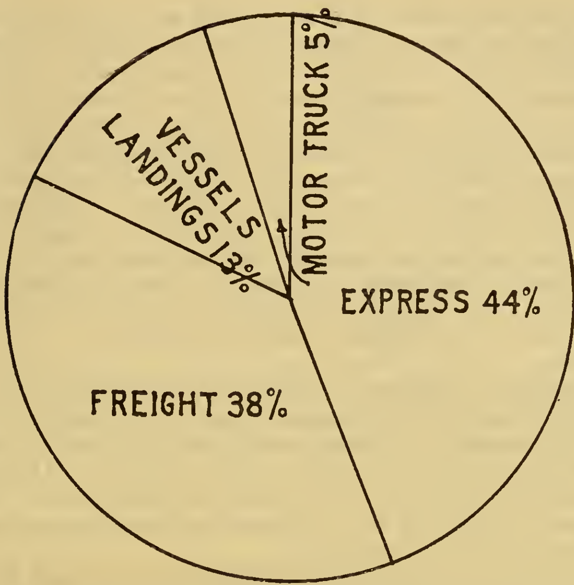

FIG. 5.—Mode of transporting fishery products to the metropolitan area, by percentages

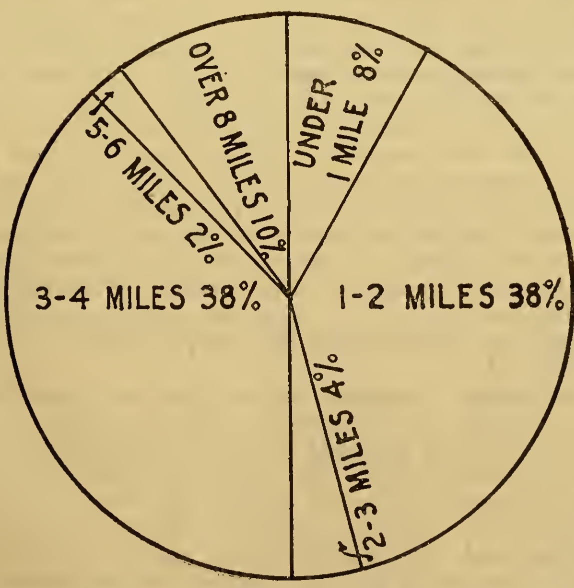

FIG. 6.—Distance volume movement of fishery products from the various receiving terminals in the metropolitan area to Fulton Fish Market, by percentages

Fishery products arriving at terminals in New York City during the hours of the day—from 9 a. m. to 5 p. m.—are subject to delay, due to congestion at the railroad terminals. Fish shipments are given preference by the transportation companies, however, and cars containing such consignments are so placed in the terminal yards that immediate delivery to waiting motor trucks may be effected. The progress of motor trucks through the congested streets of lower Manhattan en route to Fulton Market is necessarily slow during the busy hours of the day, and such delays have proved costly to both dealers and shippers. Dealers invariably advise the producers to ship their fish so that they will arrive in New York during the hours of the night, thus avoiding all intracity congestion and receiving the additional advantage of early morning sale. At present about 70 per cent of the rail shipments are delivered before 7 a. m.

The selling price of fishery products at Fulton Market is governed by the quality, size, and volume on hand, as well as by the time of arrival at the market. A delay of an hour may bring a lower price and therefore a smaller return to the producer. Occasionally a higher price is obtained because a shipment of a desired variety has been temporarily delayed in transit and arrives on a scarce market, but usually delayed arrivals suffer.

Two shipments of fish similar in character, size, and quality from the same point of origin, shipped to the same firm on the same day, may reach the market at different hours of the day, and as a result the returns to the two shippers may be quite different. This is especially true of fresh-water fish sold at auction in Peck Slip. About 7 a. m. the buyers assemble in the street in front of the establishments and await the trucks of fish. Upon the arrival of the first truck each individual shipment is auctioned directly from the truck to the buyers gathered round. By 10 a. m. the buyers have usually secured their stocks. In such cases a shipment arriving at the market at 11 a. m. would be held over for sale on the next day, undergoing some deterioration. This shipment in all likelihood, unless properly refrigerated, would sell for a few cents less per pound than if it had been offered for sale on the previous day.

It is believed that delays such as those which now occur in Peck Slip could be materially reduced should the express trucks unload upon arrival at the consignees' door, instead of waiting until each individual shipment is sold. If this were done more trips per day could be made by these trucks, and consequently more shipments could be delivered.

In any fish market, in order to attract business, it is to the interest of the wholesale fish trade to provide efficient marketing conditions. The producer is entitled to speedy and careful handling of his products to insure maximum returns. The producer should not be expected to take every precaution to assure his product arriving at the terminal in the best condition and then have his products suffer at the market from inefficient and slow handling. A market well located and mechanically equipped to give the best service will attract business. It is to the interest of the producer to ship his product to the market rendering him the most efficient and satisfactory service. Furthermore, his satisfaction will induce his neighbors to follow his example.

LIVE FISH

During 1924, 244 carloads of live fish, totaling 5,549,779 pounds, were received in New York City, consisting almost entirely of carp and buffalofish. They originated as follows: Eighty-four carloads from Ohio, 55 from Minnesota, 41 from Wisconsin, 33 from Michigan, 16 from Illinois, and 15 from Iowa. Such fish are shipped in specially constructed aerated tank cars, and upon arrival at the terminals in New York City are transferred to tanks of cold water aboard motor trucks and carried to the local retailer or wholesaler, where they are stored in live tanks and held pending sale. During the holiday season live eels are shipped down the Hudson River from the north on barges, and are unloaded at the market pier into live tanks.

SHIPMENTS BY VESSEL

Direct shipments by fishing vesesls and boats are unloaded at the piers of Fulton Market. These piers, although small for the amount of business transacted, can accomodate 50 to 75 boats and vessels. As each vessel is unloaded the fare is weighed and immediately iced and packed in containers, and then loaded on waiting trucks for distribution to firms in Fulton Market, at shipping terminals, or to retailers in the metropolitan area.

PRODUCTION

New York City is one of the most important fishing ports in the United States. The direct landings of fresh fish by fishing vessels of over 5 tons net during 1924 amounted to 35,020,585 pounds, as compared with 130,631,036 pounds at Boston and 29,263,323 pounds at Gloucester, Mass., and 15,927,190 pounds at Portland, Me. There was an increase of 719,985 pounds over 1923 and 14,331,235 pounds over 1922. The total direct landings for 1924, including vessels and boats of all sizes, is estimated at over 50,000,000 pounds, or about 13 per cent of the total fresh and frozen fishery products received in New York City. The large increase during the past few years has been due mainly to the additon of several steam trawlers having New York City for their home port, and to the fleets of other ports that bring their catches to this market.

The following table shows, by months and species, the quantity of fresh fish landed at Fulton Market by fishing vessels during the year ended December 31, 1924:

TABLE 2.—*Statement, by months, of fishery products landed at Fulton Market by fishing vessels during the calendar year 1924*

Month	Bluefish		Cod		Flounders		Haddock and mixed fish		Mackerel	
	Trips	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*
January			18	72,100	8	160,000	15	1,123,000		
February			8	136,800	32	754,000	14	1,119,000		
March			8	53,000	48	940,000	18	1,696,000		
April			2	14,000	79	1,374,000	17	1,684,000	28	931,000
May			3	33,000	74	1,438,200	8	882,000	256	1,691,385
June			15	226,500	59	1,174,000	8	820,000	45	392,800
July	5	11,300	18	293,000	73	1,452,500	9	896,000		
August	35	96,500	17	289,000	83	1,521,000	8	610,000		
September	3	2,800	15	271,000	90	1,988,000	9	796,000		
October			13	228,000	83	1,671,500	17	1,481,000	2	31,400
November			2	20,000	38	581,000	17	1,517,000		
December			11	49,500	13	227,000	22	1,825,000		
Total	43	110,600	130	1,685,900	680	13,281,200	162	14,449,000	331	3,046,585

TABLE 2.—*Statement, by months, of fishery products landed at Fulton market by fishing vessels during the calendar year 1924*—Continued

Month	Sea bass and porgies		Tilefish		Weakfish		Miscellaneous [1]		Total	
	Trips	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*	*Trips*	*Pounds*
January			6	136,000					47	1,491,100
February			10	215,000			1	25,000	65	2,249,800
March			11	266,000					85	2,955,000
April			14	327,000			1	15,000	141	4,345,000
May			5	118,000					346	4,162,585
June	11	377,000					1	5,000	139	2,995,300
July	16	325,300							121	2,978,100
August	6	64,000			1	24,000			150	2,604,500
September	7	41,500			2	12,000			126	3,111,300
October			2	50,000	10	143,000			127	3,604,900
November			4	68,000	10	141,500			71	2,327,500
December			4	82,000	1	12,000			51	2,195,500
Total	40	807,800	56	1,262,000	24	332,500	3	45,000	1,469	35,020,585

[1] Miscellaneous fish are butterfish, croakers, and pollock.

Unregistered vessels of less than 5 tons landed probably in excess of 15,000,000 pounds of fish and lobsters during the year, but no record was kept of the landings of these boats. It is estimated that more than 50,000,000 pounds of fish were landed by vessels and boats during 1924.

SHIPMENTS BY MOTOR TRUCK

About 22,000,000 pounds of fishery products caught in the waters of Connecticut, Long Island, and New Jersey are delivered to Fulton Market by motor trucks unloading their goods directly at the wholesale establishment. This mode of transporting fishery products, especially from near-by points, is rapidly increasing. The service is efficient in that it does away with rehandling at the local terminals, and it is quick because the motor trucks travel mainly at night. Fishery products caught in the afternoon are delivered at the market early the following morning. For short hauls there is every reason to believe that this method of transportation will become more and more popular with the fish wholesalers. Arrivals by motor truck constitute about 5 per cent of the total tonnage of fresh and frozen fishery products received in New York City.

RESHIPMENT OF FISHERY PRODUCTS

Although New York City is centrally located on the Atlantic seaboard and has direct rail communication with most of the important inland centers, only about 19 per cent, or 67,000,000 pounds, of the edible fresh and frozen fishery products received are reshipped to these centers. The States of New York, Pennsylvania, Connecticut, Rhode Island, and New Jersey receive most of these shipments, the vast majority being sent by less-than-carload express and auto express. Very little is sent farther than 200 miles, although a few carloads were reshipped during 1924 to points as far west as Chicago and St. Louis.

Cod, haddock, flounder, and mackerel predominate among the varieties reshipped. It will be noted that these varieties constitute a large majority of the first landings at the Fulton Market pier.

Steamships and railroad dining cars departing from New York carry large quantities aboard for the use of the passengers and crews, totaling about 4,000,000 pounds, or 1 per cent of the amount received in New York City during 1924.

FIG. 7.—Pier in rear of Fulton Fish Market. Steam trawler (in foreground) unloading fare

FIG. 8.—Packing fish in barrels after being unloaded from a steam trawler

Quantities of fresh fish and shellfish, consisting largely of salmon and oysters, were exported to such European countries as England and France. This trade is gradually increasing, the exports for 1924 being about 4,000,000 pounds, or 1 per cent of the amount received in New York City during 1924, valued at $508,390, as compared with about 2,000,000 pounds, valued at $257,647, for 1923. With market conditions in foreign countries assuming a more stable form, it is expected that the fishery export trade will become an important factor with New York City whosesalers.

Approximately 75,000,000 pounds, or 21 per cent of the edible fishery products received in New York City, are reshipped to points outside the metropolitan area. Most of the domestic shipments are carried by the express company. It is estimated that it costs that company about $150,000 to transfer these goods from Fulton Market to the terminals from whence they are shipped.

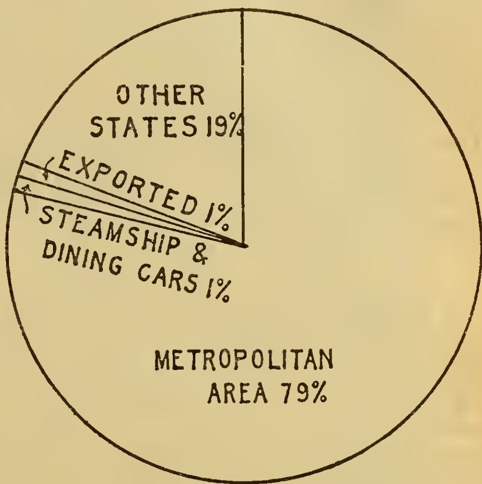

FIG. 9.—Disposition of fresh and frozen fishery products received at Fulton Fish Market, by percentages

FUTURE DEVELOPMENT OF THE WHOLESALE FISH TRADE

INCREASING VESSEL LANDINGS

Taking into consideration the steady increase in vessel landings during the past few years and the continued growing demand for ground fish for filleting purposes, it appears that direct vessel landings will become larger. The two piers at Fulton Market are already overburdened, and it is questionable whether they can accommodate more business. However, some property has been acquired adjacent to Fulton Market along the water front, and facilities for handling consignments by water and rail are being extended.

CONGESTION

With the increasing transient office population on lower Manhattan Island in the vicinity of Fulton Market, due to the construction of larger and higher office buildings, vehicular traffic will necessarily become more and more congested. As it is essential for vehicles bearing fishery products to pass through this district en route from the receiving terminals to Fulton Market, it is probable that the time consumed in intracity transportation will be increased, making for possible further delays and opportunity for spoilage.

VEHICULAR TUNNEL UNDER CONSTRUCTION

This tunnel, to be completed in the fall of 1926, is being constructed under the Hudson River and connects the Jersey City and lower southwest Manhattan fish-receiving districts. There will be two 20-foot roadways, one for each direction of traffic. The entrance plaza on Manhattan Island is at Broome Street, midway between Varick and Hudson Streets, while the exit is at Vestry and Canal Streets. The entrance plaza at the New Jersey end is at Provost and Twelfth Streets, while the exit is at Provost and Fourteenth Streets. The tunnel will be 9,250 feet long and will have a capacity estimated at 3,800 vehicles hourly, or 46,000 daily. Upon completion of the tunnel, traffic between Manhattan Island and New Jersey will be expedited and congestion minimized.

INLAND FREIGHT TERMINALS

A system of inland freight terminals has been proposed by the Port of New York Authorities to relieve congestion on Manhattan Island. Their plan involves the stopping of freight at the railheads west of the Hudson River, and provides that this freight be moved by railroad-operated street trucks via underground tunnel or ferry to freight terminals located in various districts on Manhattan Island or brought direct to the consignees' door. The tunnel that is being constructed under the Hudson River will greatly aid such a plan.

According to this plan a freight terminal probably will be erected in the vicinity of Pearl and Fulton Streets, which is about three blocks from Fulton Market. Incoming fishery shipments will be delivered at this terminal by railroad-operated motor trucks, to be picked up later by the wholesalers' trucks for delivery to their own establishments. Outgoing shipments for any railroad will also be carried to these terminals. Under this system long hauls would be eliminated.

The charges for delivery from the railheads to the inland terminals will be included in the railroad tariff, and the rate will be figured from the point of origin to the terminal on Manhattan Island.

A similar plan has already been inaugurated by several railroads, the New York, New Haven & Hartford being a notable example. Carload shipments of fish shipped on this railroad from Boston enjoy a through rate from Boston to Fulton Fish Market. Such shipments are carried by rail from Boston to the Bronx and by motor truck from the Bronx to Fulton Fish Market. Service by this method is efficient and quick.

An objectionable feature of the plan is that it necessitates the extra handling of shipments at the inland terminal. Various wholesalers are of the opinion that the intracity congestion could be lessened materially by having freight fishery shipments originating on all railroads switched to a common classification yard west of the Hudson River, and moved thence by truck directly to Fulton Fish Market.

BUILDING REPLACEMENT

Many of the wholesale fish firms are conducting business on the ground floor of old brick buildings. If the wholesale fish business in New York City is to keep pace with existing sanitary regulations,

FIG. 10.—Loading and unloading space in front of Fulton Fish Market

FIG. 11.—Loading and unloading space in front of Peck Slip Fish Market. To the left are several groups of buyers bidding on fish still on the waiting motor trucks

FIG. 12.—Auctioning fish at Peck Slip Fish Market

and is to follow the trend of the fish business, which calls for improved methods of handling fish in the wholesale fish markets, new buildings will be necessary in the near future.

SUMMARY

The prime requisites for an up-to-date wholesale fish market that is both a receiving and distributing center may be summed up as follows:

1. It should have direct rail communication with the important railroads carrying fishery products.
2. If it receives fish from fishing vessels and boats it should have suitable docking facilities.
3. There should be ample room for adequately handling the volume of present business and provision for future expansion.
4. The market should be located within easy reach of retail markets, hotels, restaurants, and population centers.
5. It should be centrally located with respect to foreign import and export facilities.
6. Business should be conducted under the most sanitary conditions possible, and devices for speedy and efficient handling of the products should be provided.

Fulton Fish Market already enjoys several of the prime requisites noted above. It will be near the proposed inland freight terminal and it is located on the water front, comparatively near the population centers, and near import and export facilities.

LOCAL MARKETING

The wholesale fresh and frozen fisheries trade in New York City is conducted in two separate markets. One, the Fulton Fish Market, handles salt-water fishery products, while the other, known as Peck Slip, handles fresh-water fishery products. Incoming fishery shipments arriving at the various freight or express terminals are delivered by motor trucks or drays to these markets during the entire 24 hours of the day, including Sunday. The greater portion arrives during the early morning hours.

SALES METHODS

Most of these shipments are sold on commission, the salt-water varieties of fish being sold in the open market in competition, while the fresh-water varieties are sold largely by auction to the highest bidder. Quantities are sometimes bought outright from the producers by the wholesalers, and the latter in turn sell on their own account.

With consignment goods, each container is labeled with a mark or number before being placed in the section of the stand or department handling that particular variety of goods. The retailer or jobber visits the stalls of the various firms and selects the products he wishes to purchase. When a sale is made the salesman calls to the clerk stationed in the sales office the mark or number of the consignment, the weight, price, and name of the purchaser. If the goods are sold to a dealer doing business in the metropolitan area delivery is made by the wholesaler to the customer's truck, or if sold to an out-of-town customer the package is prepared for shipment by express or freight, as the case may be.

Of the fishery products received at the various terminals, very little is for shipment direct to stores, retailers, restaurants, or individuals. Any fish so received is of the year-round variety, such as cod, halibut, and haddock. The principal buyers of such products are large department stores, chain grocery stores, and a few of the larger hotels.

The quantity of fish handled in the market is very much greater early in the week, business being practically over by Thursday night. The reverse is true of the retailer, who spends the early days of the week at the wholesale market buying fish to sell in his retail establishment on Thursday and Friday.

On a busy day the market presents a picture of congestion. Early in the morning several hundred buyers may be seen making purchases. The sidewalk and street in front of each place of business are piled high with boxes and barrels of fishery products, and the centers of the streets are congested with traffic, which retards the progress of incoming and outgoing shipments. By 10 o'clock the local business is practically over for the day, after which out-of-town orders are filled and shipped.

Considering the large volume of fish handled in the wholesale market, the amount of floor space utilized is comparatively small. This is due to the rapid turnover, the fish in many instances being sold immediately after it is unloaded from the express company's trucks or from the vessels.

COMMON AND SCIENTIFIC NAMES OF FISHERY PRODUCTS

Following is a list of common and scientific names of the fishery products handled in the wholesale fish markets of New York City to which reference is made in this report:

SALT-WATER FISHERY PRODUCTS

Common name	Other common names	Scientific name
Albacore		*Germo alalunga.* *Gymnosarda alleterata.*
Bluefish		*Pomatomus saltatrix.*
Blue runner	Hardtail	*Caranx chrysos.*
Bonito	Bonito mackerel	*Sarda sarda.*
Butterfish		*Poronotus triacanthus.*
Cod		*Gadus callarias.*
Croaker	Hardhead	*Micropogon undulatus.*
Dab		*Hyppoglossoides platessoides.*
Drum, black	Drum	*Pogonias cromis.*
Drum, red	Spot bass	*Sciænops ocellatus.*
Eel	Common eel, silver eel.	*Anguilla rostrata.*
Flounder	Winter flounder, roughback.	*Pseudopleuronectes americanus.*
Fluke	Summer flounder, turbot.	*Paralichthys dentatus.*
Grouper		*Epinephelus mycteroperca.*
Haddock		*Melanogrammus æglifinus.*
Hake, red	Squirrel hake	*Urophycis chuss.*
Hake, white	Ling	*Urophycis tenuis.*
Halibut		*Hippoglossus hippoglossus*
Herring, large	Sea herring, river herring, alewife.	Pomolobus sp. *Clupea harengus.*

SALT-WATER FISHERY PRODUCTS—Continued

Common name	Other common names	Scientific names
Herring, small	Sardine	*Clupea harengus* (young).
Jewfish		*Promicrops guttatus.*
Kingfish	King mackerel, cero	*Scomberomorus regalis.*
King whiting	Kingfish	Menticirrhus sp.
Mackerel	Common mackerel	*Scomber scombrus.*
Mullet	Jumping mullet	*Mugil cephalus.*
Permit	Great pompano	*Trachinotus goodei.*
Pilotfish		*Naucrates ductor.*
Pollock		*Pollachius virens.*
Pompano		*Trachinotus carolinus.*
Red snapper		*Lutianus blackfordi.*
Rosefish	Bream, red bream	*Sebastes marinus.*
Salmon, Atlantic		*Salmo salar.*
Salmon, Pacific		Oncorhynchus sp.
Scup	Porgie	*Stenotomus chrysops.*
Sea bass	Blackfish	*Centropristes striatus.*
Sea gar	Billfish	*Tylosurus marinus.*
Sea robins		Prionotus sp.
Sea trout, spotted	Spotted squeteague	*Cynoscion nebulosus.*
Shad		*Alosa sapidissima.*
Sheepshead		*Archosargus probatocephalus.*
Skate		Raja sp.
Smelt		*Osmerus mordax.*
Sergeantfish	Snook	Centropomus sp.
Sole	Fluke, lemon sole, gray sole.	*Glyptocephalus cynoglossus.*
Spanish mackerel		*Scomberomorus maculatus.*
Spot	Lafayette	*Leiostomus xanthurus.*
Striped bass	Rock	*Roccus lineatus.*
Sturgeon		*Acipenser sturio.*
Swordfish		*Xiphias gladius.*
Tautog	Blackfish	*Tautoga onitis.*
Tilefish		*Lopholatilus chamaeleonticeps.*
Tomcod		*Microgadus tomcod.*
Weakfish	Sea trout, squeteague	*Cynoscion regalis.*
Whitebait	Spearing	Menidia sp.
White perch		*Morone americana.*
Whiting	Silver hake	*Merluccius bilinearis.*
Clam, hard	Quahaug	*Venus mercenaria.*
Clam, soft		*Mya arenaria.*
Conch		Busycon sp.
Crab	Blue crab, hard crab, soft crab.	*Callinectes sapidus.*
Crab, rock		Cancer sp.
Lobster		*Homarus americanus.*
Mussel		*Mytilus edulis.*
Octopus	Devilfish	*Octopus vulgaris.*
Oyster		*Ostrea elongata.*
Scallop, bay		*Pecten irridians.*
Scallop, sea	Giant scallop	*Pecten majellanicus.*
Sea urchin		Echinodea sp.
Shrimp		*Peneus setiferus.*
Squid	Boned squid	Loligo sp.
Terrapin		Melaclemmys.
Turtle, green		*Chelonia mydas.*
Turtle, sea	Loggerhead	*Thalassochelys caretta.*
Winkle	Periwinkle	*Littorina littorea.*

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FRESH-WATER FISHERY PRODUCTS

Common name	Other common names	Scientific name
Bass, calico	Strawberry bass	*Pomoxis sparoides.*
Bass, rock		*Ambloplites rupestris.*
Bowfin	Dogfish	*Amiatus calvus.*
Buffalofish		*Ictiobus cyprinella.*
Bullhead	Catfish	Ameiurus sp. and Ictalurus sp.
Carp	German carp	*Cyprinus carpio.*
Cisco		Leucichthys sp.
Lake herring		Leucichthys sp.
Muskellunge		*Esox masquinongy.*
Perch, yellow		*Perca flavescens.*
Pickerel	Jack, grass pike, pike	Esox sp.
Pike, blue		*Stizostedion vitreum.*
Pike, yellow	Yellow	*Stizostedion vitreum.*
Red horse	Redfin, sucker	Moxostoma sp.
Sauger		*Stizostedion canadense.*
Sheepshead	Fresh-water drum	*Aplodinotus grunniens.*
Smelt		Osmerus sp.
Spoonbill cat	Paddlefish	*Polyodon spathula.*
Sturgeon		*Acipenser rubicundus.*
Sucker	Mullet	Catostomidæ sp.
Sunfish		Centrarchidæ sp.
Tullibee		*Leucichthys tullibee.*
Trout, lake		*Cristivomer namaycush.*
Whitefish		*Coregonus albus.*
Frog		Rana sp.

SALT-WATER FISH MARKET

FIG. 13.—Percentage of each class of fishery products received at Fulton Fish Market

Fresh and frozen salt-water fishery products, of which there are 79 varieties, approximating 280,000,000 pounds of fish and 54,000,000 pounds of bulk shellfish per annum, are shipped to the New York salt-water fish markets.

There are 63 wholesale dealers who make a specialty of handling fresh and frozen salt-water fishery products. These firms cater to all nationalities, selling their products at a quoted market price. A majority of the firms sell only fish, others fish and shellfish, and still others only shellfish.

PRODUCTS HANDLED

Important commercial species.—Twenty-four species of fresh and frozen salt-water fish and shellfish constitute about 70 per cent of the total volume of sales. The following table shows the form in which the important commercial salt-water species are mainly received:

TABLE 3.—*Salt-water fish and shellfish upon which the bulk of the trade is based*

Species	Form in which received	Species	Form in which received
Butterfish	Round.	Mackerel	Round.
Cod	Dressed.	Porgie	Do.
Croaker	Round.	Salmon (Pacific)	Round, dressed, and head off.
Dabs	Do.	Sea bass	Round.
Eels	Round, dressed, skinned, live.	Sea trout or squeteague	Round and dressed.
Flounders	Round.	Shad	Round.
Fluke	Do.	Smelt	Do.
Haddock	Dressed.	Spanish mackerel	Dressed.
Halibut	Do.	Clams, quahaug and soft.	Shell.
Herring, large	Round.	Oysters	Shell and shucked.
Herring, small (sardine)	Do.	Shrimp	Head off and green.
King mackerel	Dressed.	Squid	Round.

Species of moderate importance.—In this class are salt-water fishery products, of which there is a limited supply. Most of these would rank among the important commercial species if more could be produced. The 15 species of this group constitute approximately 20 per cent of the trade.

TABLE 4.—*Salt-water species of moderate importance*

Species	Form in which received	Species	Form in which received
Albacore and tuna (horse mackerel)	Round.	Red snapper	Dressed.
Bluefish	Round, dressed.	Sole, gray and lemon	Round.
Bonito	Round.	Spot or Lafayette	Do.
Mullet	Do.	Striped bass	Do.
Perch, white	Do.	Tilefish	Dressed.
Pollock	Dressed.	Crabs (soft-shell)	Live.
Pompano	Round.	Crab meat	Cold pack.
		Scallops	Shelled.

Species for which there is small demand.—Limited quantities of 39 salt-water fishery products, approximating 10 per cent of the total amount sold, are marketed in Fulton Fish Market. Large amounts of these products are used by the foreign-born population, and include varieties that are common to their native country.

TABLE 5.—*Salt-water species for which there is small demand*

Products	Reasons for limited sale	Principal form in which received
Black drum	Unpopular	Dressed.
Blue runners	Not well known	Do.
Bream or rosefish	Supply limited	Do.
Grouper	Unpopular	Do.
Hake	do	Do.
Jacks (skip, amber)	Not well known	Round.
Jewfish	Unpopular	Dressed.
King whiting	Supply limited	Round.
Ling (white hake)	Unpopular; plentiful supply	Do.
Permits	Not well known	Do.
Pigfish	do	Dressed.
Pilotfish	Unpopular	Round.
Red drum (spot bass)	do	Do.
Salmon, Atlantic	Supply limited	Round, dressed.

TABLE 5.—*Salt-water species for which there is small demand*—Continued

Products	Reasons for limited sale	Principal form in which received
Sea gar	Supply limited; unpopular	Round.
Sea robins	Unpopular	Do.
Sergeantfish or snook	do	Dressed.
Shark	do	Round, dressed.
Sheepshead	Supply limited	Do.
Skate	Used chiefly by Italians and French	Dressed wings.
Sturgeon	Very limited supply; popular	Dressed.
Swordfish	Supply limited; popular	Do.
Tautog	Supply limited; unpopular	Round.
Tomcod	Unpopular; plentiful supply	Do.
Whitebait	Supply limited and small demand	Do.
Whiting	Not generally popular; large supply	Do.
Caviar (sturgeon)	Supply and demand limited	Salt and fresh.
Cod and haddock roe	Unpopular	Fresh.
Conchs	Not generally popular; used by English	Shell.
Crabs, hard	Supply limited; popular	Live.
Crabs, rock	Unpopular	Frozen.
Crawfish (spiney lobster)	Supply limited; popular	Live.
Devilfish or octopus	Supply limited; used by Italians	Dressed.
Frog legs (fresh-water)	Popular during season among French trade	Skinned.
Lobsters	Supply limited; popular	Live, cooked.
Mussels	Unpopular	Shell.
Terrapin	Sold mostly to hotels and restaurants	Live.
Turtle	do	Do.
Winkles	Not generally popular; used by English and Irish	Shell.

FRESH-WATER FISH MARKET

Approximately 60,000,000 pounds per annum of fresh and frozen fresh-water fishery products, representing 28 varieties, are handled by the 24 wholesale dealers of the fresh-water fish market. The majority of the fresh-water fishery products are sold to the Jewish trade.

PRODUCTS HANDLED

Important commercial species.—Seven species of fish constitute approximately 70 per cent of the volume of trade in fresh and frozen fresh-water fishery products.

TABLE 6.—*Fresh-water species upon which the bulk of the trade is based*

Species	Form in which received	Type of containers
Blue pike (pike perch)	Round	100-pound boxes.
Buffalofish	Round and dressed	100, 150, and 175 pound boxes; also live.
Carp, German	Round	100 and 150 pound boxes; also live.
Cisco	Round and dressed	100-pound boxes.
Sucker (mullet)	Round	50 and 100 pound boxes.
Whitefish	Round and dressed	100-pound boxes.
Yellow pike	Round	Do.

Species of moderate importance.—The five species represent about 20 per cent of the total amount of fish handled in the fresh-water fish market. In some instances certain species in this group would rank among the important commercial species if more could be produced.

TABLE 7.—*Fresh-water species of moderate importance*

Species	Reasons for moderate sale	Form in which received	Type of container
Lake herring	Substitute for cisco	Round	50 and 100 pound boxes.
Pickerel (grass pike, jacks).	Limited supply	do	100 pound boxes.
Red horse (sucker)	Limited supply; good demand	do	Do.
Sheepshead	Unpopular, though inexpensive	do	Do.
Yellow perch	Interchangeable with white perch.	do	Do.

Species for which there is small demand.—Limited quantities of 16 fresh-water fishery products are marketed at the fresh-water fish market. The products of this group represent about 10 per cent of the total amount handled.

TABLE 8.—*Fresh-water species for which there is small demand*

Products	Reasons for limited sale	Principal form in which received	Usual containers
Bowfin	Limited trade; not well known	Round	100 and 150 pound boxes.
Bullheads	do	Skinned	All-sized boxes.
Calico bass	Scarce; little demand; not well known.	Round	50 and 100 pound boxes.
Eels	Good trade; increasing; foreigners.	Round and skinned; live at Christmas.	All-sized boxes and barrels; live in barges.
Lake trout	Limited demand; increasing; supply can be increased; not well known.	Dressed and round	100-pound boxes.
Muskellunge and pike.	Very limited supply	Round	Mixed with pickerel in 100-pound boxes.
Rock bass	Supply limited; good sale	do	100-pound boxes.
Sauger (pike perch)	Seasonable variety; limited supply.	do	Do.
Smelts	Supply limited; good sale	do	10, 20, and 100 pound boxes.
Spoonbill cat	One-class trade; supply limited	Smoked and dressed.	Barrels of all sizes.
Sturgeon	do	do	Boxes and barrels.
Sunfish	Limited supply; good demand	Round	50 to 100 pound boxes.
Tullibee	Seasonable variety; supply limited.	Round and dressed	100-pound boxes.
Caviar (spoonbill)	Supply limited	Prepared	Cans, pails, and kegs of various sizes.
Caviar (sturgeon)	do	do	Do.
Frog legs	Limited trade; hotels and restaurants.	Skinned	Boxes and kegs.

REGULATIONS GOVERNING FISH STORES

Fish stores located in New York City are subject to the following regulations, as stated in the Sanitary Code of the Board of Health, City of New York, for 1922:

ARTICLE NO. 9

SEC. 150. REGULATIONS GOVERNING THE CONDUCT OF FISH STORES

Regulation 35. Construction of counters, workbenches, display cases, etc.: All counters, workbenches, refrigerated display cases, stationary trays, and appurtenances thereof used in the handling, displaying, and storing of fish and shellfish shall be of a smooth, hard material, and constructed and arranged so as to permit of thorough cleansing and ready access, and shall be water-tight and properly drained.

Regulation 36. Maintenance of counters, workbenches, display cases, etc.: All counters, workbenches, refrigerated display cases, stationary trays, and appurtenances thereof used in the handling, displaying, and storing of fish and shellfish shall be kept clean and sanitary and in good repair, and must be scrubbed in hot water and sal soda, or other suitable cleansing agent, at the close of each day's use.

Regulation 37. Iced fish and shellfish to be stored so as not to cause a nuisance: All iced fish and shellfish stored in wooden boxes or barrels shall be kept or stored in such a manner as not to cause a nuisance.

Regulation 38. Refrigeration: All fish shall be kept properly chilled or refrigerated at all times.

Regulation 39. Protection of fish when displayed for sale: All fish and shellfish displayed for sale shall be kept within closed refrigerator display cases or properly covered by close-mesh wire screening, so as to prevent unwarranted human handling and contamination by dust, dirt, and flies.

SEC. 171. SHELLFISH, SALE OF ADULTERATED OR MISBRANDED PROHIBITED

No person shall bring into the city of New York, or have, sell, or offer for sale, shellfish which are adulterated or misbranded. Shellfish shall be deemed adulterated—

1. If after removal from the shell they have been subjected to a process whereby their solid content is decreased or their volume increased.
2. If grown, floated, or cleansed in contaminated water, so as to render them unfit for food.
3. If they consist, wholly or in part, of diseased, decomposed, putrid, or rotten animal or vegetable substance.
4. If they contain any antiseptic or preservative injurious to health.
5. If they are floated in water of lower salinity than the water in which they were grown.
6. If any substance or substances has or have been mixed and packed with them so as to reduce or lower or injuriously affect their quality or strength.
7. If after removal from the shell they are cleansed in fresh water or water of a lower salinity than the water in which they were grown.

Shellfish shall be deemed misbranded—

1. If they are labeled or branded so as to deceive or mislead the purchaser.
2. If the container or its label shall bear any statement, design, or device regarding the shellfish or the other ingredients contained therein which statement, design, or device shall be false or misleading in any particular. (As amended by the board of health April 29, 1920.)

COLD STORAGE

Frozen fishery products received in New York City are usually transported to the wholesale fish markets for immediate sale. However, considerable quantities are held in cold-storage warehouses for future sale. Large quantities of fish caught in near-by waters are shipped fresh to New York City and Jersey City, and are frozen in freezing plants at those places for later consumption.

During the year ended December 15, 1924, 8,038,668 pounds of fishery products were frozen in New York City and Jersey City, and 15,922,258 pounds were received frozen, making a total of 23,960,926 pounds of frozen fishery products handled in these two cities of the metropolitan area. During the same period 24,691,820 pounds were withdrawn, while the quantity held over from the previous year amounted to 10,418,335 pounds. The reduction of the holdings for the year ended December 15, 1925, was 730,894, as compared with the holdings at the beginning of the year. The average number of firms engaged in the freezing of fishery products in 1924 was three, the average number of firms carrying cured fish was nine, and the average number engaged in the storing of fish was six.

TABLE 9.—*Quantities of frozen fish handled in cold storage in Greater New York City and Jersey City, N. J., monthly, for the year ended December 15, 1924*[1]

Month ended—	On hand at beginning of month	Frozen during month	Received frozen during month	Withdrawn during month	On hand at end of month
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
January 15	10, 418, 335	196, 359	2, 390, 063	3, 297, 497	9, 707, 260
February 15	9, 707, 260	754	2, 296, 022	3, 660, 152	8, 343, 884
March 15	8, 343, 884	6, 901	2, 140, 750	3, 940, 034	6, 551, 501
April 15	6, 551, 501	78, 003	1, 059, 064	3, 161, 907	4, 526, 661
May 15	4, 526, 661	839, 247	239, 954	1, 646, 970	3, 958, 892
June 15	3, 958, 892	1, 207, 855	165, 961	1, 023, 836	4, 308, 872
July 15	4, 308, 872	1, 055, 672	270, 425	644, 484	4, 990, 485
August 15	4, 990, 485	1, 059, 480	478, 514	835, 425	5, 693, 054
September 15	5, 693, 054	1, 014, 152	564, 333	1, 150, 146	6, 121, 393
October 15	6, 121, 393	1, 137, 864	1, 331, 318	1, 185, 176	7, 404, 399
November 15	7, 404, 399	918, 922	2, 195, 625	1, 776, 661	8, 742, 285
December 15	8, 742, 285	524, 459	2, 790, 229	2, 369, 532	9, 687, 441

[1] Prepared by the United States Department of Agriculture, Bureau of Agricultural Economics.

REGULATIONS GOVERNING COLD STORAGE

Certain regulations govern the conduct of cold-storage warehouses and food kept in cold storage in New York City. The following excerpts are taken from the Sanitary Code of the Board of Health, city of New York, for 1922:

ARTICLE 5

SEC. 72. COLD-STORAGE FOOD TO BE MARKED

It shall hereafter be unlawful for any person or persons, corporation or corporations, engaged in the business of cold-storage warehousemen or in the business of refrigerating, to receive any kind of food unless the said food is in an apparently pure and wholesome condition, and the food or the package containing the same is branded, stamped, or marked in some conspicuous place with the day, month, and year when the same is received in storage or refrigeration.

It shall be unlawful for any person or persons, corporation or corporations, engaged in the business of cold-storage warehousemen or in the business of refrigerating, to permit any article of any kind whatsoever used for food in the possession of any person or persons, corporation or corporations, engaged in the business of cold-storage warehousemen or refrigerating, to be taken from their possession without first having branded, stamped, or marked on said foodstuffs or the package containing same in a conspicuous place the day, month, and year when said foodstuffs or package was removed from cold-storage refrigeration.

It shall also be unlawful for any person or persons, corporation or corporations, to offer for storage in a cold-storage warehouse any article of food unless the same is in an apparently pure and wholesome condition.

SEC. 73. TIME THAT COLD-STORAGE FOOD MAY BE KEPT

It shall hereafter be unlawful for any person or persons, corporation or corporations, engaged in the business of cold-storage warehousemen or refrigerating, or for any person or corporation placing food in a cold-storage warehouse, to keep in storage for preservation or otherwise any kind of food or any article used for food a longer period than 12 calendar months. (As amended by the board of health December 31, 1918.)

SEC. 74. FOOD WHEN RELEASED FOR THE PURPOSE OF PLACING SAME ON MARKET FOR SALE NOT TO BE RETURNED TO COLD STORAGE

When food has been in cold storage or refrigeration and is released therefrom for the purpose of placing the same on the market for sale, it shall be a violation of the provisions of this article to again place such food in cold storage or refrigeration.

SEC. 75. FOOD KEPT IN COLD STORAGE NOT TO BE SOLD WITHOUT REPRESENTING THE FACT OF SUCH STORAGE

It shall be a violation of the provisions of this article to sell any article or articles of food that have been kept in cold storage or refrigeration without representing the same to have been so kept.

CONTAINERS

There are no standard containers for fish transported to and from the salt-water fish market of New York City, although boxes predominate for shipments received from the more remote sections, ranging from the 10, 15, and 25 pound North American smelt box to the large 200 and 300 pound North Pacific halibut box and the 500-pound Boston codfish box.

With the exception of the large outsize shrimp barrel, having a capacity of only about 150 pounds of shrimp, due to the large amount of ice required to keep the products fresh in transit from the South, consignments from the Middle Atlantic and South Atlantic usually arrive in standard-size sugar and flour barrels having an approximate capacity of 200 pounds. There are numbers of freezing plants along the New Jersey coast that ship their frozen fish in more or less standard-size boxes. Live crabs and lobsters are received in ordinary slat barrels with a net weight of about 100 to 125 pounds. Scallops are received in tubs weighing about 45 to 60 pounds. Soft crabs are received in the Chesapeake crab box, which is known to the trade as a "crab trunk," so called because of its several layers of trays. Shell clams and oysters are received in sacks with a capacity of about 90 pounds and barrels with a capacity of 270 to 300 pounds. Live fish are received in carload lots in specially constructed aerated tank cars. Live eels are brought in barges down the Erie Canal and Hudson River in the month of December for the holiday trade.

The lake fish usually are received by the fresh-water market in boxes such as the common 100-pound size, known as the "Lake Erie box," the 150-pound size, and also the especially constructed 140 and 175 pound sizes with handles.

The local wholesalers, especially those in the salt-water fish trade, express their desire for the adoption of standard boxes for the shipment of products received in their market. At present, with the products arriving in containers of all sizes and descriptions, the handling of the fish is difficult and necessitates delays.

For shipment of the smaller varieties of fish, such as pike, cisco, flounder, and similar varieties, the 100-pound box is suggested; the 140-pound box for varieties of medium size, such as the salmon and shad; and the 200 to 300 pound boxes for halibut. A box of larger size is cumbersome to handle. The smaller and medium sizes should be equipped with handles extending not more than 4 inches over each end. Each container should provide for the proper amount of fish, with sufficient space remaining for snow or ice to insure preservation en route.

From a selling standpoint the contents of such containers will represent a standard net weight for each class of fishery product. The contents could then be sold by the container (as is done now to a large extent in the fresh-water market), eliminating weighing and rehandling at the market. From the standpoint of transportation an express or freight car could be more completely filled. The extension handles make it easy to pick up and set down the container, and eliminate the possibility of upending the boxes while in transit. The 100 and 140 pound boxes, being of medium size, can easily be handled by two men.

Shipments made in containers of this style present a better appearance upon arrival at their destination. The fish lie flat in the boxes, and loss due to spoilage, caused by the breaking of the body wall of fish packed in containers not conforming to their size, will be eliminated. Also, the lower layers will not present that "squashed" appearance which is frequently the case with fish packed in boxes or barrels of larger dimensions and holding a greater quantity of fish.

Shrinkage of shipments made in boxes is about 1 per cent less than when made in barrels. While this amount is of no great significance in the case of a single package, the aggregate will amount to several hundred pounds where a carload shipment is involved.

The use of stencils is suggested where possible for marking the name and address of the consignee on the container, instead of using shipping tags for this purpose. Such stenciling should always be done on both ends of the boxes.

POPULATION OF THE METROPOLITAN AREA, 1920

The population of the metropolitan area of New York City within a radius of 19 miles of Fulton Fish Market, according to the 1920 census, was as follows:

New Jersey:	
Bergen County	194, 982
Passaic County	249, 742
Hudson County	629, 154
Union County	167, 233
Middlesex County	66, 177
Essex County	625, 089
Total	1, 959, 377
New York State:	
Westchester County	193, 342
Nassau County	47, 909
Total	241, 251
Greater New York:[1]	
Roman Catholic	1, 943, 370
Protestant	1, 941, 847
Jewish	1, 643, 012
Greek Catholic	91, 847
Total	5, 620, 048
Grand total	7, 820, 676

[1] Calculated on the basis of tabulations of a house-to-house religious canvass in all the boroughs for over 20 years, conducted by the New York Federation of Churches.

ESTIMATED POPULATION, 1924

The estimated population of the metropolitan area, computed by the arithmetical method, is as follows:

Grand total in 1920	7, 820, 676	7, 820, 676
Population in 1915	6, 984, 772	
Increase in 5 years	835, 904	
Increase in 1 year	167, 180. 8	
Increase in 4 years	668, 723. 2	668, 723
Total estimated population, 1924		8, 489, 499

PER CAPITA CONSUMPTION OF FISHERY PRODUCTS DURING 1924

The per capita consumption of fresh and frozen fishery products in the metropolitan district is influenced to no little extent by the comparatively large Jewish and Catholic populations, the foreign born, and also the daily transient population of perhaps 100,000 individuals.

Of the fresh and frozen fishery products received in New York City approximately 271,000,000 pounds, or 79 per cent, of the edible portion is consumed in the metropolitan area within a radius of 19 miles from Fulton Fish Market. The population of this area is about 8,500,000, giving a per-capita consumption for these products of 31.8 pounds.

On this basis the per-capita consumption of fresh and frozen fishery products per week is about six-tenths of a pound, or sufficient for about one meal. In other words, the people of the metropolitan area are eating fish on the average of once a week, probably on Tuesday or Friday.

Many of the wholesalers have asked whether local consumption can be increased. Fish is a tasty food, both clean and wholesome, and ranks high in dietary value. It is believed that by advertising these facts consumption can be materially stimulated.

TABLE 10.—*Directory of wholesale dealers in fresh and frozen fishery products in New York City*

Dealers	Salt-water fish	Fresh-water fish	Oysters	Clams	Other shell-fish
Ackerly & Sanderford, 9 Fulton Street	X				X
Acme Fish Co., Peck Slip		X			
Anderson & Price Fish Corporation, 27 Fulton Market	X				
Atlantic Coast Fisheries Corporation, 309 Water Street	X				X
Baldauf & McCarthy, 36 Fulton Market	X	X			X
Begloff Fish Co., 28 Peck Slip		X			
Berman Fish Co., 109 South Street		X			
Beyer Fish Co., 110-111 South Street	X	X			
Bishop & Pannen (Inc.), Fulton Market	X				
Booth Fisheries Co., 28 Fulton Market	X	X			
Brien & Mahon, 26 Fulton Market	X				
Caleb Haley & Co., 14 Fulton Market	X				
Century Fish Co., 39 Fulton Market	X		X	X	X
Chesebro Bros. & Robbins (Inc.), 123 Fulton Market	X	X		X	X
Conduit & Steiner, 144 Beekman Street	X				X
Cornelius, R. J., 39 Fulton Market	X	X			
Doane, Oscar L., 20 Fulton Market	X	X			
Doc Fish Co. (Inc.), Fulton Market	X				X
Day-Walters, 146 Beekman Street					X

TABLE 10.—*Directory of wholesale dealers in fresh and frozen fishery products in New York City*—Continued

Dealers	Salt-water fish	Fresh-water fish	Oysters	Clams	Other shell fish
De More & Gregory (Inc.), Fulton Market	X				X
Eagle Fish Co., 22 Peck Slip		X			
Eastern Shell Fish Co., 11 South Street			X	X	
Eldred & Haley (Inc.), 8 Fulton Market	X				X
Elliott Bros., 98 Fulton Market	X				X
Elsworth Co., J. & J. W., corner Fulton and South Streets			X	X	
Empire State Fish Co., 39 Peck Slip		X			
Feeney Corporation, John, 13 Fulton Market	X				
Finlay Fish Co., 233 Front Street		X			
Fort Fish Co., 146 Beekman Street	X	X			X
Fuccio & Vicedomini, 105 South Street	X				
Galilee Interstate Fish Corporation, Fulton Market	X	X			X
Globe Fish Co., 109 Fulton Market		X			
Goodman & Co., H., 113 South Street	X				
Haff, (Inc.), Alvah W., 12 Fulton Market	X				
Hall, R. F., & Co., 37 Fulton Market	X				X
Hanson, John J., 6 Fulton Market	X				X
Hayes & Co. (Inc.), Fulton Market	X				
Housman Oyster Co., N. P., foot of Pike Street			X	X	
Hunter & Trimm Co., 206 Front Street	X	X			X
Hyman, K., 30 Peck Slip		X			
Ihl Co., John B., 650 Hudson Street	X				
Jackson, G. W., 99 Fulton Market				X	
Kaiser, Joseph A., 2 Fulton Street	X				
Kaufman (Inc.), William, Peck Slip		X			
Keen, Harold W. J., 105 South Street	X	X			
Kurtz & Samuels, 41 Peck Slip		X			
Lakeside Fish Co., 43 Peck Slip		X			
LoVerde, Anthony, foot of Fulton Street	X				X
Lay Fish Co., 24 Peck Slip		X			
Leibner, Joseph, 50 Sheriff Street		[1] X			
Lester & Toner (Inc.), Fulton Market			X	X	X
Lockwood & Winant, 4 Fulton Market	X				
Lyons, Charles, 26 Peck Slip		X			
Majestic Fish Co. (Inc.), 38 Peck Slip		X			
Merrill & Son, J. I., foot of Pike Street			X	X	
Michaels, J. H., & Co., 204 Front Street	X				X
Miller & Co. (Inc.), S. B., 7 Fulton Market	X				
Minugh Co., J. M., 19 Fulton Market	X				X
Mischler Fish Co., 30 Peck Slip		X			
Moore & Co., 204 Front Street	[2] X	[2] X			
National Fisheries Co., 35 Peck Slip		X			
New Fish Co. (Inc.), 35 Peck Slip		X			
New York Fish Co., 15 Fulton Market	X				
Northwestern Fish Co., 24 Peck Slip		X			
Ocean Fish Co., 21 Fulton Market	X				
Olympic Fish Co. (Inc.), 110 South Street		X			
Parish Co., W. W., 113 South Street		X			
Pollock Fish Co., 41 Peck Slip		X			
Porth, William C., foot of Pike Street			X	X	
Portland Trawling Co., 1 Fulton Market	X				
Rogers & Co. (Inc.), H. M	X				
Sandiford & Co. (Inc.), 38 Fulton Market	X			X	X
Sea Tang Oyster Co., foot of Pike Street			X		
Sprague (Inc.), W. Elsworth, 102 South Street			X	X	X
Star Fish Co., 36 Peck Slip		X			
Stewart, J. L., 10 Fulton Market	X				
Still, Geo. M., foot of Pike Street			X	X	
Thompson, George, foot of Pike Street			X	X	
Treakle, J. Edwin, 20 Fulton Market	X				
Wadman & Co., C. G., 25 Fulton Market	X				X
Wallace, Keeney & Lynch Corporation, 18 Fulton Market	X			X	X
Wenig Live Fish Co., 435 East Houston Street		[1] X			
Williams & Perry, 24 Fulton Market	X	X			X
Willis, L. Vernon, 23 Fulton Market					[3] X
Wilson & Barry, Fulton Market	X				
Winant & Co., 203 Front Street	X	X			X
Winona Fish Co., 37 Peck Slip	X	X			

NOTE.—Eels are handled by a majority of the firms selling fresh and salt water fish.

[1] Live fish, carp, etc., only.
[2] Live terrapin and turtles only.
[3] Shrimp only.

TABLE 11.—*Summary of New York City market survey*

Item	Salt-water fish market	Fresh-water fish market	Total
Number of wholesale fish dealers	63	24	87
Number of species of fish handled	78	28	106
Species on which bulk of trade is based (70 per cent)	24	7	31
Species of moderate importance (20 per cent)	15	5	20
Species for which demand is slight (10 per cent)	39	16	55
Because supply is limited	14	10	24
Because species is unpopular	17		17
Sold chiefly to foreigners	2	1	3
Sold chiefly to hotels and restaurants	2	1	3
Because not well known	4	4	8
Principal containers:			
Boxes ... pounds	All kinds and sizes.	100–140 150–175	
Barrels ... do	200		
Quantity of products handled in 1924:			
Fish ... do	280,000,000	60,000,000	340,000,000
Bulk shellfish, including oysters, clams, crabs, etc ... do	54,000,000		54,000,000
Total	334,000,000	60,000,000	394,000,000
Edible fresh and frozen fishery products utilized in 1924 (exclusive of oyster and clam shells) ... pounds			346,000,000
Quantity consumed in metropolitan area (79 per cent) ... do			271,000,000
Quantity shipped to other States (19 per cent) ... do			67,000,000
Quantity used on railroad diners and steamships (1 per cent) ... do			4,000,000
Quantity exported (1 per cent) ... do			4,000,000
Estimated population of metropolitan area in 1924, within a radius of 19 miles from Fulton Fish Market ... number			8,489,499
Per capita consumption of fresh and frozen fishery products, 1924 ... pounds			31.8

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to New York City*

[Distances shown were taken from War Department mileages or War Department mileages in connection with Official Railway Guide. Notes to reference symbols are grouped at end of table]

Points of origin	Short-line travel distance, in miles	Rate in cents per 100 pounds: Fresh or frozen fish: Carload, freight	Rate in cents per 100 pounds: Fresh or frozen fish: Less-than-carload, freight	Rate in cents per 100 pounds: Fresh or frozen fish and oysters: Carload, express	Rate in cents per 100 pounds: Fresh or frozen fish and oysters: Less-than-carload, express
DOMINION OF CANADA					
Alberta:					
Cheecham	2,823	EI320½	F		XA1255
Edmonton	2,561	294	527		XA975
British Columbia:					
Prince Rupert	3,518	DG188	555	B428	XA1390
Vancouver	3,215	DG188	555	B428	A790
Manitoba:					
Gimli	1,823	I213½	389½	ACD500	A635
Hodgson	1,971	215	365		XA675
Langruth	1,959	213	362		#A635
Lundar	1,843	210	356		#A635
Mafeking	2,100	242	420		XA790
Ochre River	1,930	222	380		#A680
Riverton	1,849	I218½	397½		#A635
Selkirk	1,787	I207½	377½	ACD480	A635
Steep Rock	1,911	219	374		#A680
Winnipeg	1,765	192	323	AC401	A595
Winnipegosis	1,982	230	396	AC520	A735
New Brunswick:					
Bathurst	1,008	84½	151		#A340
Chatham	898	84½	151		#A320
Loggieville	903	84½	151		#A320
Port Elgin	836	85½	154		#A340
St. John	689	84½	151		XA320

Table 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to New York City*—Continued

Points of origin	Short-line travel distance, in miles	Rate in cents per 100 pounds			
		Fresh or frozen fish		Fresh or frozen fish and oysters	
		Carload, freight	Less-than-carload, freight	Carload, express	Less-than-carload, express
DOMINION OF CANADA—continued					
Nova Scotia:					
Halifax	967	85½	154	AC325	A350
Lunenburg	1,039	102	188½		XA395
Liverpool	1,081	102	192		XA375
Lockeport	1,116	102	195	AC350	A375
Yarmouth	1,217	102	192½		XA355
Ontario:					
Dunnville	439	73½	111		#A195
Port Burwell	570	73½	111		#A235
Port Dover	467	73½	111		#A210
Port Maitland	514	73½	M		#A195
St. Thomas	514	73½	111		XA245
Sault Ste. Marie	953	113½	170		XA355
Sudbury	774	104	156	AC290	A320
Toronto	549	73½	111		XA260
Quebec: La Reine		F	F		#A445
Saskatchewan:					
Big River	2,404	273	483		XA900
Moose Jaw	2,035	251	437		XA750
UNITED STATES					
Alabama: Mobile	1,230	94	218½		XA379
Arkansas:					
Felsenthal	1,382	171	341½		XA424
Helena	1,220	132	275½		XA379
Little Rock	1,291	146½	300		XA409
Pine Bluff	1,313	148	303		XA409
California:					
Monterey	3,249	D225	555	E428	A788
Pittsburg	3,165	D225	555	E428	A788
San Francisco	3,180	D225	555	E428	A788
Connecticut:					
New Haven	76	36	53½		XAH94
New London	127	42½	63½		XAH109
Noank	135	44	65½		XAH124
Delaware:					
Lewes	220	50	70		XAH139
Rehobeth	226	50	70		XAH139
District of Columbia: Washington	227	50	70		XA139
Florida:					
Apalachicola	1,115	B98½–A117	272		XA352
Bradentown	1,232	134	247½		XA367
Fernandina	1,019	B82½–A75½	176½		XA319
Fort Pierce	1,225	B114½–A135½	266½		XA379
Gulfport	1,170	115½	234½		
Jacksonville	983	B82½–A75½	176½		XA329
Key West	1,805	B126–A117½	239½		XA450
Miami	1,649	B126–A149½	284		XA409
Pensacola	1,214	B98½–A112½	232		XA379
St. Augustine	1,020	97½	198		XA326
Palatka	1,047	U82	U169		XA326
Tampa	1,195	B98½–A109	217		XA367
West Palm Beach	1,283	B122½–A144	273½		XA394
Georgia:					
Brunswick	923	B82½–A75½	176½		XA304
Savannah	845	B79–A75½	176½		XA296

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to New York City*—Continued

Points of origin	Short-line travel distance, in miles	Rate in cents per 100 pounds			
		Fresh or frozen fish		Fresh or frozen fish and oysters	
		Carload, freight	Less-than-carload, freight	Carload, express	Less-than-carload, express
UNITED STATES—continued					
Illinois:					
Depue	1,040	I104	I156		XA296
Havanna	1,006	I110½	I166		XA300
Henry	1,040	I104	I156		XA296
Kankakee	951	I94½	I142		XA285
Meredosia	1,048	I110½	I166		XA311
Peoria	1,006	I104	I156		XA300
Indiana: Evansville	987	I149	I199		XA296
Iowa:					
Bellevue	1,095	I110½	I166		XA311
Burlington	1,118	I110½	I166		XA311
Davenport	1,095	I110½	I166		XA300
Dubuque	1,079	I110½	I166		XA311
Harpers Ferry	1,229	I129½	I218	E320	A326
Keokuk	1,119	I110½	I166		XA311
Kentucky: Frankfort (I)	833	94½	142		XA274
Louisiana:					
Atchafalaya River	1,452	129	276½		
Atchafalaya				E359	A435
Houma	1,435	138½	292½	E359	A405
Monroe	1,359	139½	294½		XA439
Morgan City	1,445	141½	297½	E359	A465
New Orleans	1,345	94	219		XA405
Maine:					
Augusta	413	59½	90		XA199
Bowdoinham	385	59½	90		XA199
Eastport	586	83½	124½		XA232
Portland	350	58½	85½		XA154
Richmond	393	59½	90		XA199
Rockland	407	59½	90		#F139
Thomaston	403	59½	90		XA199
Maryland:					
Annapolis	212	61	90		XAH139
Baltimore	187	44	65		XAH124
Cambridge	235	50	70		XAH139
Crisfield	253	50	70		XAH139
Ocean City	241	BJ191 A50– BK95	A70		XAH139
Oxford	209	50	70		XAH139
Popes Creek	261	51	72½		XAH139
Massachusetts:					
Boston	214	50	66½		XA139
Chatham	305	50	66½		XA154
Fall River	183	50	66½		XA124
Gloucester	266	55½	79		XA154
Nantucket		L55½	L66		XA165
New Bedrord	219	50	66½		XA139
Newburyport	275	55½	79		XA154
Provincetown	288	50	66½		XA154
Vineyard Haven		L49	L63		XA165
Michigan:					
Brimley	875	I151½	I256½		XA416
Chatham	870	I152	I256½		XA397
Monroe	729	I73½	I111	E229	A255
Mount Clemens	715	I73½	I111		XA270
Port Huron	648	I73½	I111		XA270
Trenton	708	I73½	I111		XA262
Minnesota:					
Clinton	1,447	164½	294		XA450
Duluth	1,277	137½	241		XA412
Fairmont	1,397	142	251½		XA386
Granite Falls	1,406	161½	285½		XA427
Madison Lake	1,368	135½	238		XA394
Milan	1,437	160	277½		XA442
Minneapolis	1,317	135½	233½	E320	A394
Ortonville	1,447	160	282		XA450
Rainer	1,386	194½	399½		XA491

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to New York City*—Continued

Points of origin	Short-line travel distance, in miles	Rate in cents per 100 pounds			
		Fresh or frozen fish		Fresh or frozen fish and oysters	
		Carload, freight	Less-than-carload, freight	Carload, express	Less-than-carload, express
UNITED STATES—continued					
Minnesota—Continued.					
Redby	1,416	203½	355		
Round Lake	1,438	143	263½		XA405
St. Paul	1,307	135½	233½	E320	A394
Warroad	1,453	191	344	E428	A506
Wayzata	1,329	146½	254½		XA394
Mississippi:					
Biloxi	1,290	94	218½		XA379
Gulfport	1,299	94	218½		XA394
Natchez	1,337	94	218½		XA405
Vicksburg	1,283	94	218½		XA394
Missouri: St. Louis	1,065	I110½	I166		XA300
Montana: Bowdoin	2,352	279½	491½	E428	A649
New Jersey:					
Anglesia	176	44	69		XA109
Atlantic City	158	41½	59½		XA109
Barnegat City	190	46	56½		
Barnegat					XA109
Cape May	181	44	69		XA139
Manasquan	83	28½	41½		XA86
Port Monmouth	36	25	34		XA86
Port Morris	47	28½	40½		
Seabright	46	25	34		XA86
Seaside Park	96	31½	47½		XA94
Wildwood	179	44	69		XA109
New York:					
Bayport	54	32	46		XAH86
Black Rock	400	54½	79		XA184
Brewerton	307	47½	66½		XA154
Buffalo	396	54½	79		#A123
Cape Vincent	357	56½	83½		#A151
Dunkirk	460	56½	85		#A151
Glen Head	28	28	36½		XA75
Greenport	97	41½	54		XAH94
Irving	425	56½	85		#A151
Matteawan	62	40½	56½		XA79
Montauk	120	41½	54	ACG70	AHX109
Pulaski	300	55½	79		XA154
Sayville	54	28	38		XAH86
Sodus Point	369	46	69		XA169
Westfield	454	56½	85		#A151
North Carolina:					
Beaufort	555	B87½–A54	133		XA229
Columbia	461	72	166½		XA229
Elizabeth City	402	48½	121½		XA202
Hertford	418	52	129½		XA202
Mackeys	439	54	133		XA229
Manteo	520	58½	144		
Morehead City	552	B80½–A54	133		XA229
New Bern	517	51	R306–T196 S346–133		XA214
Southport	618	66½	155½		XA266
Wilmington	588	58½	144		XA244
Ohio:					
Ashtabula	564	I63	I94½	E199	A221
Cleveland	579	I67	I101	E229	A232
Lorain	605	I72	I108		XA244
Port Clinton	652	I73½	I111	E229	A244
Sandusky	639	I73½	I111	E229	A244
Toledo	701	I73½	I111	E229	A255
Venice	644	I73½	I111		XA244
Vermilion	623	I73½	I111		XA244

TABLE 12.—*Short-line travel distance and freight and express rates on fresh and frozen fish and oysters from principal sources of supply to New York City*—Continued

Points of origin	Short-line travel distance, in miles	Rate in cents per 100 pounds			
		Fresh or frozen fish		Fresh or frozen fish and oysters	
		Carload, freight	Less-than-carload, freight	Carload, express	Less-than-carload, express
UNITED STATES—continued					
Oregon:					
Astoria	3,262	DG188	555	E428	A788
Gardiner	3,388	DG188	555		
Portland	3,162	DG188	555	E428	A788
Rainier	3,208	DG188	555	E428	A788
Reedsport	3,389	DG188	555	E428	A788
Pennsylvania:					
Erie	484	56½	85	E185	A221
Philadelphia	92	28½	41½		XA109
Rhode Island:					
Block Island		F	F		XAH176
Narragansett Pier	170	47½	66½		
Narragansett					XAH124
Newport	165	50	66½		XAH124
South Carolina:					
Charleston	739	B71½–A72	166½		XA277
Georgetown	702	B59½–A72	166½		XA266
South Dakota: Watertown	1,519	163½	288		XA450
Tennessee: Memphis	1,158	87½	202½		XA364
Texas:					
Corpus Christi	1,954	AI355–B209½	389½		XA607
Galveston	2,117	AI355–HB189½	389½		XA532
Liberty	1,747	AI355–BI209½	389½		XA499
Matagorda	2,114	AI355–B209½	389½		XA547
Orange	1,602	AI355–B209½	389½		XA480
Virginia:					
Cape Charles	310	51	76		XAH154
Chincoteague	266	50	70		XAH154
Exmore	287	51	76		XAH154
Hampton	338	32	102½		XAH202
Norfolk	347	31	79		XAH202
Old Point Comfort	335	31	79		XAH202
Portsmouth	346	31	79		XAH202
Princess Anne Courthouse	362	V38½	104½		XAH202
Virginia Beach	364	V41½	110½		XAH214
Washington:					
Aberdeen	3,213	DG188	555	E428	A788
Ephrata	2,909	DG188	555	E428	A788
Everett	3,093	DG188	555	E428	A788
Seattle	3,107	DG188	555	E428	A788
Snohomish	3,084	DG188	555	E428	A788
Wisconsin:					
Bay City	1,262	135½	233½	E320	A371
Bayfield	1,372	135½	233½		XA394
Beaver Dam	1,059	122½	203½		XA304
Big Suamico	1,132	106½	160½		XA349
Fort Atkinson	1,020	111½	167½	E320	A296
Green Bay	1,106	101	151½		XA349
Oconto	1,152	106½	160½		XA352
Sheboygan	1,046	94½	142		XA296
Superior	1,371	135½	233½		XA412

EXPLANATION OF REFERENCE MARKS GOVERNING THE FREIGHT RATES

Unless otherwise shown, the following will govern all the freight rates:

Less-than-carload shipments must be in barrels or boxes, or barrels with cloth tops.

No less-than-carload shipment handled for less than 50 cents, and no carload for less than $15.

Less-than-carload and "any quantity" rates do not obligate the carrier to provide protection against heat, etc.

Carload rates are subject to a minimum weight of 24,000 pounds.

Carload rates do not include the expense of refrigeration.

When ice or other preservative is in the bunker of the car no charge will be made for its transportation; but if ice is taken by consignee charges shall be made on actual weight of the ice in bunkers at destination and at the carload rate applicable on the freight which it accompanies; if not taken it becomes the property of the carrier.

Ice or other preservative placed in the body of the car for protection of the freight, when permitted, is subject to the same provisions as govern ice in the bunkers.

No allowance in weight will be made for ice or other preservative placed in the same package with the freight.

A.—Applies on "frozen fish" only.

B.—Applies on "fresh fish" only.

C.—Carload minimum weight 20,000 pounds.

D.—Carload minimum weight 30,000 pounds.

E.—Carload minimum weight 30,000 pounds for $1.85 and 24,000 pounds for the balance of the rate.

F.—Rates not on file with Interstate Commerce Commission.

G.—Fresh fish packed in ice will be billed and charges collected thereon at the gross weight of the fish including the packages (less 6,000 pounds for ice), subject to minimum carload weight as provided above.

Frozen fish will be billed and charges collected thereon at gross weight of the fish including package; no deductions will be made for preservatives loaded in the body of the car, unless sawdust is used, when actual weight of sawdust will be deducted, with a maximum allowance of 3,000 pounds, subject to minimum carload weight as provided above.

The allowances as above are for preservatives in the packages or the body of the car and do not include ice in the tanks or bunkers.

H.—6,000 pounds will be the allowance (without charge) of preservative (ice) on shipments of fresh fish up to East St. Louis, Ill.

I.—Fresh fish in packages, iced, may be billed from April 1 to November 30, inclusive, at actual gross weight, less 20 per cent for weight of ice used. From December 1 to March 31, inclusive, full gross weight, including weight of ice, shall be charged. (Applies from points on and east of the Mississippi River, north of the Ohio River, and to the eastern portion of the rates from points west thereof when so referenced.)

J.—Per standard barrel or standard barrel box, any quantity.

K.—Per standard half barrel or standard half-barrel box, any quantity.

L.—Applies via all-water route.

M.—No less-than-carload freight handled.

R.—Fresh fish in flour barrels (estimated weight 275 pounds per barrel), rates per barrel.

S.—Fresh fish in sugar barrels or standard boxes (estimated weight 250 pounds per barrel or box), rates per barrel or box.

T.—Fresh fish in half boxes (estimated weight 200 pounds per half box), rates per half box.

U.—Rates apply via "rail and water" routes.

V.—Also additional rates per package, as follows: Fresh fish, 173 cents per flour barrel, 195 cents per sugar barrel, 195 cents per standard box, 128 cents per half box.

EXPLANATION OF REFERENCE MARKS GOVERNING THE EXPRESS RATES

#.—Any quantity, commodity rate.

X.—Any quantity, second-class rate.

A.—Must be charged for on basis of gross weight, except that fresh or frozen fish shipped with ice, which is necessary for its preservation, must be charged for on the basis of 25 per cent added to the net weight of the fish, unless actual gross weight is less at time of shipment.

The minimum billing weight of any iced shipment of fish under this rule is 40 pounds, unless the gross weight is less.

On shipments of fresh salmon, packed with ice or snow, from points in Canada the minimum billing weight will be 75 pounds per box unless the gross weight is less. (Effective May 10, 1925.)

B.—Fresh fish will be charged for on basis of net weight of the fish. Frozen fish will be charged for on gross weight. Minimum weight 20,000 pounds per car.

C.—Minimum weight 20,000 pounds per car.

D.—Applies only on shipments routed Dominion Express Co., via Hamilton, Ontario, or Montreal, Quebec.

E.—Minimum weight 20,000 pounds on basis of net weight.

F.—Applies only on fresh fish in barrels containing water and ice. Charges must be assessed on the following basis: Barrels of 2 bushels capacity, 225 pounds; barrels of more than 2 bushels capacity to be charged on the basis of gross weight less 25 per cent.

G.—Delivery to be taken at Long Island City, N. Y., by consignee.

H.—Oysters in shell, glass jars, canned, or in bulk. When shipped in bulk, estimated at 12 pounds per gallon, shippers must mark upon each package the number of gallons contained therein. In glass jars, estimate 24 pints at 45 pounds, 36 pints at 65 pounds, 48 pints at 90 pounds; 48 half-pints at 50 pounds.

The following estimated weights will apply to oysters in metal cans with or without ice, when packed in boxes: One-tenth gallon cans, 1¼ pounds each; pint cans, 1½ pounds each; standard or three-fourth cans, 2 pounds each; one-fifth gallon cans, 2½ pounds each; full quart cans, 3 pounds each; half-gallon cans, 6 pounds each; gallon cans, 12 pounds each.

Shippers must mark the exact number and the kind of cans on the case.

Gross weight at time of shipment will apply when less than estimated weight shown.

On mixed shipments of fish and oysters shipped with ice necessary for preservation, charge on the basis of 25 per cent added to the net weight of the fish, plus the weight of the oysters, as specified above.

The minimum billing weight of such a mixed shipment is 40 pounds, unless the gross weight is less, in which event the gross weight will apply.

K.—Minimum billing weight, 12,000 pounds on the following basis: When in shell, actual weight; shucked oysters in carriers, estimate at 12 pounds per gallon; shucked oysters in naked cans without other packing, charge on the basis of actual weight of the oysters and containers.

No charge will be made for transportation of necessary chopped ice, packed on top or around the cans; nor, when refrigerator cars are used, will any charge be made for transportation of ice in the bunkers.

The cost of all ice furnished by the express company must be paid by shipper or consignee.

TABLE 13.—*Salt-water fishery products obtainable*

[The months of the year are represented by the figures 1 to 12 and

Product	Sources of supply and when in season											
	Quebec	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	New York	New Jersey
Albacore	-----	-----	-----	-----	-----	-----	-----	9–12	7–11	-----	9–12	6–11
Bluefish	-----	-----	-----	-----	-----	-----	-----	9–10	9–11	-----	8–12	5–11
Blue runner	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bonito	-----	-----	-----	-----	-----	-----	-----	9–12	7–11	-----	9–11	7–11
Butterfish	-----	-----	-----	-----	-----	-----	-----	6–12	5–10	-----	5–11	5–11
Cod	12–3	-----	12–3	12–3	-----	2–5	2–5	1–12	3–11	12–6	11–6	10–3
Croakers	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5–11
Dabs	-----	-----	-----	-----	-----	-----	-----	12–5	12–5	12–5	-----	-----
Drum, black	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7–10
Drum, red	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Eels	10–1	10–1	10–1	10–1	10–1	6–12	-----	1–12	[1] 5–10	[1] 5–10	5–11	[1] 4–12
Flounders	9–3	-----	-----	-----	9–3	1–4	-----	1–12	1–12	1–12	1–12	[1] 12–6
Fluke	-----	-----	-----	-----	-----	-----	-----	6–10	5–11	1–12	5–12	5–11
Grouper	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Haddock	12–3	-----	12–2	12–2	12–2	2–5	-----	1–12	5–7	6–12	-----	-----
Hake, red	12–3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5–12
Hake, white	12–3	-----	-----	-----	-----	2–5	2–5	1–12	5–9	-----	-----	5–12
Halibut	3–6, 9–12	-----	-----	3–9	-----	4–10	-----	1–12	-----	-----	-----	-----
Herring, large	-----	1–12	-----	1–12	-----	2–11	-----	2–11	3–11	3–12	3–12	4–11
Herring, small	-----	-----	-----	-----	-----	4–11	-----	4–12	7–9	-----	4–7	-----
Jewfish	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Kingfish	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
King whiting	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6–11	5–11
Mackerel	5–10	-----	6–8	6–11	6–8	6–11	6–11	6–11	5–11	6–11	4–7	4–6
Mullet	-----	-----	-----	-----	-----	2–7	-----	-----	-----	-----	-----	-----
Permits	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pilotfish	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pollock	12–3	-----	-----	12–2	-----	11–2	11–2	1–12	5–7	-----	-----	-----
Pompano	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Red snapper	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosefish	-----	-----	-----	-----	-----	12–3	-----	-----	-----	-----	-----	-----
Salmon, Atlantic	5–8	6–7	-----	6–9	6–9	-----	-----	-----	-----	-----	-----	-----
Salmon, Pacific	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Scup	-----	-----	-----	-----	-----	-----	-----	5–10	5–10	-----	5–10	5–10
Sea bass	-----	-----	-----	-----	-----	-----	-----	5–8	5–7	-----	5–7	5–11
Sea gar	-----	-----	-----	-----	-----	-----	-----	8–12	9–12	-----	-----	-----
Sea robins	-----	-----	-----	-----	-----	-----	-----	5–9	5–9	-----	5–9	-----
Sea trout, spotted	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Shad	-----	-----	-----	6–8	5–6	-----	-----	5–7	5–7	5–6	5–6	4–6
Sheepshead	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Skate	-----	-----	-----	-----	-----	5–2	-----	7–2	6–12	-----	12–6	4–10
Smelts	9–11	10–2	11–3	11–3	11–2	1–5	-----	-----	3–4	-----	2–5	-----
Sergeantfish	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sole	-----	-----	-----	-----	-----	-----	-----	1–12	1–12	-----	-----	-----
Spanish mackerel	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Spot	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6–9	6–11
Striped bass	10–12	-----	-----	9–3	5–8	-----	-----	5–10	5–11	-----	4–6, 11–1	11–1
Sturgeon	5–12	-----	-----	5–10	4–12	6–11	-----	6–11	5–10	-----	5–7	5–11
Swordfish	-----	-----	-----	-----	-----	-----	-----	-----	7–9	-----	7–9	-----
Tautog	-----	-----	-----	-----	-----	-----	-----	8–10	6–12	12–2	6–12	5–11
Tilefish	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10–5	-----
Tomcod	-----	-----	-----	-----	12–3	12–4	-----	11–4	-----	-----	10–5	-----
Weakfish	-----	-----	-----	-----	-----	-----	-----	8–11	5–10	-----	5–6	5–12
Whitebait	-----	-----	-----	-----	-----	-----	-----	1–6	-----	-----	8–6	-----
White perch	3–9	-----	-----	-----	3–8	2–12	-----	11–4	5–10	-----	9–6	9–6
Whiting	-----	-----	-----	-----	-----	-----	-----	6–12	5–12	-----	6–12	5–12
Clams, hard	-----	-----	3–9	3–9	5–8	1–12	-----	1–12	1–12	-----	-----	1–12
Clams, soft	-----	-----	-----	-----	5–8	1–12	-----	1–12	1–12	-----	1–12	1–12
Conchs	-----	-----	-----	-----	-----	4–11	-----	4–11	4–11	-----	4–11	-----
Crabs	3–9	-----	-----	-----	-----	-----	-----	-----	-----	-----	8–10	8–10
Crabs, rock	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Lobsters	5–7	5–7	6–9	5–7	4–10	1–12	-----	2–12	4–11	5–12	4–11	5–11
Mussels	-----	-----	-----	-----	1–12	1–12	-----	1–12	1–12	-----	1–12	1–12
Octopus	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Oysters	-----	-----	-----	-----	-----	-----	-----	9–5	9–5	9–5	9–5	9–5
Scallops, bay	-----	-----	-----	-----	-----	-----	-----	10–4	10–1	-----	9–4	-----
Scallops, sea	9–11	-----	-----	10–5	12–4	11–4	-----	1–12	1–12	-----	1–12	-----
Sea urchins	-----	-----	-----	3–9	3–9	3–9	-----	-----	-----	-----	-----	-----
Shrimp	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Squid	-----	-----	-----	-----	-----	5–11	-----	5–11	5–11	-----	5–8	5–11
Terrapin	-----	-----	-----	-----	-----	-----	-----	11–4	11–4	11–4	11–4	11–4
Turtle, green	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Turtle, sea	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5–11	5–11
Winkles	-----	-----	5–9	3–12	5–9	4–11	-----	4–11	-----	-----	1–12	-----

[1] A few all year.

in the wholesale fish markets of New York City

are inclusive. Example: 5–11 means May to November, inclusive]

Sources of supply and when in season															
Delaware	Maryland	Virginia	North Carolina	South Carolina	Georgia	Florida	Alabama	Mississippi	Louisiana	Texas	Alaska	British Columbia	Washington	Oregon	California
5–11	5–11	4–11	4–12	4–12	4–9	10–5	10–5								
						11–5									
	7–11	6–11	4–6												
5–11	4–12	4–12	4–11												
		1–3	3–5												
4–7	4–11	3–11	2–11												
	1–10	1–10				12–5									
						11–4									
3–1	3–11	1–12	1–12	1–12	1–12	11–4									
1–12	1–12	1–12													
5–12	4–12	5–12													
				12–4	12–4	11–4									
											2–11	2–11	2–11		
3–6	3–5	3–5	2–5												
						12–4									
				5–6	3–6	1–4									
	5–8	4–8	10–5	10–5		1–4									
		4–5													
10–6	4–10	6–9	2–4		1–5	11–4									
			8–10	4–10	1–12	12–4	12–4								
						11–5									
		7–10	8–10	4–10	1–12	12–4	12–4								
				4–6	11–5	1–12									
											1–12	1–12	1–12	1–12	7–11
5–11	4–9	4–9		1–5											
	5–11	5–11		12–5	11–5	12–5									
			11–5	11–5	11–5	11–4									
4–6	3–5	3–5	2–5	2–4	2–4	12–3								{11–6 8–9	11–6 8–9
					10–2	11–5	12–3	12–3							
						11–4									
		6–9	4–7		11–4	10–5	12–4								
6–9	6–9	7–10													
12–7	{3–6 10–12}	12–6	11–5												
4–6	3–10	4–11	5–6	4–9	4–6	5–7		11–1							
5–10	4–11	4–11													
2–5	6–5	12–5				11–5									
	5–6														
	1–12	1–12	1–12												
	12–4	12–4													
5–10	1–12	1–12	3–5												
						12–5									
5–10						[2] 1–3									
				10–5											1–12
9–5	9–5	9–5													
	12–4	12–6	12–4												
			5–12	4–12	3–12	1–12	12–4	12–4		10–5					
5–11	4–6	4–6													1–12
11–4	11–4	10–5	11–4	11–5	11–5	11–5	11–5	11–5	11–5	11–5					
				9–6		1–12									
	5–9														

[2] Spiny lobsters.

Table 14.—*Fresh-water fishery products obtainable in the wholesale fish markets of New York City*

[The months of the year are represented by the figures 1 to 12 and are inclusive. Example: 5–11 means May to November, inclusive]

Species	Sources of supply and when in season								
	Quebec	Maine	Vermont	New York	Pennsylvania	Virginia	Kentucky	Tennessee	Alabama
Bass, calico				5–6					
Bass, rock				5–6					
Bowfin				4–5		3–5			
Buffalofish								1–4	1–4
Bullhead				5					
Carp				5–7 9–10		3–5		1–4	
Cisco				3–12	3–12				
Perch, yellow	5–6		11–4	5–6	3–5	3			
Pickerel	1–12		11–4	5–6 10–11					
Pike, blue				1–12	3–5				
Pike, yellow	1–12		11–4	12–3					
Red horse				4–6					
Smelts	12–3	12–4		1–2					
Spoonbill cat							12–3	12–3	12–3
Sturgeon	5–12			5–7					
Suckers		12–4		4–6	3–6				
Sunfish				4–10					
Trout, lake				4–11					
Whitefish	9–12 5			4–5 11	4–5				
Frogs	6–10			6–10					

Species	Sources of supply and when in season								
	Mississippi	Louisiana	Ohio	Illinois	Michigan	Wisconsin	Minnesota	Iowa	Missouri
Bowfin				3–5		3–5			
Buffalofish	11–5	11–3		9–5		9–5	11–4	9–5	1–4
Bullhead							6–10		
Carp			3–11	9–5	4–10	1–12	11–4	9–5	1–4
Cisco			3–12						
Lake herring					1–12	1–3			
Perch, yellow			3–5		1–12	1–3			
Pike, blue			3–5						
Pike, yellow			3–5		1–12	1–3			
Red horse						4–5			
Saugar			11–5		4–5				
Sheepshead			3–6			2–3			
Spoonbill cat	12–3	12–3							12–3
Sturgeon			4–12		1–12		6–10		
Suckers			4–5			11–4			
Whitefish			4–5 11–12			9–12	9–10		
Frogs		6–10							

TABLE 14.—*Fresh-water fishery products obtainable in the wholesale fish markets of New York City*—Continued

Species	Sources of supply and when in season								
	Arkansas	Oklahoma	Texas	South Dakota	Montana	Washington	Ontario	Manitoba	Alberta
Bass, rock							4–5		
Bowfin							4–5		
Buffalofish	11–5		11–4	12–2					
Bullhead				4–5			4–6		
Carp				12–2	12–4	4–9	3–10		
Cisco							3–12		
Lake herring							10–12		
Muskellunge							12–2		
Perch, yellow							3–12	12–3	
Pickerel							1–12	12–3	1–3
Pike, blue							3–12		
Pike, yellow							1–12	12–3	1–3
Red horse							3–12		
Sauger							3–12	12–3	
Sheepshead							5–7		
Spoonbill cat	12–3	12–3	12–3						
Sturgeon							5–12	11–2	
Suckers							1–12	12–3	
Sunfish							3–12		
Tullibee								12–3	
Trout, lake							4–11		
Whitefish							3–12	12–3	
Frogs			6–10						

FISHERY INDUSTRIES OF THE UNITED STATES, 1924 [1]

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Assistant in Charge, Division of Fishery Industries

CONTENTS

[1] Appendix VII to the Report of the United States Commissioner of Fisheries for 1925. B. F. Doc. 997.

INTRODUCTION

During 1924 the fishery industries appear to have reached the end of their period of recovery from the postwar depression, which was so severely felt during 1919 and to a lesser extent in subsequent years. In general, the production of fish and fishery products was greater in volume than during the previous year, but the prices which they commanded were somewhat lower.

According to statistics collected on various geographical sections during the past five years over 190,000 persons are engaged in the fisheries and related industries, about $200,000,000 is invested, and the annual yield by fishermen is about 2,600,000,000 pounds of fish, shellfish, and other aquatic products, for which the fishermen receive about $90,000,000. The output of canned fishery products in 1924 was valued at $72,000,000, and the yield of by-products exceeded $10,000,000 in value.

SUMMARY OF OPERATIONS

The technological work of the division during 1924 included a continuation of experiments in the canning of sardines in California and Maine; continuation of investigations relative to the use of copper oleate as a net preservative, with particular reference to preservative action and comparative costs in actual commercial operation; investigation of the utilization of wastes in the fishery industries; and analyses of canned, salted, and smoked fish and shellfish to determine their iodine content. These investigations are fully discussed in following pages.

The statistical work included the collection and monthly publication of statistics of the landings of fish by vessels at the ports of Boston and Gloucester, Mass.; Portland, Me.; and Seattle, Wash., with publication of annual bulletins summarizing these landings for the year; monthly publication of statistics on the cold-storage holdings of fish, which are collected by the Bureau of Agricultural Economics, Department of Agriculture; collection of the statistics on quarterly production, consumption, and holdings of oils in the fishery industries for use of the Bureau of the Census; collection of the statistics on the production of canned fishery products and by-products of the United States and Alaska for the year 1924; compilation and publication of the statistics of the fisheries of the Mississippi River and tributaries and the Great Lakes; compilation of statistics of the fisheries of the Pacific coast in 1922; and collection of statistics on the fisheries of the South Atlantic and Gulf States for 1923.

Including those published in this report, the most recent detailed statistics available for each of the various geographical sections are as follows: New England States, 1919; New York, New Jersey, and Delaware, 1921; Maryland and Virginia, 1920; South Atlantic States, 1923; Gulf States, 1918; Pacific Coast States, 1922 and 1923; Mississippi River and tributaries, 1922; and Great Lakes, 1922.

In order to make results of statistical canvasses and technological research available to those interested, 16,000 copies of statistical bulletins on 42 subjects were distributed to interested persons, and over 1,600 letters were written in reply to specific requests for statistical, technological, and trade information.

In response to urgent requests from men in the crab industry, a special investigation to determine the cause for the present serious condition of this industry was begun during the latter part of 1924 and is being continued.

PUBLICATIONS OF THE DIVISION

During the calendar year 1923 the following publications, prepared in this division, were issued. This list does not include the monthly statistical bulletins for Boston and Gloucester, Mass.; Portland, Me.; and Seattle, Wash., nor the monthly publication of the cold-storage holdings of frozen fish.

DOCUMENTS

Iodine content of sea foods; by Donald K. Tressler and Arthur W. Wells, 8°, 12 pp. Document No. 967.

Fishery industries of the United States, 1923; by Oscar E. Sette, 8°, 219 pp. Document No. 976.

STATISTICAL BULLETINS

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Seattle, Wash., by American fishing vessels during the calendar year 1923. Statistical Bulletin No. 598.

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1923. Statistical Bulletin No. 599.

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1923. Statistical Bulletin No. 600.

Fisheries of the Mississippi River and tributaries, 1922. Statistical Bulletin No. 607.

Canned fishery products and by-products of the United States and Alaska, 1923. Statistical Bulletin No. 608.

Fisheries of the Great Lakes, Lake of the Woods, and Rainey Lake, 1922. Statistical Bulletin No. 618.

Fisheries of Alaska, 1923. Statistical Bulletin No. 625.

TECHNOLOGICAL INVESTIGATIONS

The bureau is giving attention to such technological research as limited funds and personnel permit. Its policy is to select broad, fundamental studies which are urgent, which promise to be of greatest value to the largest number, and which the fisheries industries themselves are least capable of undertaking. These industries offer excellent opportunities for the application of science, and a large amount of research in this field must be conducted before they can be placed on the same plane of efficiency as similar industries in other fields. Few realize, especially in the fisheries industries, the advancements which can be brought about by means of well-directed, adequately supported, technological investigations, and it is important that the bureau demonstrate the possibilities of such research. Rapid progress of the fisheries industries depends largely upon work of this nature combined with the application of sound business principles.

CANNING SARDINES

Sardine canning is an important part of the fishery industries. In 1924 over 3,250,000 cases were packed, having a value in excess of $12,500,000. These figures place this industry next to that of salmon canning in importance and, excluding Alaska salmon, first among our canned fishery products. This industry, too, can be greatly expanded, there being large supplies of herring, pilchards, and like fishes which can be utilized. In time, undoubtedly, this expansion will take place, due to the increasing world demand for cheap food of high protein content.

Our canned sardines, meet very keen competition at home and abroad, however, and if we are to capture and hold our share of the world markets our products must be high in quality as well as low in price. Since 1920 the bureau has been conducting research upon the preparation of fish for canning as sardines, making available lacking fundamental scientific information upon this important subject and working toward the development of a better and cheaper method of preparing the fish. Considerable success is being attained along these lines.

In the last report mention was made of the development and successful operation on small and semicommercial scales of a new process of preparing fish for canning as sardines. This method was developed in the bureau's experimental laboratory at San Pedro, Calif. Since then experiments have been carried out in Maine, ending in the successful application of the same process to the preparation of Maine sardines.

The new process depends on rapidly moving hot air to cook and dry the fish at the same time, followed, if desired, by a period of cooling in a blast of cold air so that they may be packed immediately. An additional development was brought forward by the Maine experiments—while simultaneously drying and cooking small fish they can also be given a light smoking by the simple and inexpensive procedure of adding smoke to the drying air.

It is firmly believed that no other method of preparing fish for canning as sardines offers equal possibilities for lowering the production costs and improving the products made from both small and large fish in California and Maine. The packs put up by the new process from California fish are, in the long run, better than similar products which have been fried in oil. The same is true with regard to packs produced by the new method as compared with goods prepared from steamed and fried fish in Maine.

Tests extensive enough to prove the above claims have been carried out. It remains to be shown, however, how well the process will work out on a commercial scale. For this purpose a commercial-sized installation of relatively expensive equipment, different from any now being used, is required. Engineering companies will design and construct equipment and make guaranties both upon the equipment itself and the cost of operation. These guaranties in effect assure successful operation, but even with these assurances there is reluctance upon the part of the canners to scrap old equipment and purchase new until there is positive proof that the venture will be successful both from the technical and business standpoints. It is becoming evident that some plan for bringing about development of the process on a large scale must be formulated which will eliminate most of the risk to the canners. This phase of the problem is now receiving consideration.

UTILIZATION OF BY-PRODUCTS

Considerable progress has been made in the last few years in the utilization of the large quantities of waste fish and offal from fish markets and concerns manufacturing preserved products. Oil can be extracted from most fish waste and the residue made into fish meal. These products are very valuable. The oil is used in making soaps, paints, in tanning leather, and for many other purposes, and the meal serves as a stock and poultry food and as a fertilizer. Although considerable has been accomplished in eliminating waste, much yet remains to be done. Less than half the supply of waste products of the fisheries is now being utilized, and present practices of manufacturing fish meal and oil, both from offal and from non-edible fish, are in general quite inefficient. There are also possibilities for producing better and more valuable products. The bureau is especially interested in these problems, as any improvement which can be brought, either through education or by research, increases the prosperity of the fisheries industries and contributes to national economy.

Some phases of this problem are of particular importance at this time. Ways should be developed of either eliminating the press liquors or of economically recovering and utilizing the protein matter which is present in these liquors and now discarded. This material is not only a large waste but it seriously pollutes our coastal waters in some places. There is need for small, inexpensive plants to handle small quantities of offal, such as collect in many places, and for equipment to handle profitably large quantities of material for a period of 4 to 6 weeks of each year. At present it only pays to handle relatively large amounts of fish or offal where operation can be continuous over a good part of the year. Research is now being conducted along these lines.

PRESERVATION OF NETS

Many very good reports are being received concerning the use of copper oleate as a net preservative. It is proving particularly effective on pound nets, especially in combination with copper paint. On the coasts of Long Island and New Jersey tarred netting ordinarily lasts but two season and has to be taken from the water about twice a month during part of the season in order that hydroids, barnacles, and other growths may be removed. Where the copper oleate-copper paint mixture is used it is only necessary to remove the netting for treatment about every two months, there being no growth. Under such conditions with the twine in a pound net costing around $4,000 for each net it is proving very profitable to use this mixture.

Unfavorable reports also are received, and in many cases fishermen who started to use copper oleate have gone back to old methods of preserving their twine. Copper oleate may be applied improperly or used for a purpose for which it was not intended, and cases of dissatisfaction are frequently traced to these causes. Copper oleate, however, has proved to be an excellent preservative and antifouling agent for fish nets wherever used properly. Usually a fisherman considers only the first cost and does not consider whether it might not be much cheaper in the long run to frequently treat his nets with copper oleate rather than to buy new netting.

The full value of cooper oleate as a net preservative can not be determined until accurate data are available upon the costs of treating netting with different preservatives, including copper oleate, and the length of life of the twine so treated. Practical tests of this nature have been arranged in cooperation with fishermen at several points on the Atlantic seaboard and on the Great Lakes. These tests will also show the advantages and disadvantages of using copper oleate under practical conditions and indicate what modifications in its use are necessary for different kinds of gear under the widely varying conditions to which they are subjected.

Cordage manufacturers are finding copper oleate to be a good preservative and antifouling agent for manila rope. At least one company now sells for marine use a line of rope treated with this material.

IODINE CONTENT OF PRESERVED SEA FOODS

In a paper published during 1924 (Bureau of Fisheries Document No. 967) it was shown that fresh sea foods contain a higher percentage of iodine than other common foods. It was pointed out that since goiter and other thyroid disorders are caused by a lack of iodine being ingested, the liberal use of sea foods in the diet should be an effective preventive of these disorders, especially in so-called goiterous belts where the iodine content of the water and foods is below normal. The amount of iodine necessary to prevent goiter is very small—only about one part in 3,000,000 parts of the body weight—but it is important that this balance be maintained.

Many of these goiterous belts are so located that it is rather difficult for the inhabitants to obtain marine fish in the fresh condition. Much of the marine fish which they consume has been preserved in some manner, such as canning, salting, and smoking. The question naturally arises as to whether these preserved products contain iodine in quantities comparable to that in fresh fish. A series of analyses was made which indicates that such products do contain comparable quantities of iodine. The results of these analyses were published in Bureau of Fisheries Document No. 979.

CRAB FISHERY OF CHESAPEAKE BAY

Due to the alarming decline in the crab production of Chesapeake Bay, particularly along the eastern shore, the bureau was strongly urged to investigate this industry. Very little information was available upon which to base a determination of the character or reasons for the decline, and it was therefore first necessary to make a statistical survey in which particular attention was directed to the discovery of such statistics on catches during previous years as could be found in the records of crab houses. An analysis of such statistics as were found indicated that the decline in abundance of crabs took place well in advance of a decline in total catch. The total catch did not decline seriously until sometime between 1915 and 1920, whereas the catch per boat began its most serious decline in 1909, and the total catch has since been maintained by vastly greater fishing effort. Apparently in recent years the scarcity of crabs has been so pronounced that high prices and greater fishing effort have not been productive of a yield sufficient to meet present demands. All available data point to the fact that the depletion is due to overfishing and not to natural causes.

A feature of the soft-crab industry which came to light upon examining the records of crab houses was the excessive losses in converting peeler crabs into soft crabs. Among 10 firms whose records were made available there was a loss of 30 to 70 per cent in the shedder floats during the year. The average loss was over 50 per cent. This was due almost exclusively to the practice of taking crabs long before they were in the true peeler stage and attempting to hold them for extended periods of time in the hope that they would shed and become soft crabs.

There are well-defined differences which take place in the external appearance of the crab as it approaches shedding time and these are well known to fishermen. Two firms which accepted only crabs in the advances peeler stage sustained shedding losses averaging only 15 per cent. It was recommended that steps be taken to avoid these losses, and, with active interest of administrating officials of both States in this matter, it is believed that the evil will be rectified.

Although this may bring about an improvement of conditions in the crab industry, it will be necessary to employ more drastic measures to bring about a satisfactory recovery of the fishery. Surveys are now under way to determine the relationship of the Virginia and Maryland fisheries to the depletion of the general stock of crabs and the probable effect of restrictive measures.

TRAWL-NET FISHERY OF CHESAPEAKE BAY AND TRIBUTARIES

During the winter of 1924–25 trawl-net fishermen were reported to be operating in the Patuxent River and Chesapeake Bay with a new and destructive type of gear. At the urgent invitation of the Conservation Department of Maryland the writer was detailed to cooperate in observing this fishery and investigating its destructiveness.

It was found that the net operated was essentially a small otter trawl, fished in the deeper waters of this region in the wintertime when the white perch (*Morone americana*) and striped bass (*Roccus lineatus*) were concentrated in the deeper "holes" and could be caught by this gear in unusually large quantities.

Actual counts of fish taken by this gear showed that 20 to 55 per cent of white perch and 25 to 50 per cent of the striped bass were under the size which was legal in the State of Maryland, and observations indicated that these undersized fish when returned to the water did not survive.

The conclusions drawn from the investigation were:

1. This fishery catches from 20 to 55 per cent of small, unmarketable fish, few of which can survive.
2. This fishery can destroy large quantities of brood stock necessary to perpetuate the species.

3. A continuation of the fishery might seriously deplete the white perch and striped bass of the Patuxent River and Chesapeake Bay or of any waters where similar conditions obtain.

It was therefore recommended that the Conservation Department of Maryland prohibit this fishery, and subsequent advices received from the department indicate that it has been entirely stopped.

CANNED FISHERY PRODUCTS AND BY-PRODUCTS OF THE UNITED STATES AND ALASKA, 1924

The fish-canning and by-products industries of the United States and Alaska attained a production in 1924 valued at $82,473,579, of which canned goods amounted to $72,164,589 and by-products to $10,308,990. This is a decrease of 0.4 per cent in the value of canned products and of 18.4 per cent in the value of by-products as compared with 1923. Named in order of value, the most important canned products in 1924 were salmon, sardines, tuna, shrimp, and oysters. Of the by-products, fish oils, fish scrap and meal, and crushed oyster shells were most important.

CANNED FISHERY PRODUCTS

SALMON

In 1924 there were 186 plants engaged in canning salmon in the Pacific Coast States and Alaska as compared with 188 in the previous year. Of the total in 1924, 130 were operated in Alaska, 32 in Washington, 22 in Oregon, and 2 in California. The pack of canned salmon, on the basis of forty-eight 1-pound cans to the case, amounted to 6,253,577 cases, valued at $42,401,602, as compared with 6,402,906 cases, valued at $45,533,573, in 1923, a decrease of 2.3 per cent in quantity and 6.9 per cent in value.

In the Pacific Coast States the pack amounted to 958,662 cases, valued at $9,394,467, as follows: Chinook, 349,014 cases, valued at $4,599,759; sockeye, 85,800 cases, valued at $1,478,698; coho or silver, 231,139 cases, valued at $1,774,078; humpback or pink, 12,778 cases, valued at $79,436; chum, 247,858 cases, valued at $1,192,156; steelhead, 32,073 cases, valued at $270,340; and other salmon products valued at $122,228. Of the total canned salmon in the Pacific Coast States Washington produced 541,962 cases, valued at $5,062,082, and Oregon and California together 416,700 cases, valued at $4,332,385.

In Alaska the pack amounted to 5,294,915 cases, valued at $33,007,135, divided as follows: Chinook, 33,648 cases, valued at $299,009; red or sockeye, 1,447,895 cases, valued at $13,803,932; coho or silver, 183,601 cases, valued at $1,254,551; humpback or pink, 2,601,283 cases, valued at $12,837,346; and chum or keta, 1,028,488 cases, valued at $4,812,297. Of the total 2,787,789 cases, valued at $14,711,842, were packed in the southeastern district; 1,605,107 cases, valued at $10,067,602, in the central district; and 902,019 cases, valued at $8,227,691, in the western district.

Compared with 1923, there was a decrease of three plants in Washington and an increase of one each in Oregon, Alaska, and California. The pack in the Pacific Coast States decreased 29.9 per cent in quantity and 25.8 per cent in value. Most of the decrease was due to the very small pack of humpbacks, although the packs of chinooks, sockeyes, and silvers also decreased. The pack of chums was larger than in 1923 and the pack of steelheads about the same. In Alaska the pack increased 5.2 per cent in quantity and 0.4 per cent in value. The increase of the Alaska pack was due almost entirely to the unusually large pack of humpbacks in the central district, although the pack of cohos was also larger than in 1923. A distinct decrease of nearly 50 per cent occurred in the pack of chums. The packs of kings or chinooks and reds or sockeyes also decreased.

Pack of canned salmon, 1924

Products	Pacific Coast States						Alaska	
	Washington		Oregon and California		Total		Southeast	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
King, chinook, or spring:								
1-pound tall	17, 613	$102, 160	11, 173	$89, 374	28, 786	$191, 534	2, 566	$18, 555
1-pound flat	36, 161	477, 056	95, 865	1, 184, 459	132, 026	1, 661, 515	4, 721	44, 622
1-pound oval	2, 355	47, 100	4, 554	89, 140	6, 909	136, 240		
½-pound flat	78, 111	1, 089, 469	102, 578	1, 508, 921	180, 689	2, 598, 390	995	11, 516
½-pound oval	360	7, 200	244	4, 880	604	12, 080		
Total	134, 600	1, 722, 985	214, 414	2, 876, 774	349, 014	4, 599, 759	8, 282	74, 693
Red or sockeye:								
1-pound tall	211	2, 954			211	2, 954	140, 989	1, 291, 148
1-pound flat	16, 215	227, 012			16, 215	227, 012	39, 717	415, 789
½-pound flat	64, 160	1, 154, 880	5, 214	93, 852	69, 374	1, 248, 732	11, 801	156, 738
Total	80, 586	1, 384, 846	5, 214	93, 852	85, 800	1, 478, 698	192, 507	1, 863, 675
Coho or silver:								
1-pound tall	55, 769	392, 539	49, 332	345, 324	105, 101	737, 863	100, 016	667, 530
1-pound flat	38, 221	290, 481	40, 546	305, 841	78. 767	596, 322	5, 034	45, 367
½-pound flat	23, 734	223, 354	23, 537	216, 539	47, 271	439, 893	4, 939	50, 649
Total	117, 724	906, 374	113, 415	867, 704	231, 139	1, 774, 078	109, 989	763, 546
Humpback or pink:								
1-pound tall	2, 841	14, 205	2, 438	12, 190	5, 279	26, 395	1, 647, 157	8, 079, 281
1-pound flat			776	4, 190	776	4, 190	8, 932	51, 796
½-pound flat	5, 964	43, 386	759	5, 465	6, 723	48, 851	21, 365	151, 507
Total	8, 805	57, 591	3, 973	21, 845	12, 778	79, 436	1, 677, 454	8, 282, 584
Chum or keta:								
1-pound tall	173, 812	794, 534	42, 478	195, 399	216, 290	989, 933	798, 581	3, 722, 311
1-pound flat			1, 353	6, 494	1, 353	6, 494	630	2, 819
½-pound flat	15, 184	103, 492	15, 031	92, 237	30, 215	195, 729	346	2, 214
Total	188, 996	898, 026	58, 862	294, 130	247. 858	1, 192, 156	799, 557	3. 727, 344
Steelhead:								
1-pound tall	3, 262	20, 878	196	1, 254	3, 458	22, 132		
1-pound flat	2, 961	20, 727	8, 926	61, 880	11, 887	82, 607		
½-pound flat and oval	5, 028	50, 655	11, 700	114, 946	16, 728	165, 601		
Total	11, 251	92, 260	20, 822	178, 080	32, 073	270, 340		
Grand total	541, 962	5, 062, 082	416, 700	4, 332, 385	958, 662	9, 394, 467	2, 787, 789	14, 711, 842

Pack of canned salmon, 1924—Continued

Products	Alaska—Continued						Grand total	
	Central		Western		Total			
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
King, chinook, or spring:								
1-pound tall	5, 246	$44, 871	14, 835	$119, 298	22, 647	$182, 724	51, 433	$374, 258
1-pound flat	4, 779	54, 475			9, 500	99, 097	141, 526	1, 760, 612
1-pound oval							6, 909	136, 240
½-pound flat	506	5, 672			1, 501	17, 188	182, 190	2, 615, 578
½-pound oval							604	12, 080
Total	10, 531	105, 018	14, 835	119, 298	33, 648	299, 009	382, 662	4, 898, 768
Red or sockeye:								
1-pound tall	361, 021	3, 339, 510	803, 586	7, 638, 051	1, 305, 596	12, 268, 709	1, 305, 807	12, 271, 663
1-pound flat	63, 201	633, 365	7, 434	70, 794	110, 352	1, 119, 948	126, 567	1, 346, 960
½-pound flat	15, 827	200, 801	4, 319	57, 736	31, 947	415, 275	101, 321	1, 664, 007
Total	440, 049	4, 173, 676	815, 339	7, 766, 581	1, 447, 895	13, 803, 932	1, 533, 695	15, 282, 630
Coho or silver:								
1-pound tall	65, 691	433, 070	4, 432	26, 909	170, 139	1, 127, 509	275, 240	1, 865, 372
1-pound flat	369	2, 462			5, 403	47, 829	84, 170	644, 151
½-pound flat	3, 120	28, 564			8, 059	79, 213	55, 330	519, 106
Total	69, 180	464, 096	4, 432	26, 909	183, 601	1, 254, 551	414, 740	3, 028, 629
Humpback or pink:								
1-pound tall	888, 250	4, 390, 431	31, 416	142, 205	2, 566, 823	12, 611, 917	2, 572, 102	12, 638, 312
1-pound flat	4, 163	22, 126			13, 095	73, 922	13, 871	78, 112
½-pound flat					21, 365	151, 507	28, 088	200, 358
Total	892, 413	4, 412, 557	31, 416	142, 205	2, 601, 283	12, 837, 346	2, 614, 061	12, 916, 782
Chum or keta:								
1-pound tall	192, 934	912, 255	35, 997	172, 698	1, 027, 512	4, 807, 264	1, 243, 802	5, 797, 197
1-pound flat					630	2, 819	1, 983	9, 313
½-pound flat					346	2, 214	30, 561	197, 943
Total	192, 934	912, 255	35, 997	172, 698	1, 028, 488	4, 812, 297	1, 276, 346	6, 004, 453
Steelhead:								
1-pound tall							3, 458	22, 132
1-pound flat							11, 887	82, 607
½-pound flat and oval							16, 728	165, 601
Total							32, 073	270, 340
Grand total	1, 605, 107	10, 067, 602	902, 019	8, 227, 691	5, 294, 915	33, 007, 135	6, 253, 577	42, 401, 602

NOTE.—The pack of salmon has been reduced to the equivalent of forty-eight 1-pound cans to the case. There were other salmon products, valued at $125,174, not shown in the above table.

SARDINES

In 1924 there were 28 plants canning sardines in Maine, 1 in Massachusetts, and 24 in California. This is a decrease of one plant in Maine and an increase of two plants in California, as compared with 1923. The total pack in Maine, Massachusetts, and California was valued at $12,636,599, as compared to $9,896,796 in 1923, an increase of 28 per cent.

In Maine and Massachusetts there were produced 1,819,868 cases of various sizes, which are equivalent to 1,899,925 standard cases of 100 quarter-pound tins, valued at $7,191,026, as compared with 1,272,277 standard cases, valued at $5,288,865, in the previous year, an increase of 49.3 per cent in quantity and 36.0 per cent in value. The average price per standard case was $3.78 in 1924, as compared to $4.16 in 1923.

In California there were produced 1,407,731 cases of various sizes, which are equivalent to 1,367,139 standard cases of forty-eight 1-pound tins, valued at $5,445,573, as compared with 1,100,162 standard cases, valued at $4,607,931 in 1923, an increase of 24.3 per cent in quantity and 18.2 per cent in value. The average price per standard case has declined continuously since 1921, the averages being as follows: $5.89 in 1921, $4.70 in 1922, $4.19 in 1923, and $3.98 in 1924.

Pack of canned sardines, 1924

Sardines (herring)	Maine and Massachusetts		Sardines (pilchard)	California	
	Cases	*Value*		*Cases*	*Value*
In olive oil: Quarters (100 cans)	39,012	$247,025	½-pound oval (48 cans) [1]	16,934	$49,349
In cottonseed oil: Quarters (100 cans)	[2] 1,464,830	5,664,578	1-pound oval (48 cans):		
In mustard:			In tomato sauce	1,240,905	4,494,233
Quarters (100 cans)	114,296	483,867	In mustard	46,675	173,749
Three-quarters (48 cans)	[3] 181,948	707,366	Soused	4,098	15,266
In tomato sauce: Quarters (100 cans)	19,782	88,190	Spiced	5,217	18,623
			In other sauces	22,587	89,113
			¼-pound square (100 cans) [4]	[5] 67,386	552,536
			½-pound square (100 cans) [4]	[6] 3,929	52,704
Total	1,819,868	7,191,026	Total	1,407,731	5,445,573

[1] Largely in tomato sauce.
[2] Includes a few cases of ¾-pound cans, 50 to the case, which have been converted to the basis of ¼-pound cans, 100 to the case.
[3] Includes a few cases of 50 cans each which have been converted to a basis of 48 cans to the case.
[4] Largely in oil.
[5] Includes a few cases packed round, 24 cans each, which have been converted to a basis of 100 cans to the case.
[6] Includes a few cases of 48 cans each, which have been converted to a basis of 100 cans to the case.

SHAD AND ALEWIVES

Shad and shad roe were canned at 7 plants in Washington, 11 in Oregon, and 1 in California. The total pack amounted to 9,686 cases of various sizes, valued at $93,393, as compared to 3,409 cases, valued at $52,483, in 1923. Alewives and alewife roe were packed at 8 plants in Maryland, 22 in Virginia, and 3 in North Carolina. The total pack amounted to 92,142 cases, valued at $337,363, as compared with 43,920 cases, valued at $171,350, in 1923.

Pack of shad and alewives, 1924

Shad	Washington, Oregon, and California		Alewives	Maryland, Virginia, and North Carolina	
	Cases	*Value*		*Cases*	*Value*
½-pound flat and oval (48 cans)	1,774	$3,712	No. 1 and No. 2 (24 cans)	[1] 3,306	$5,118
1-pound tall (48 cans)	5,583	16,749	Roe: No. ½, No. 1, and No. 2 (24 cans)	[1] 88,836	332,245
Roe:					
½-pound flat (48 cans)	228	4,104			
½-pound oval (48 cans)	2,101	68,828			
Total	9,686	93,393	Total	92,142	337,363

[1] The pack of alewives and alewife roe has been reduced to the equivalent of No. 2, 15-ounce cans, 24 to the case.

TUNA AND TUNALIKE FISHES

In 1924, 19 plants were canning tuna and tunalike fishes. All of them were in California, just as in 1923. The total production amounted to 708,752 cases of various sizes, which were equivalent to 652,416 standard cases of 48 half-pound tins, valued at $5,756,586. This is a decrease of 20.2 per cent in quantity and 16.8 per cent in value, as compared to the pack of the previous year.

The pack of tuna and tunalike fishes includes albacore (put up under the name of "white-meated tuna"), yellowfin and bluefin tuna, striped tuna or skipjack, "tonno," bonito, and skipjack. "Tonno" is prepared from striped tuna and the blue and yellowfin tunas, but mostly from the first named. It consists of a highly seasoned and spiced pack put up in oil after the Italian method. The 1924 pack shows a decided increase of the albacore, of which there was an unusually large run in the southern waters. The pack might have been larger but for a fishermen's strike occurring at the height of the season. The packs of the other tunas were considerably smaller than in 1923, especially that of the yellowfin tuna, which is caught largely in waters off the coast of Mexico. The average price received for all kinds of tuna was $8.80 per standard case, as compared with $8.45 in 1923.

Pack of tuna and tunalike fishes, 1924

Sizes	Albacore		Yellowfin		Bluefin		Tuna, bluefin, and yellowfin	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
¼-pound round (48 cans)	45,773	$274,924	5,234	$21,979	[1] 5,373	$24,683	621	$2,484
½-pound round (48 cans)	292,268	2,804,603	26,307	172,448	13,922	103,442	8,464	59,248
1-pound round (48 cans)	50,833	944,982	2,405	27,846	2,370	29,359	1,043	13,559
Total	388,874	4,024,509	33,944	222,273	21,665	157,484	10,128	75,291

Sizes	Tuna, striped		"Tonno"		Bonito		Yellowtail		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
¼-pound round (48 cans)	[1] 6,219	$23,194	[1] 160,819	$728,016	[1] 15,319	$64,772			239,356	$1,140,052
½-pound round (48 cans)	33,923	188,446	[2] 15,566	120,240	5,239	30,034	[3] 10,365	$52,965	406,054	3,531,426
1-pound round (48 cans)	3,063	27,558	664	13,605			2,964	28,199	63,342	1,085,108
Total	43,205	239,198	177,049	861,861	20,558	94,806	13,329	81,164	708,752	5,756,586

[1] Includes the pack of 100 cans to the case, which has been converted to the equivalent of 48 cans to the case.
[2] Includes the pack of 50 cans to the case, which has been converted to the equivalent of 48 cans to the case.
[3] Includes a few cases of ¼-pound round, which have been converted to a basis of ½-pound round.

SHRIMP AND CRABS

In 1924, 94 canneries were engaged in canning shrimp, 30 of these being in Louisiana, 26 in Mississippi, 12 in Georgia, 9 in Florida, 7 in Alabama, 5 in Texas, 3 in North Carolina, 1 in South Carolina, and 1 in New York. The total pack of shrimp amounted to 752,471 cases of various sizes, which were equivalent to 718,517 standard cases of 48 No. 1 cans, valued at $4,608,950. This is an increase of 2.6 per cent in quantity and 5.2 per cent in value, as compared with the production in 1923.

Crabs were canned at 1 plant in Alaska, 1 in Maine, 1 in Maryland, 2 in Virginia, and 1 in Mississippi, making a total of 6 plants, as compared with 9 in 1923. The total pack amounted to 3,563 cases of various sizes, valued at $35,944. Compared with 1923, when the pack amounted to 4,138 cases of various sizes, valued at $47,023, this is a distinct decrease.

Pack of shrimp and crabs, 1924

Shrimp	Georgia, North Carolina, and South Carolina		Florida		Alabama	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
No. 1 dry (4 dozen)	20,107	$126,416	2,245	$13,985	26,467	$160,519
No. 1 wet (4 dozen)	61,997	385,748	34,346	223,932	22,167	132,353
No. 1½ dry (2 dozen)	5,311	32,065	1,162	7,437	4,501	28,200
No. 1½ wet (2 dozen)	1,146	7,008	888	5,615	388	2,250
Total	88,561	551,237	38,641	250,969	53,523	323,322

Shrimp	Mississippi		Louisiana and Texas		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
No. 1 dry (4 dozen)	18,757	$110,906	[1] 236,559	$1,417,661	304,135	$1,829,487
No. 1 wet (4 dozen)	90,638	548,661	132,251	884,131	341,399	2,174,825
No. 1½ dry (2 dozen)	4,704	29,516	22,225	138,993	37,903	236,211
No. 1½ wet (2 dozen)	232	1,406	2,444	15,152	5,098	31,431
Total	114,331	690,489	393,479	2,455,937	[2] 688,535	[2] 4,271,954

Crabs	Alaska, Maine, Maryland, Virginia, and Mississippi	
	Cases	*Value*
7½, 8, 9, and 12 ounce (4 dozen)	[3] 3,004	$29,572
15, 16, and 17 ounce (2 dozen)	[4] 559	6,372
Total	3,563	35,944

[1] Includes a few cases packed 4 ounces to the can, which have been converted to the equivalent of No. 1 5-ounce cans.
[2] In addition to the above there were packed in 5¼, 5¾, 6¼, 14, and 18 ounce glass jars in Florida, Alabama, Mississippi, New York, and Texas, 63,936 cases of shrimp, valued at $336,996, making a total of 752,471 cases, valued at $4,608,950.
[3] The 8, 9, and 12 ounce cans have been converted to the equivalent of 7¼-ounce cans, 4 dozen to the case.
[4] The 16 and 17 ounce cans have been converted to the equivalent of 15-ounce cans, 2 dozen to the case.

CLAMS

The pack of clams of all kinds in 1924 amounted to 389,435 cases of various sizes, valued at $2,161,389. Razor clams were canned at 19 plants in Washington, 4 in Oregon, and 13 in Alaska, the total pack amounting to 113,717 cases of various sizes, valued at $863,684. This is a decrease as compared with the previous year, when 130,389 cases, valued at $883,844, were packed. The decrease occurred entirely in the Pacific Coast States, Alaska's pack being larger than in 1923.

Hard clams were packed at 2 plants in Florida, 1 in Georgia, 1 in Rhode Island, and 4 in Washington. The pack, exclusive of chowders, bouillon, and juices, amounted to 38,544 cases, valued at $271,911. Soft clams were packed in 19 plants in Maine and 2 in Massachusetts, the pack, exclusive of chowders, etc., amounting to 80,561 cases of various sizes, valued at $459,882. The chowders, soups, bouillon, and juices of both hard and soft clams totaled 156,613 cases of various sizes, valued at $565,912.

Pack of clams, 1924

RAZOR CLAMS

Sizes	Washington and Oregon		Alaska		Total	
	Cases	Value	Cases	Value	Cases	Value
Whole:						
No. 1 (4 dozen) and No. 2 (2 dozen)	1,490	$11,333			1,490	$11,333
1-pound (4 dozen)	1,628	19,686	8,020	$75,315	9,648	95,001
5-pound (½ dozen)			1,200	7,650	1,200	7,650
10-pound (½ dozen)			65	585	65	585
Minced:						
½-pound flat (4 dozen)	12,132	87,064	52,131	354,961	64,263	442,025
No. 1 (4 dozen)	14,210	110,131	21,074	185,456	35,284	295,587
No. 2 (2 dozen)	677	4,231			677	4,231
1-pound (4 dozen)	140	1,269	645	5,172	785	6,441
10-pound (½ dozen)			26	273	26	273
Juice: No. 2 (2 dozen)	279	558			279	558
Total	30,556	234,272	83,161	629,412	113,717	863,684

HARD CLAMS

Sizes	Florida and Washington	
	Cases	Value
Whole:		
1-pound (4 dozen)	2,074	$18,043
No. 1 (4 dozen)	11,010	82,458
No. 2 (2 dozen)	14,179	81,267
No. 10 (½ dozen)	2,800	38,071
Minced:		
No. 1 (4 dozen)	[1] 5,402	34,943
No. 2 (2 dozen	[2] 3,079	17,129
Total	38,544	271,911

SOFT CLAMS

Sizes	Rhode Island, Maine, and Massachusetts	
	Cases	Value
Whole:		
5-ounce (4 dozen)	[3] 57,991	$294,639
8-ounce (4 dozen)	[4] 17,477	140,804
10-ounce (2 dozen)	5,093	24,439
Total	80,561	459,882

OTHER HARD AND SOFT CLAM PRODUCTS

Sizes	Maine, Florida, Massachusetts, Georgia, Rhode Island, and Washington	
	Cases	Value
Chowder and soup:		
No. 1 (2 dozen)	[5] 78,719	$179,711
No. 1½ and No. 2 (2 dozen)	[6] 24,355	89,036
No. 3 (2 dozen)	43,612	239,274
No. 10 (½ dozen)	2,022	10,261
Bouillon and juice: 10-ounce (4 dozen)	[7] 7,905	47,630
Total	156,613	565,912

[1] Includes the pack of ½-pound flat cans which has been converted to a basis of No. 1 cans, 4 dozen to the case.
[2] Includes a few cases of No. 10 cans, ½ dozen to the case, which have been converted to a basis of No. 2 cans, 2 dozen to the case.
[3] Includes a few cases of 4-ounce cans converted to a basis of 5-ounce cans.
[4] Includes the pack of 6, 8, and 8½ ounce cans, 2 dozen to the case, which has been converted to a basis of 8-ounce cans, 4 dozen to the case.
[5] Includes a few cases of No. ½ cans, 2 dozen to the case, which have been converted to a basis of No. 1 cans, 2 dozen to the case.
[6] The pack of No. 2 cans, 2 dozen to the case, has been reduced to the equivalent of No. 1½ cans, 2 dozen to the case.
[7] The pack of clam bouillon and juice has been converted to the equivalent of 10-ounce cans, 4 dozen to the case.

OYSTERS

Oysters were canned at 9 plants in Maryland, 6 in North Carolina, 13 in South Carolina, 6 in Georgia, 6 in Florida, 5 in Alabama, 21 in Mississippi, 6 in Louisiana, and 1 in Texas. The total pack amounted to 460,427 cases of various sizes, which were equivalent in quantity to 447,481 standard cases of forty-eight 5-ounce tins, valued at $2,478,044. This is a decrease of 14.7 per cent in quantity and 8.9 per cent in value, as compared with the previous year. The average price per standard case of oysters has increased constantly since 1922, the figures being $4.79, $5.19, and $5.54 in 1922, 1923, and 1924, respectively.

Pack of oysters, 1924

Sizes	Maryland		North Carolina		South Carolina		Georgia	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
4-ounce (4 dozen)	7,343	$42,441	668	$3,337	[1] 12,855	$61,101		
5-ounce (4 dozen)	40,715	260,370	32,221	167,958	72,387	365,300	12,120	$65,046
6-ounce (4 dozen)	7,684	82,446			104	1,040		
8-ounce (2 dozen)	3,138	17,618			2,195	10,293		
10-ounce (2 dozen)	9,092	57,255	3,968	19,318	16,267	73,095	106	575
12-ounce (2 dozen)	723	7,925						
Total	68,695	468,055	36,857	190,613	103,808	510,829	12,226	65,621

Sizes	Florida		Alabama		Mississippi		Louisiana and Texas		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
4-ounce (4 dozen)					32,035	$155,553			52,901	$262,432
5-ounce (4 dozen)	12,608	$67,163	9,922	$49,896	120,189	632,762	7,585	$44,315	307,747	1,652,810
6-ounce (4 dozen)							2,000	13,600	9,788	97,086
8-ounce (2 dozen)	278	1,251			16,730	81,393			22,341	110,555
10-ounce (2 dozen)	400	2,000	1,500	7,500	35,594	187,493			66,927	347,236
12-ounce (2 dozen)									723	7,925
Total	13,286	70,414	11,422	57,396	204,548	1,057,201	9,585	57,915	460,427	2,478,044

[1] Includes pack of 3-ounce cans converted to the equivalent of 4-ounce cans, 4 dozen to the case.

MISCELLANEOUS CANNED PRODUCTS

During 1924 there were produced miscellaneous canned fishery products, not mentioned above, as follows: In Maine, Massachusetts, New York, New Jersey, Maryland, Virginia, North Carolina, Georgia, Florida, and Oregon, 5,836,164 pounds of canned fish, turtles, and terrapin, valued at $1,083,941, and 956,428 pounds of fish roe, valued at $251,695; and in California 33,294 cases of tuna flakes, abalone, barracuda, mackerel, squid, and "tuniento," valued at $193,909.

Comparative statistics of canned fishery products from 1921 to 1924

Year	Salmon					
	Pacific Coast States		Alaska		Total	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	1,002,948	$9,234,425	2,596,826	$19,632,744	3,599,774	$28,867,169
1922	733,246	8,633,524	4,501,652	29,787,193	5,234,898	38,420,717
1923	1,367,263	12,660,566	5,035,697	32,873,007	6,402,960	45,533,573
1924	958,662	9,394,467	5,294,915	33,007,135	6,253,577	42,401,602

Comparative statistics of canned fishery products from 1921 to 1924—Continued

Year	Maine sardines		California sardines		Tuna and tunalike fishes	
	Cases	*Value*	*Cases*	*Value*	*Cases*	*Value*
1921	1, 399, 507	$3, 960, 916	398, 668	$2, 346, 446	549, 150	$3, 074, 626
1922	1, 869, 719	5, 750, 109	715, 364	3, 361, 480	672, 321	4, 511, 873
1923	1, 272. 277	5, 288, 865	1, 100, 162	4, 607, 931	817, 836	6, 914, 760
1924	1, 899, 925	7, 191, 026	1, 367, 139	5, 445, 573	652, 416	5, 756, 586

Year	Oysters		Shrimp		Other canned products	Total
	Cases	*Value*	*Cases*	*Value*	*Value*	*Value*
1921	442, 086	$2, 179, 271	655, 364	$3, 804, 781	$2, 401, 497	$46, 634, 706
1922	505, 973	2, 423, 616	579, 797	3, 064, 087	2, 933, 065	60, 464, 947
1923	524, 544	2, 720, 073	700, 429	4, 381, 534	2, 998, 469	72, 445, 205
1924	447, 481	2, 478, 044	718, 517	4, 608, 950	4, 282. 808	72, 164, 589

NOTE.—Cases have been converted to a standard basis, as follows: Salmon, forty-eight 1-pound cans; Maine sardines, one hundred ¼-pound cans; California sardines, forty-eight 1-pound cans; tuna and tunalike fishes, forty-eight ½-pound cans; oysters, forty-eight 5-ounce cans; and shrimp, forty-eight No. 1 cans.

EXPORTS OF CANNED FISHERY PRODUCTS IN 1924

Statistics of the quantity of canned fish exported from the United States during the calendar year, collected and compiled by the Bureau of Foreign and Domestic Commerce, are given in the following table:

Domestic exports of canned fish from the United States, by countries, 1924

Countries	Salmon		Sardines		Tuna		Other canned fish	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Austria			192	$55				
Azores and Madeira Islands	332	$55						
Belgium	1, 337, 489	138, 779	997, 820	85, 530			203, 375	$17, 467
Czechoslovakia			48	4				
Denmark	9, 600	1, 488						
France	42, 659	7, 855	15, 930	1, 432	48	$10	160	74
Germany	150, 167	20, 820	7, 525	714			14, 878	2, 091
Gibraltar	1, 536	227						
Greece	494, 062	57, 988	19, 370	2, 079	250	80	32, 656	5, 920
Italy	107, 880	10, 594	4, 636	400			1, 200	133
Malta, Gozo, and Cyprus Islands	1, 528	253						
Netherlands	622, 228	89, 085	71, 605	6, 019	48	26		
Norway	21, 120	2, 628			130	35	390	78
Rumania	3, 720	639	48	5	41	16		
Russia in Europe			631	109				
Spain							3, 800	1, 001
Sweden	14, 160	2, 223						
Switzerland	4, 800	520						
Turkey in Europe	38, 400	1, 280						
England	36, 485, 985	5, 865, 023	639, 897	59, 261	830	229	46, 122	13, 677
Scotland	391, 100	60, 689	6, 900	602	72	39		
Ireland	308, 120	36, 621						
Canada	2, 051, 011	264, 052	3, 047, 793	291, 790	95, 593	28, 129	596, 077	63, 966
British Honduras	24, 910	2, 763	39, 325	4, 501			130	13
Costa Rica	139, 776	13, 793	231, 564	20, 156	96	31	12, 743	819
Guatemala	71. 388	8, 043	258, 516	24, 589	95	26	9, 512	669
Honduras	52, 478	6, 715	112, 614	16, 950	644	247	1, 598	423
Nicaragua	109, 730	13, 208	163, 590	18, 327	1, 266	319	9, 123	571
Panama	277, 357	36, 579	200, 661	21, 823	5, 669	2, 010	4, 259	1, 051
Salvador	5, 814	729	127, 077	10, 464	25	10	933	185
Mexico	2, 482, 065	227, 473	2, 721, 796	262, 791	2, 612	964	109, 847	13, 004
Newfoundland and Labrador	96	18			50	24	110	41
Bermuda	46, 485	8, 943	23, 461	3, 684	1, 038	397	1, 052	381
Barbados	43, 024	7, 222	250	62				
Jamaica	52, 956	10, 951	24, 948	2, 207	111	37	497	137

Domestic exports of canned fish from the United States, by countries, 1924—Contd.

Countries	Salmon		Sardines		Tuna		Other canned fish	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Trinidad and Tobago	37,910	$7,082	4,393	$454			60	$31
Other British West Indies	45,744	7,771	17,593	2,849	36	$26	1,882	526
Dutch West Indies	37,026	6,901	3,229	367	349	118	798	132
Cuba	647,574	66,161	2,327,454	181,880	2,240	713	88,406	8,338
Dominican Republic	230,416	23,643	116,428	18,450	481	182	3,038	1,030
French West Indies	2,068	181						
Haiti	5,365	897	1,582	290	157	53	117	65
Virgin Islands of the United States	37,989	4,496	18,685	2,538	146	26	1,816	243
Argentina	218,068	24,048	4,133,186	351,699			175,865	9,820
Bolivia	25,918	2,896	387,830	34,348			180	86
Brazil	13,033	2,442	1,550	160				
Chile	154,006	23,192	699,582	58,473	27	12	6,730	487
Colombia	558,147	64,456	129,894	13,415	7,523	2,941	3,608	747
Ecuador	112,538	12,611	556,354	46,734	124	60	8,614	2,555
Falkland Islands	48	11						
British Guiana	58,742	11,819	66,779	7,382			12,632	1,405
Dutch Guiana	42,346	4,957	16,063	1,923	26	12		
French Guiana	12,586	1,470						
Paraguay	720	109						
Peru	226,972	23,285	568,692	48,061	1,134	467	6,899	1,689
Uruguay	18,130	2,424	13,340	1,108				
Venezuela	957,426	103,093	474,970	36,853	2,384	793	1,786	567
Aden	1,340	188			35	12		
Armenia and Kurdistan			4,500	400				
British India	439,559	74,608	1,200,939	125,723	1,300	446	849	240
Ceylon	134,750	19,412	26,853	3,755	786	317	490	98
Straits Settlements	175,130	18,210	10,595,759	805,326	48	24	214,524	13,614
Other British East Indies			2,880	260				
China	100,425	17,828	572,114	53,497	4,576	1,677	55,814	4,057
Chosen	768	112	5,326	572	300	105	36	11
Java and Madura	260,822	32,483	3,113,243	254,080	97	43	11,050	4,589
Other Dutch East Indies	79,128	10,400	644,556	55,888				
French Indo-China			182,788	17,031			2,231	584
Hejaz, Arabia	1,680	144					550	180
Hongkong	59,852	9,327	772,880	66,051	230	114	17,398	1,222
Japan	249,350	27,847	87,697	8,278	620	275	36,488	5,225
Kwangtung	144	38	131,715	10,750				
Palestine and Syria	14,269	1,601						
Persia					234	81		
Philippine Islands	7,884,986	793,939	15,417,030	1,210,034	2,794	813	432,768	33,136
Siam	3,469	1,386	111,344	8,073				
Turkey in Asia	9,600	1,280						
Australia	7,167,084	1,186,765	8,615	875	4,240	905	2,055	791
British Oceania	23,464	3,016	11,361	1,000			1,191	143
French Oceania	246,556	27,170	92,950	12,670			919	198
New Zealand	102,078	17,289	3,300	192			3,438	212
Other Oceania	59,381	7,218	5,507	678			758	117
Belgian Kongo	1,587	338			28	11		
British West Africa	75,162	6,820	150	37			149	37
British South Africa	980,445	105,558	7,045	1,407	191	47	6,220	931
British East Africa	15,816	2,120			27	13		
Canary Islands	8,388	695						
Egypt	27,376	4,499	7,529	1,297	36	12	96	10
Other French Africa	636	92	384	35				
Liberia	3,164	323	450	65			65	13
Portuguese East Africa	45,648	4,505					341	147
Other Portuguese Africa	444	75	120	35				
Spanish Africa	6,120	639						
Total	67,013,369	9,667,126	51,260,836	4,278,547	138,787	42,927	2,148,323	214,977

COMPARATIVE STATISTICS OF EXPORTS OF CANNED FISH

The exports of canned fish from the United States have been growing steadily for the last three years, as may be seen in the following table. Exports of canned sardines are particularly conspicuous in this respect, those in 1924 having increased over 150 per cent as compared with those of 1922 and over 50 per cent as compared with 1923. The tuna exports also are on the increase, those in 1924 being in excess of the 1923 exports by 80 per cent.

Domestic exports of canned fish, 1922 to 1924

Year	Salmon		Sardines		Tuna	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1922	63,797,279	$7,962,375	20,059,845	$1,780,956	(1)	(1)
1923	59,594,422	9,154,711	33,660,937	2,919,767	76,342	$23,992
1924	67,013,369	9,667,126	51,260,836	4,278,547	138,787	42,927

Year	Other		Total	
	Pounds	*Value*	*Pounds*	*Value*
1922	4,559,142	$528,409	88,416,266	$10,271,740
1923	2,033,468	228,971	95,365,169	12,327,441
1924	2,148,323	214,977	120,561,315	14,203,577

[1] Not shown separately in 1922.

BY-PRODUCTS OF THE FISHERIES

The by-products of the fisheries include a variety of materials, such as fish oils, fish scrap and meal, shrimp bran, crushed oyster shells for poultry grit, lime from oyster shells, liquid glue, scales from which pearl essence is extracted, and others. Their production is important in providing a more complete utilization of marine products, or, stated differently, the production of a greater number and volume of products without taking more fish or shellfish from the sea.

If we include the production of materials in the menhaden and whale industries, the total value of by-products in 1924 amounted to $10,308,990, as compared to $12,634,590 in 1923. The decrease is due to a failure of the menhaden industry. Other by-products have increased, compared with former years, as may be seen in the following table, which summarizes the statistics on by-products for the years 1921 to 1924.

Comparative statistics of fishery by-products from 1921 to 1924

Year	Menhaden industry					
	Dried scrap and meal		Acidulated scrap		Oil	
	Tons	*Value*	*Tons*	*Value*	*Gallons*	*Value*
1921	37,858	$1,380,455	44,804	$905,640	6,260,478	$1,719,892
1922	67,821	2,665,441	25,755	556,317	7,102,677	2,904,833
1923	43,452	2,029,406	44,935	1,064,870	7,461,365	3,316,277
1924	21,008	996,866	24,409	495,684	3,923,904	1,817,626

Year	Miscellaneous by-products					
	Dried scrap and meal		Crude or green scrap		Shrimp bran	
	Tons	*Value*	*Tons*	*Value*	*Tons*	*Value*
1921	22,173	$1,232,906	1,810	$21,327	628	$16,814
1922	21,638	1,090,346	390	9,175	562	15,398
1923	22,636	1,257,098	1,593	13,721	1,269	48,290
1924	30,847	1,373,351	4,097	15,217	936	31,580

Year	Fish and whale oils		Crushed oyster shell		Other by-products	Total
	Gallons	*Value*	*Tons*	*Value*	*Value*	*Value*
1921	1,185,803	$358,778	185,474	$1,759,120	$956,895	$8,351,827
1922	3,432,796	1,325,927	236,021	2,005,838	817,418	11,390,693
1923	3,912,436	1,787,917	224,983	1,986,249	1,130,762	12,634,590
1924	5,287,391	2,494,107	219,211	2,019,254	1,065,305	10,308,990

FISH SCRAP AND MEAL

In 1924 the production of fish scrap and meal of all kinds amounted to 81,297 tons, valued at $2,912,898. The total value in 1923 was $4,413,385. The decrease was due almost entirely to the small production of menhaden scrap and meal. Noteworthy increases occurred in the production of all other fish scrap and meal excepting shrimp bran, which was produced in lesser amounts than in 1923.

FISH OILS

In 1924 there were produced 3,923,904 gallons of menhaden oil, valued at $1,817,626; 4,044,555 gallons of other fish oils, valued at $1,832,836; 1,141,695 gallons of whale oil, valued at $619,475; and 101,141 gallons of sperm oil, valued at $41,796, making a total of 9,211,295 gallons, valued at $4,311,733. The production of sardine and herring oils was greatly increased as compared with 1923, while a considerable decrease took place in the production of menhaden oils.

LIQUID FISH GLUE

In 1924 the production of liquid fish glue was 502,940 gallons, valued at $550,391, an increase of 8 per cent in quantity and a decrease of 19 per cent in value, as compared with the production in 1923, which was 465,814 gallons, valued at $680,504.

Production of various by-products of the fisheries, 1924

Products	Maine, Massachusetts, and New York		Maryland and Virginia		North Carolina, Georgia, and Florida		Mississippi and Louisiana	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish scrap and meal:								
Dried..........tons	2,780	$119,539	2,375	$48,894				
Acidulated..........do	354	7,255						
Pomace..........do	3,543	6,262						
Shrimp bran..........do					192	$8,890	744	$22,690
Oil:								
Herring..........gallons	75,587	24,290	56,743	21,000				
Sperm..........do	13,391	6,696						
Cod-liver, crude..........do	106,415	65,916						
Miscellaneous..........do	511	41	2,650	1,191	38,610	16,005		
Liquid glue..........do	502,940	550,391						
Miscellaneous by-products [1]..do	1,882,627	140,527	141,000	9,750	169,268	24,826		
Total		920,917		80,835		49,721		22,690

Products	Alaska, Washington, Oregon, and California		Indiana, Wisconsin, and Pennsylvania		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish scrap and meal:						
Dried..........tons	25,692	$1,204,918			30,847	$1,373,351
Acidulated..........do			200	$1,700	554	8,955
Pomace..........do					3,543	6,262
Shrimp bran..........do					936	31,580
Oil:						
Salmon..........gallons	169,561	76,554			169,561	76,554
Sardine..........do	2,338,711	1,076,903			2,338,711	1,076,903
Tuna..........do	35,408	10,801			35,408	10,801
Herring..........do	1,171,672	514,909	20,000	11,200	1,324,002	571,399
Whale..........do	1,141,695	619,475			1,141,695	619,475
Sperm..........do	87,750	35,100			101,141	41,796
Cod-liver, crude..........do					106,415	65,916
Miscellaneous..........do	25,516	12,758	3,171	1,268	70,458	31,263
Liquid glue..........do					502,940	550,391
Miscellaneous by-products [1]..do	49,500	619			2,242,395	175,722
Total		3,552,037		14,168		4,640,368

[1] Includes shark hides and fins, herring skins and scales, isinglass, and whale tails.

SHELL BY-PRODUCTS

In 1924 the by-products of the oyster industry, consisting of crushed oyster shells for poultry grit, lime dust, and lime, amounted to 289,480 tons, valued at $2,355,638, as compared with 308,791 tons, valued at $2,358,535, in 1923. In addition to the oyster-shell products there were 234 tons of crushed marine clam shells, valued at $2,808.

Production of oyster-shell by-products, 1924

States	Poultry grit		Lime		Total	
	Tons	*Value*	*Tons*	*Value*	*Tons*	*Value*
Rhode Island, New York, New Jersey, and Pennsylvania	12,634	$158,044	3,695	$14,438	16,329	$172,482
Maryland	70,961	708,042	28,309	88,516	99,270	796,558
Virginia	22,019	226,126	28,968	205,663	50,987	431,789
North Carolina, South Carolina, and Georgia	6,472	72,098	3,131	17,625	9,603	89,723
Florida and Alabama	16,565	141,185	693	1,408	17,258	142,593
Mississippi	30,266	257,920	1,400	750	31,666	258,670
Louisiana	56,288	419,785	3,478	6,251	59,766	426,036
Texas	4,006	36,054	595	1,733	4,601	37,787
Total	219,211	2,019,254	70,269	336,384	289,480	2,355,638

MENHADEN INDUSTRY

In 1924 there were in operation 16 menhaden factories in Virginia, 14 in North Carolina, 3 in New Jersey, 3 in Delaware, 3 in Florida, 2 in Texas, 2 in New York, 1 in Connecticut, and 1 in Georgia, making a total of 45 plants, as compared to 52 in 1923.

There were produced 21,008 tons of dry scrap and meal, valued at $996,866, 24,409 tons of acidulated scrap, valued at $495,684, and 3,923,904 gallons of oil, valued at $1,817,626, making a total production valued at $3,310,176, as compared to $6,410,553 in 1923. The decrease, amounting to 48 per cent, is due largely to a shortage of fish and has placed the menhaden industry in a precarious position economically.

Products of the menhaden industry, 1924

Products	Connecticut and New York		New Jersey and Delaware		Virginia	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish utilized: Menhaden..number	78,797,100	$475,814	86,478,000	$513,141	137,175,493	$630,320
Manufactured products:						
Dry scrap and fish meal..tons	976	50,800	376	17,331	10,100	521,351
Acidulated scrap..do	5,423	117,037	7,960	185,852		
Total	6,399	167,837	8,336	203,183	10,100	521,351
Oil..gallons	676,143	272,607	623,247	282,448	1,408,312	686,581
Grand total		440,444		485,631		1,207,932

Products of the menhaden industry, 1924—Continued

Products	North Carolina		Georgia, Florida, and Texas		Total	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Fish utilized: Menhaden ....number..	115,876,333	$452,643	95,530,380	$314,219	[1] 513,857,306	$2,386,137
Manufactured products:						
Dry scrap and fish meal ....tons..	5,858	252,350	3,698	155,034	[2] 21,008	996,866
Acidulated scrap.....do....	3,875	99,613	7,151	93,182	24,409	495,684
Total....	9,733	351,963	10,849	248,216	45,417	1,492,550
Oil....gallons..	783,379	382,787	432,823	193,203	3,923,904	1,817,626
Grand total....		734,750		441,419		3,310,176

[1] 308,314,384 pounds. [2] Of this quantity 1,750 tons, valued at $101,067, were reported as fish meal.

COLD-STORAGE HOLDINGS OF FROZEN FISH

The statistics of the cold-storage holdings of frozen fish and the quantities of fish frozen are collected by the Bureau of Agricultural Economics, Department of Agriculture, and in 1924, as in previous years, were published monthly and disseminated to the frozen-fish trade by the Bureau of Fisheries. A summary of the statistics for the year is herewith presented. Statistics for previous years are also given for comparison. It will be found that in some cases they do not correspond to totals previously published, for in the past there has been some variation with respect to dividing the year at January 15 or December 15. The statistics here given have been put upon a uniform basis by dividing each year, so as to begin with the report for the month ending January 15 and end with that for the month ending on December 15 of each year.

During 1924 cold-storage holdings were rather larger than during the previous year. They varied between 21,488,525 and 70,405,786 pounds, the smallest holdings being recorded in April and the largest in November. The average monthly holdings during the year were 45,040,533 pounds, as compared with the average in 1923 of 36,202,434 pounds, an increase of 24.4 per cent. Compared with the five-year average, the monthly holdings in 1924 were only slightly high, being 0.5 per cent above the five-year average. The following tables give the summaries of the statistics of the cold-storage holdings of the United States in 1924 and previous years.

Comparative statement of monthly cold-storage holdings of frozen fish in 1924 and 1923, and the five-year average

Month	1924	1923	Five-year average	Increase (+) or decrease (−)	
				Compared with 1923	Compared with five-year average
	Pounds	*Pounds*	*Pounds*	*Per cent*	*Per cent*
January	52,627,290	40,032,255	56,880,000	+31.46	−7.48
February	40,420,614	27,069,882	44,490,000	+49.32	−9.15
March	29,570,628	16,723,513	31,119,000	+76.82	−4.98
April	21,488,525	10,589,532	22,852,000	+102.92	−5.97
May	21,839,714	12,312,003	22,542,000	+77.39	−3.12
June	27,115,359	17,779,934	29,506,000	+52.51	−8.10
July	36,036,010	27,237,105	37,862,000	+32.30	−4.82
August	49,026,140	39,100,868	46,209,000	+25.38	+6.10
September	56,606,759	53,220,398	54,941,000	+6.36	+3.03
October	67,024,996	62,616,212	63,553,000	+7.04	+5.46
November	70,405,786	63,457,565	65,101,000	+10.95	+8.15
December	68,324,572	64,289,945	62,430,000	+6.28	+9.44
Average for year	45,040,533	36,202,434	44,790,000	+24.41	+.55

Monthly holdings of frozen fish in the United States in 1924, by species, and in 1917 to 1923, by totals

Species	Month ended—					
	Jan. 15	Feb. 15	Mar. 15	Apr. 15	May 15	June 15
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	422, 210	252, 617	177, 324	149, 774	107, 891	115, 388
Butterfish (all trade sizes)	409, 825	221, 176	130, 889	55, 812	42, 778	170, 802
Catfish	236, 109	170, 876	111, 494	86, 557	162, 519	162, 614
Ciscoes (including bluefin, blackfin, chub, lake herring, etc.)	10, 323, 849	8, 117, 715	5, 353, 289	3, 963, 579	3, 118, 078	2, 702, 213
Ciscoes (tullibees)	648, 304	778, 131	714, 642	726, 296	770, 802	751, 270
Cod, haddock, hake, pollock	1, 104, 551	881, 921	686, 803	387, 404	464, 035	476, 257
Croaker	249, 115	103, 637	52, 387	84, 540	296, 056	303, 755
Flounders	517, 028	396, 187	325, 867	226, 210	214, 545	384, 092
Halibut (all trade sizes)	5, 533, 267	3, 753, 674	2, 309, 934	3, 341, 501	4, 074, 417	5, 647, 312
Herring, sea (including alewives and bluebacks)	2, 309, 165	1, 742, 173	1, 744, 364	708, 029	1, 927, 109	2, 710, 163
Lake trout	1, 232, 855	897, 434	745, 146	282, 200	269, 522	405, 652
Mackerel (except Spanish)	4, 355, 166	3, 266, 074	2, 063, 094	1, 225, 933	917, 815	1, 013, 864
Pike perches and pike or pickerel	2, 461, 107	2, 320, 771	1, 332, 453	543, 328	888, 041	892, 128
Sablefish (black cod)	1, 915, 018	1, 522, 302	1, 322, 127	964, 102	466, 759	378, 366
Salmon:						
Silver and fall	2, 598, 415	1, 834, 964	1, 414, 845	921, 449	726, 383	725, 201
Steelhead trout	697, 411	181, 446	105, 674	63, 757	46, 785	61, 918
All other	2, 985, 058	2, 355, 794	1, 662, 583	1, 189, 857	864, 086	1, 179, 168
Scup (porgies)	679, 400	468, 128	174, 787	87, 036	32, 414	76, 481
Shad and shad roe	461, 483	580, 256	144, 189	107, 366	215, 599	409, 092
Shellfish	781, 215	714, 943	450, 213	243, 944	323, 213	400, 554
Smelts, eulachon, etc	442, 654	789, 531	1, 266, 708	537, 035	273, 161	225, 779
Squeteagues or "sea trout"	769, 540	375, 837	132, 256	39, 042	166, 433	213, 049
Squid	580, 280	326, 997	180, 008	37, 905	166, 656	1, 660, 087
Sturgeon and spoonbill cat	299, 144	188, 510	133, 217	54, 404	153, 400	272, 877
Suckers	32, 173	32, 271	21, 600	16, 092	35, 434	49, 153
Whitefish	1, 381, 207	1, 463, 003	1, 981, 538	1, 440, 949	1, 073, 506	1, 025, 573
Whiting	3, 792, 699	2, 244, 524	1, 446, 557	1, 150, 959	932, 085	1, 007, 427
Miscellaneous frozen fish	5, 409, 042	4, 439, 722	3, 386, 640	2, 853, 465	3, 110, 192	3, 695, 124
Total, 1924	52, 627, 290	40, 420, 614	29, 570, 628	21, 488, 525	21, 839, 714	27, 115, 359
Total, 1923	40, 032, 255	27, 069, 882	16, 723, 513	10, 589, 532	12, 312, 003	17, 779, 934
Total, 1922	48, 320, 212	37, 742, 262	25, 474, 714	17, 484, 975	17, 075, 917	20, 821, 345
Total, 1921	53, 851, 000	42, 116, 000	33, 404, 000	28, 440, 000	26, 346, 000	32, 311, 000
Total, 1920	61, 510, 357	47, 904, 057	29, 958, 132	20, 632, 834	19, 803, 817	27, 779, 230
Total, 1919	80, 683, 761	67, 617, 473	50, 036, 475	37, 110, 856	37, 174, 104	48, 840, 359
Total, 1918	51, 116, 37	35, 907, 071	28, 457, 301	26, 548, 272	31, 403, 425	50, 298, 027
Total, 1917	32, 234, 530	14, 727, 099	13, 374, 429	9, 516, 217	14, 040, 024	27, 791, 047

Monthly holdings of frozen fish in the United States in 1924, by species, and in 1917 to 1923, by totals—Continued

Species	Month ended—					
	July 15	Aug. 15	Sept. 15	Oct. 15	Nov. 15	Dec. 15
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	101, 248	93, 478	88, 863	106, 662	124, 308	319, 914
Butterfish (all trade sizes)	322, 373	437, 948	805, 413	849, 543	886, 686	735, 619
Catfish	227, 198	219, 699	185, 944	167, 556	305, 900	244, 358
Ciscoes (including bluefin, blackfin, chub, lake herring, etc.)	2, 530, 838	3, 213, 024	5, 044, 751	7, 856, 427	8, 090, 621	9, 608, 580
Ciscoes (tullibees)	810, 073	959, 611	732, 078	785, 414	859, 784	712, 911
Cod, haddock, hake, pollock	622, 138	694, 717	709, 667	731, 717	887, 680	1, 041, 335
Croaker	378, 961	757, 897	616, 724	402, 952	278, 322	222, 972
Flounders	437, 565	395, 901	383, 913	345, 937	395, 178	474, 082
Halibut (all trade sizes)	8, 376, 481	11, 735, 918	14, 107, 183	14, 609, 027	13, 663, 426	11, 458, 888
Herring, sea (including alewives and bluebacks)	2, 781, 164	3, 661, 482	3, 317, 720	3, 653, 279	4, 453, 975	4, 632, 857
Lake trout	629, 748	653, 072	686, 986	928, 113	1, 816, 384	1, 952, 914
Mackerel (except Spanish)	2, 525, 839	3, 893, 770	4, 922, 247	4, 894, 724	4, 614, 956	4, 050, 396
Pike perches and pike or pickerel	992, 344	790, 854	854, 279	906, 679	1, 254, 421	1, 892, 949
Sablefish (black cod)	442, 789	911, 705	1, 159, 867	1, 529, 649	1, 700, 014	1, 359, 316
Salmon:						
Silver and fall	1, 259, 815	1, 928, 464	2, 508, 903	5, 782, 171	6, 219, 428	5, 155, 350
Steelhead trout	260, 840	892, 099	903, 278	940, 952	700, 420	644, 716
All other	2, 109, 858	3, 506, 271	4, 620, 121	6, 119, 933	6, 281, 463	5, 718, 124
Scup (porgies)	218, 693	290, 971	254, 732	226, 179	191, 924	132, 473
Shad and shad roe	876, 921	796, 599	683, 414	717, 441	801, 357	879, 488
Shellfish	457, 114	489, 748	542, 485	766, 722	1, 108, 148	1, 310, 634
Smelts, eulachon, etc	208, 077	211, 776	271, 425	329, 550	318, 494	288, 818
Squeteagues or "sea trout"	259, 604	279, 359	256, 209	295, 721	498, 316	446, 157
Squid	2, 117, 062	2, 281, 461	2, 230. 726	2, 558, 046	2, 429, 721	1, 850, 358
Sturgeon and spoonbill cat	369, 353	508, 152	548, 563	543, 181	530, 900	554, 786
Suckers	49, 491	43, 784	38, 028	38, 435	37, 582	39, 024
Whitefish	1, 149, 463	1, 306, 126	1, 351, 440	1, 410, 453	1, 821, 871	2, 134, 465
Whiting	1, 527, 493	3, 008, 257	3, 368, 558	3, 218, 372	3, 466, 747	3, 500, 248
Miscellanequs frozen fish	3, 993, 467	5, 063, 997	5, 413, 242	6, 310, 161	6, 667, 760	6, 962, 840
Total, 1924	36, 036, 010	49, 026, 140	56, 606, 759	67, 024, 996	70, 405, 786	68, 324, 572
Total, 1923	27, 237, 105	39, 100, 868	53, 220, 398	62, 616, 212	63, 457, 565	64, 289, 945
Total, 1922	25, 620, 042	32, 226, 170	41, 141, 144	54, 756, 783	54, 502, 283	48, 689, 830
Total, 1921	40, 160, 000	47, 431, 000	54, 469, 000	58, 899, 000	61, 228, 000	59, 125, 646
Total, 1920	36, 617, 706	47, 140, 132	56, 295, 975	64, 730, 531	67, 549, 377	65, 841, 000
Total, 1919	59, 674, 301	65, 145, 234	69, 580, 555	76, 763, 253	78, 769, 101	74, 202, 339
Total, 1918	64, 864, 532	82, 554, 798	89, 203, 946	93, 811, 909	99, 631, 789	96, 600, 247
Total, 1917	38, 431, 221	44, 024, 666	47, 197, 660	60, 676, 722	70, 938, 957	69, 986, 671

QUANTITIES OF FISH FROZEN

The total quantity of fish frozen during the year ended December 15, 1924, was 97,324,144 pounds, as compared with 91,548,643 pounds in 1923, an increase of 6 per cent. The principal species frozen during the year were halibut, 14,650,787 pounds; salmon, including steelhead trout, 14,309,666 pounds; ciscoes, 13,195,023 pounds; herring, 8,695,698 pounds; whiting, 7,528,339 pounds; mackerel, 5,457,676 pounds; and pike perch, pike, or pickerel, 3,200,624 pounds. The following tables give the statistics of the quantities of fish frozen during 1924.

Fish frozen monthly in 1924, by species, and in 1920 to 1923, by totals

Species	Month ended—						
	Jan. 15	Feb. 15	Mar. 15	Apr. 15	May 15	June 15	July 15
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	57,022	1,068	1,729	28,795	8,593	33,210	20,486
Butterfish (all trade sizes)	5,160	6,129		9,781	23,833	149,087	172,998
Catfish	9,514	14,533	3,769	5,197	90,641	26,599	81,646
Ciscoes (including bluefin, blackfin chub, lake herring, etc.)	717,719	2,621	34,938	11,032	76,512	149,447	329,288
Ciscoes (tullibees)	38,686	52,976	55,652	32,996	101,292	16,257	75,577
Cod, haddock, hake, pollock	54,840	61,987	62,937	22,674	203,089	91,966	254,479
Croaker	925			60,000	229,833	8,887	77,457
Flounders	24,719	21,177	12,417	5,920	61,803	224,727	116,404
Halibut (all trade sizes)	621,709	283,522	158,687	1,146,596	1,164,138	1,736,650	3,092,267
Herring, sea (including alewives and bluebacks)	122,947	384,078	264,944	101,374	1,561,301	1,329,671	595,183
Lake trout	73,082	64,400	38,786	4,341	70,663	154,875	258,541
Mackerel (except Spanish)	122,131	91,945	59,321	30,144	58,436	269,531	1,422,598
Pike perches and pike or pickerel	118,903	232,495	149,241	69,915	412,167	209,408	251,928
Sablefish (black cod)	96,523	37,364	108,252	38,889	22,977	63,353	163,458
Salmon:							
Silver and fall	102,862	68,096	19,617	18,168	37,273	89,613	598,366
Steelhead trout		1,775			1,310	26,241	292,611
All other	32,535	43,328	98,809	77,699	77,382	545,276	1,452,120
Scup (porgies)					7,408	64,775	149,413
Shad and shad roe	5,855	1,518	50	18,034	155,673	171,197	287,100
Shellfish	118,307	51,305	33,224	36,150	160,014	147,096	146,875
Smelts, eulachon, etc	8,740	100,381	102,827	11,853	5,748	1,542	45
Squeteagues or "sea trout"	35				146,390	53,793	63,640
Squid	32,104	4,353	1,426	7,803	149,548	1,527,715	510,464
Sturgeon and spoonbill cat	5,000	1,621	7,320	8,151	132,809	143,408	125,387
Suckers	21,495	12,103	3,496		20,465	8,515	1,509
Whitefish	41,006	292,884	246,950	96,201	49,352	7,140	111,062
Whiting	217,385	278,410	604,673	602,928	89,506	210,994	741,106
Miscellaneous frozen fish	529,894	330,094	348,408	284,725	922,105	820,543	604,003
Total, 1924	3,179,098	2,440,163	2,417,473	2,729,366	6,040,261	8,281,516	11,996,011
Total, 1923	2,741,538	1,662,135	1,412,490	1,400,078	5,026,888	7,671,127	11,871,645
Total, 1922	2,441,892	1,452,801	1,363,942	1,496,538	1,980,435	5,849,537	7,376,237
Total, 1921	4,005,000	2,843,000	1,770,000	2,413,000	2,698,000	9,624,000	10,151,000
Total, 1920	2,291,082	2,273,744	2,630,482	2,465,375	3,687,538	10,094,367	12,761,791

Fish frozen monthly in 1924, by species, and in 1920 to 1923, by totals—Continued

Species	Month ended— Aug. 15	Sept. 15	Oct. 15	Nov. 15	Dec. 15	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	8, 595	12, 251	34, 411	29, 993	176, 184	412, 337
Butterfish (all trade sizes)	139, 244	393, 083	100, 090	97, 484	34, 733	1, 131, 622
Catfish	29, 366	8, 988	17, 573	90, 083	37, 116	415, 025
Ciscoes (including bluefin, blackfin, chub, lake herring, etc.)	1, 214, 225	2, 562, 454	4, 195, 606	1, 293, 120	2, 608, 061	13, 195, 023
Ciscoes (tullibees)	169, 928	40, 195	64, 755	102, 914	99, 557	850, 785
Cod, haddock, hake, pollock	206, 956	114, 139	200, 005	305, 415	283, 676	1, 862, 163
Croaker	377, 321	44, 913	3, 663	1, 167	404	804, 570
Flounders	65, 704	54, 768	102, 043	76, 276	42, 798	808, 756
Halibut (all trade sizes)	3, 056, 370	1, 492, 447	677, 516	745, 835	475, 050	14, 650, 787
Herring, sea (including alewives and bluebacks)	1, 282, 551	195, 236	869, 084	1, 142, 898	846, 431	8, 695, 698
Lake trout	68, 097	159, 301	304, 111	873, 307	244, 280	2, 313, 784
Mackerel (except Spanish)	1, 431, 237	1, 234, 266	161, 003	334, 840	242, 244	5, 457, 696
Pike perches and pike or pickerel	65, 507	154, 563	168, 433	459, 492	908, 572	3, 200, 624
Sablefish (black cod)	459, 074	382, 366	525, 326	303, 094	90, 630	2, 291, 306
Salmon:						
Silver and fall	753, 695	446, 725	3, 261, 539	989, 760	150, 974	6, 536, 688
Steelhead trout	675, 386	172, 096	124, 157	14, 330	4, 015	1, 311, 921
All other	1, 597, 773	457, 703	1, 362, 144	614, 036	102, 252	6, 461, 057
Scup (porgies)	95, 926	590	4, 231	5, 557	4, 203	332, 103
Shad and shad roe	44, 317	2, 796	8, 657	107, 489	37, 288	839, 974
Shellfish	158, 032	217, 118	347, 886	503, 263	349, 775	2, 269, 045
Smelts, eulachon, etc	13, 008	67, 828	79, 903	40, 020	52, 065	483, 960
Squeteagues or "sea trout"	63, 762	25, 020	51, 552	219, 023	24, 854	648, 069
Squid	274, 917	161, 163	516, 404	140, 054	26, 601	3, 352, 552
Sturgeon and spoonbill cat	169, 064	109, 404	44, 246	21, 756	19, 556	787, 722
Suckers	483	662	1, 798	2, 763	5, 879	79, 168
Whitefish	141, 691	114, 176	84, 010	328, 092	263, 481	1, 776, 045
Whiting	1, 996, 887	783, 336	486, 952	1, 147, 826	368, 336	7, 528, 339
Miscellaneous frozen fish	982, 525	1, 177, 685	1, 080, 836	864, 986	881, 521	8, 827, 325
Total, 1924	15, 541, 641	10, 585, 272	14, 877, 934	10, 854, 873	8, 380, 536	97, 324, 144
Total, 1923	13, 943, 978	16, 417, 132	12, 511, 606	6, 951, 639	9, 938, 387	91, 548, 643
Total, 1922	9, 121, 160	10, 826, 942	16, 830, 080	9, 344, 469	7, 069, 995	75, 154, 028
Total, 1921	9, 845, 000	9, 356, 000	9, 990, 000	9, 869, 000	8, 173, 000	80, 737, 000
Total, 1920	13, 620, 232	11, 803, 606	11, 168, 810	9, 711, 800	9, 750, 844	92, 259, 671

Quantities of fish frozen during 1924, by geographical sections and by species

Species	New England	Middle Atlantic	South Atlantic	North Central, East
	Pounds	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	522	124, 921		285, 811
Butterfish (all trade sizes)	111, 620	978, 732	36, 110	
Catfish	86	5, 417		78, 946
Ciscoes (including bluefin, blackfin, chub, lake herring, etc.)		9, 600, 868		2, 825, 105
Ciscoes (tullibees)	4, 844	499, 001	3, 850	146, 332
Cod, haddock, hake, pollock	788, 105	614, 211	1, 500	31, 073
Croakers		643, 571	142, 600	13, 999
Flounders	264, 291	455, 082		7, 845
Halibut (all trade sizes)	568, 521	356, 571		1, 404, 270
Herring, sea (including alewives and bluebacks)	7, 420, 148	651, 534	13, 200	218, 493
Lake trout	6[illegible]. 812	587, 841		1, 385, 951
Mackerel (except Spanish)	3, 876, 176	969, 560	15, 725	96, 941
Pike perches and pike or pickerel	955	1, 410, 869		1, 564, 171
Sablefish (black cod)		1, 270		125, 037
Salmon:				
Silver and fall	259, 561	111, 456	250	298, 155
Steelhead trout	5, 840	59, 935		900
All other	482, 827	114, 682		378, 874
Scup (porgies)	231, 351	99, 108		
Shad and shad roe	431, 541	108, 830	4, 720	43, 923
Shellfish	299, 405	717, 949	221, 344	464, 121
Smelts, eulachon, etc	53, 227	4, 573		140, 625
Squeteagues or "sea trout"	1, 986	594, 883	51, 200	
Squid	2, 352, 507	950, 280		34, 908
Sturgeon, and spoonbill cat		583, 166	4, 300	15, 996
Suckers		7, 574		71, 594
Whitefish	4, 418	492, 636		1, 190, 272
Whiting	3, 362, 737	948, 942	2, 179	12, 912
Miscellaneous frozen fish	1, 101, 890	2, 567, 295	335, 878	1, 543, 475
Total	21, 686, 370	24, 260, 757	832, 856	12, 379, 729

Quantities of fish frozen during 1924, by geographical sections and by species—Continued

Species	North Central, West	South Central	Pacific	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*
Bluefish (all trade sizes)	683	400		412, 337
Butterfish (all trade sizes)			5, 160	1, 131, 622
Catfish	291, 579	38, 997		415, 025
Ciscoes (including bluefin, blackfin, chub, lake herring, etc.)	749, 050		20, 000	13, 195, 023
Ciscoes (tullibees)	142, 386	700	53, 672	850, 785
Cod, haddock, hake, pollock	40, 195	930	386, 149	1, 862, 163
Croakers		4, 400		804, 570
Flounders	69		81, 469	808, 756
Halibut (all trade sizes)	444, 528	3, 830	11, 873, 067	14, 650, 787
Herring, sea (including alewives and bluebacks)	266, 770	7, 500	118, 053	8, 695, 698
Lake trout	275, 180	1, 000		2, 313, 784
Mackerel (except Spanish)	23, 267	540	475, 487	5, 457, 696
Pike perches and pike or pickerel	220, 309	1, 250	3, 070	3, 200, 624
Sablefish (black cod)	62, 931		2, 102, 068	2, 291, 306
Salmon:				
Silver and fall	167, 849	100	5, 699, 317	6, 536, 688
Steelhead trout			1, 245, 246	1, 311, 921
All other	79, 612	18, 063	5, 386, 999	6, 461, 057
Scup (porgies)	1, 644			332, 103
Shad and shad roe	9, 494	15	241, 451	839, 974
Shellfish	152, 437	4, 031	409, 758	2, 269, 045
Smelts, eulachon, etc	40, 388		245, 147	483, 960
Squeteagues or "sea trout"				648, 069
Squid	9, 608		5, 249	3, 352, 552
Sturgeon, and spoonbill cat	941	53, 877	130, 442	787, 722
Suckers				79, 168
Whitefish	81, 693	1, 991	5, 035	1, 776, 045
Whiting	3, 201, 569			7, 528, 339
Miscellaneous frozen fish	904, 527	1, 127, 470	1, 246, 790	8, 827, 325
Total	7, 166, 709	1, 264, 095	29, 733, 629	97, 324, 144

Fish frozen in 1924, by geographical sections and by months

Month ending the 15th of—	New England	Middle Atlantic	South Atlantic	North Central, East	North Central, West	South Central	Pacific	Total
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
January	110, 065	582, 997	10, 025	1, 227, 714	517, 798	87, 029	643, 470	3, 179, 098
February	144, 971	283, 039	17, 295	1, 090, 300	624, 607	50, 493	229, 458	2, 440, 163
March	170, 876	148, 291	10, 900	867, 218	786, 670	96, 729	336, 789	2, 417, 473
April	29, 294	168, 930	82, 715	282, 333	824, 026	63, 652	1, 278, 416	2, 729, 366
May	1, 886, 814	1, 317, 007	107, 840	702, 187	461, 240	169, 582	1, 395, 591	6, 040, 261
June	2, 893, 482	1, 636, 262	58, 475	700, 573	205, 148	62, 814	2, 724, 762	8, 281, 516
July	3, 613, 056	2, 126, 272	28, 108	616, 924	250, 409	65, 109	5, 296, 133	11, 996, 011
August	5, 421, 320	2, 939, 285	103, 308	304, 840	254, 989	160, 287	6, 357, 612	15, 541, 641
September	2, 279, 202	3, 993, 360	99, 729	664, 210	370, 349	181, 486	2, 996, 936	10, 585, 272
October	2, 069, 698	5, 230, 149	210, 457	819, 246	760, 660	121, 983	5, 665, 741	14, 877, 934
November	2, 025, 623	3, 158, 908	84, 769	2, 330, 291	1, 048, 406	98, 061	2, 108, 815	10, 854, 873
December	1, 041, 969	2, 676, 257	19, 235	2, 773, 893	1, 062, 407	106, 869	699, 906	8, 380, 536
Total	21, 686, 370	24, 260, 757	832, 856	12, 379, 729	7, 166, 709	1, 264, 094	29, 733, 629	97, 324, 144

NEW ENGLAND VESSEL FISHERIES

GENERAL STATISTICS

The vessel fisheries centering at Boston and Gloucester, Mass., and Portland, Me., were more productive in 1924 than in the previous year, but there was a slight decrease in the value of the products. There was an increase of 14.38 per cent in the number of trips and of 4.58 per cent in the quantity of products, with a decrease of 0.83 per cent in their value, as compared with 1923. The increase in the number of trips was all at Boston and Gloucester. There was an increase in products at each of the three ports and in the value at Gloucester but a decrease in value at Boston and Portland. The increase in the number of trips at Boston was 10.90 per cent and at Gloucester 36.61 per cent, with a decrease of 0.31 per cent at Portland. At Boston the increase in the products landed amounted to 5.44 per cent, with a decrease of 0.59 per cent in the value; at Gloucester there was an increase of 2.33 per cent in quantity and of 14.36 per cent in value, and at Portland an increase of 2.80 per cent in quantity with a decrease of 22.19 per cent in value. Statistics of the 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 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 1924 numbered 343 sail, steam, and gasoline vessels, including 32 steam trawlers. These vessels landed at Boston 3,735 trips, aggregating 130,966,256 pounds of fish, valued at $5,401,590; at Gloucester, 2,157 trips, aggregating 35,845,920 pounds, valued at $1,041,476; and at Portland, 1,583 trips, aggregating 16,136,018 pounds, valued at $549,886. The total for the three ports amounted to 7,475 trips, aggregating 182,948,194 pounds of fresh and salted fish having a value to the fishermen of $6,992,952.

Compared with the previous year there was an increase of 940 trips, or 14.38 per cent, in the total number landed at Boston, Gloucester, and Portland, and an increase of 8,006,725 pounds, or 4.58 per cent, in quantity, and a decrease of $58,202, or 0.83 per cent, in the value of the products landed. There was a small decrease in both the quantity and value of cod and an increase in the quantity with a decrease in the value of haddock. Hake, pollock, cusk, and herring increased in both quantity and value. Halibut decreased in both quantity and value, while mackerel and swordfish decreased in quantity but increased in value. The catch of cod declined 1,206,521 pounds, or 1.92 per cent, in quantity and $45,835, or 2.10 per cent, in value, and haddock increased 6,140,252 pounds, or 8.32 per cent, in quantity but decreased $114,572, or 4.73 per cent, in value. Hake increased 946,834 pounds, or 14.94 per cent, in quantity and $43,734, or 30.72 per cent, in value; pollock increased 280,952 pounds, or 5.85 per cent, in quantity and $7,249, or 4.76 per cent, in value; and cusk increased 407,385 pounds, or 13.59 per cent, in quantity and $6,386, or 10.34 per cent, in value. The catch of halibut decreased 452,358 pounds, or 9.28 per cent, in quantity and $133,045, or 14.44 per cent, in value. The mackerel catch decreased 1,807,719 pounds, or 15.63 per cent, in quantity and increased $54,147, or 11.10 per cent in value; and swordfish decreased 432,003 pounds, or 17.59 per cent, in quantity and increased $1,718, or 0.38 per cent, in value. The herring catch increased 2,927,896 pounds, or 197.45 per cent, in quantity and $83,349, or 187.22 per cent, in value. The Newfoundland herring catch increased from 1,219,200 pounds, valued at $40,861, in 1923, to 2,943,480 pounds, valued at $108,371, in 1924. In the various other species combined there was an increase of 1,202,007 pounds, or 30 per cent, in quantity and $38,667, or 20.94 per cent, in value.

The catch of scrod cod landed at these ports decreased from 414,659 pounds, valued at $6,447, in 1923, to 318,440 pounds, valued at $5,371, in 1924, and the catch of scrod haddock increased from 4,845,695 pounds, valued at $94,481, in 1923, to 11,927,105 pounds, valued at $199,386, in 1924. The small quantity of these grades landed, as compared with other grades of these species, is said to be due to the fact that the price is so low that the fishermen do not save all that are caught.

The following tables present in detail, by fishing grounds and also by months, the fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels for the calendar year 1924. 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 grade, or sizes, given for certain species are those recognized in the trade.

Statement, by fishing grounds, of quantities and value of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924

Fishing grounds	Number of trips	Cod							
		Large (10 pounds and over)				Market (under 10 and over 2½ pounds)			
		Fresh		Salted		Fresh		Salted	
		Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
LANDED AT BOSTON									
East of 66° W. longitude									
La Have Bank	32	320,552	$17,905			173,085	$6,072		
Western Bank	109	1,980,007	84,153	11,000	$358	739,690	21,353		
Quereau Bank	35	30,760	1,129	6,000	255	1,490	33		
Green Bank	4								
Grand Bank	25	16,130	778			2,800	112		
St. Peters Bank	13	4,700	165			500	10		
Burgeo Bank	1								
Off Newfoundland	1								
Cape Shore	52	231,385	11,912			113,840	4,164		
The Gully	2								
Labrador Coast	1								
West of 66° W. longitude									
Browns Bank	184	2,530,858	109,895			1,768,242	48,876		
Georges Bank	720	11,864,940	428,888			3,964,873	105,209		
Cashes Bank	13	98,960	5,176			35,950	1,224		
Clark Bank	1	3,750	375			3,050	153		
Fippenies Bank	3	37,300	2,003			4,230	104		
Tillies Bank	4								
Middle Bank	269	177,988	12,021			95,455	4,093		
Jeffreys Ledge	414	427,313	32,852			201,230	9,388		
South Channel	886	5,669,936	283,103			2,730,261	86,015		
Nantucket Shoals	148	615,429	37,455			636,685	21,487		
Off Chatham	86	107,691	5,835			103,315	3,771		
Seal Island	2	16,100	752			21,000	493		
Shore, general	730	759,493	36,045			363,730	11,910		
Total	3,735	24,893,292	1,070,442	17,000	613	10,959,426	324,467		

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Number of trips	Cod							
		Large (10 pounds and over)				Market (under 10 and over 2½ pounds)			
		Fresh		Salted		Fresh		Salted	
		Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT GLOUCESTER									
East of 66° W. longitude									
La Have Bank	15	311,620	$7,221	112,142	$5,689	133,950	$3,252	22,730	$964
Western Bank	98	6,193,275	142,089	626,075	31,330	2,625,781	47,854	501,517	19,594
Quereau Bank	26	46,555	1,586	234,315	11,336	7,945	240	38,840	1,481
Green Bank	3	-------	-------	31,285	1,687	-------	-------	3,505	158
Grand Bank	31	40,230	924	228,454	10,875	3,835	91	41,480	1,597
St. Peters Bank	15	10,830	246	150,803	7,454	1,230	22	28,382	1,111
Off Newfoundland	11	-------	-------	-------	-------	-------	-------	-------	-------
Cape Shore	11	67,145	1,504	-------	-------	72,755	1,286	-------	-------
Labrador Coast	1	-------	-------	4,670	234	-------	-------	205	8
West of 66° W. longitude									
Browns Bank	35	575,790	12,914	66,510	3,356	379,175	6,651	12,265	461
Georges Bank	162	4,458,555	100,358	406,205	20,116	747,555	13,979	83,665	3,188
Cashes Bank	1	-------	-------	-------	-------	-------	-------	-------	-------
Middle Bank	23	-------	-------	-------	-------	-------	-------	-------	-------
South Channel	37	54,020	1,315	-------	-------	139,760	2,626	-------	-------
Nantucket Shoals	4	2,165	54	-------	-------	9,770	179	-------	-------
Shore, general	1,684	2,469,465	117,698	1,763	79	39,605	744	317	11
Total	2,157	14,229,650	385,909	1,862,222	92,156	4,161,361	76,924	732,906	28,573
LANDED AT PORTLAND									
East of 66° W longitude									
La Have Bank	4	14,645	445	12,300	554	10,735	252	2,400	84
Western Bank	30	1,583,820	34,890	78,885	4,063	150,800	3,512	15,225	633
Quereau Bank	5	-------	-------	9,380	478	-------	-------	1,280	51
Green Bank	1	-------	-------	-------	-------	-------	-------	-------	-------
Grand Bank	2	-------	-------	-------	-------	-------	-------	-------	-------
St. Peters Bank	3	8,850	288	3,300	157	825	17	2,000	50
Burgeo Bank	1	-------	-------	-------	-------	-------	-------	-------	-------
Cape Shore	13	-------	-------	-------	-------	-------	-------	-------	-------
Gulf of St. Lawrence	1	-------	-------	-------	-------	-------	-------	-------	-------
St. Anns Bank	1	-------	-------	-------	-------	-------	-------	-------	-------
The Gully	1	2,500	63	-------	-------	-------	-------	-------	-------
West of 66° W. longitude									
Browns Bank	4	9,270	209	8,635	432	1,110	22	1,000	45
Georges Bank	8	-------	-------	-------	-------	-------	-------	-------	-------
Cashes Bank	23	76,945	2,476	1,825	87	33,630	776	75	3
Fippenies Bank	2	8,090	667	-------	-------	4,325	155	-------	-------
Middle Bank	2	1,750	61	-------	-------	760	19	-------	-------
Platts Bank	122	210,511	11,526	3,765	207	92,873	2,928	805	32
Jeffreys Ledge	251	219,873	12,780	-------	-------	80,025	2,750	-------	-------
Shore, general	1,109	1,386,730	66,118	3,270	149	231,304	6,835	940	37
Total	1,583	3,522,984	129,523	121,360	6,127	606,387	17,266	23,725	935
Grand total	7,475	42,645,926	1,585,874	2,000,582	98,896	15,727,174	418,657	756,631	29,508

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Cod—Continued				Haddock			
	Scrod (1 to 2½ pounds)				Large (over 2½ pounds)			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Valu*
LANDED AT BOSTON								
East of 66° W. longitude								
La Have Bank	850	$17			471, 395	$16, 123		
Western Bank	2, 400	48			2, 250, 535	56, 612		
Cape Shore	3, 350	57			208, 860	8, 181		
West of 66° W. longitude								
Browns Bank	44, 395	1, 640			4, 819, 827	156, 093		
Georges Bank	4, 925	68			12, 372, 955	349, 876		
Cashes Bank	150	2			84, 280	3, 323		
Clark Bank					28, 600	1, 098		
Fippenies Bank					7, 500	198		
Middle Bank	5, 005	89			1, 242, 970	56, 244		
Jeffreys Ledge	26, 955	450			2, 956, 320	134, 020		
South Channel	71, 050	1, 011			25, 127, 169	814, 956		
Nantucket Shoals	490	7			5, 222, 820	151, 942		
Off Chatham	1, 870	29			820, 400	38, 350		
Seal Island					72, 500	1, 345		
Shore, general	14, 950	221			1, 432, 430	58, 773		
Total	176, 390	3, 639			57, 118, 561	1, 847, 134		
LANDED AT GLOUCESTER								
East of 66° W. longitude								
La Have Bank	1, 260	13	135	$4	87, 815	1, 104		
Western Bank	7, 215	54	29, 318	893	1, 229, 370	15, 456	78	$2
Quereau Bank			1, 380	41			150	4
Grand Bank					425	5	40	1
St. Peters Bank			25	1				
Cape Shore	690	6			6, 185	92		
West of 66° W. longitude								
Browns Bank	4, 275	33			318, 175	4, 360		
Georges Bank	2, 925	30	90	3	1, 228, 615	16, 158	55	1
South Channel	490	5			777, 810	13, 080		
Nantucket Shoals					274, 055	3, 602		
Shore, general	660	5	25	1	751, 171	30, 828		
Total	17, 515	146	30, 973	943	4, 673, 621	84, 685	323	8
LANDED AT PORTLAND								
East of 66° W. longitude								
La Have Bank	950	5			15, 450	219		
Western Bank	500	4	4, 540	111	3, 876, 233	75, 673	3, 095	62
West of 66° W. longitude								
Cashes Bank	6, 530	32			92, 085	3, 185		
Fippenies Bank	440	2			10, 820	418		
Middle Bank	300	2			20, 450	873		
Platts Bank	20, 415	107			360, 600	16, 369		
Jeffreys Ledge	24, 300	150			844, 056	40, 059		
Shore, general	35, 447	227	140	3	959, 376	40, 534		
Total	88, 882	529	4, 680	114	6, 179, 070	177, 330	3, 095	62
Grand total	282, 787	4, 314	35, 653	1, 057	67, 971, 252	2, 109, 149	3, 418	70

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Haddock—Continued				Hake			
	Scrod (1 to 2½ pounds)				Large (6 pounds and over)			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
East of 66° W. longitude								
La Have Bank	2,000	$40						
Western Bank	55,300	825						
Grand Bank					1,000	$30		
Cape Shore	475	5						
West of 66° W. longitude								
Browns Bank	36,720	718			735	37		
Georges Bank	1,456,900	23,676			600	30		
Cashes Bank	9,515	142						
Middle Bank	226,750	4,936			26,990	1,267		
Jeffreys Ledge	600,440	12,646			134,440	5,363		
South Channel	6,350,335	109,312			404,805	11,848		
Nantucket Shoals	1,685,848	25,328			450	33		
Off Chatham	204,090	5,299			6,700	242		
Shore, general	395,375	7,600			12,947	253		
Total	11,023,748	190,527			588,667	19,103		
LANDED AT GLOUCESTER								
East of 66° W. longitude								
La Have Bank					9,595	117	575	$12
Western Bank					12,535	156	2,295	35
Quereau Bank					6,120	86	5,170	99
Green Bank					7,250	91	680	17
Grand Bank					16,640	296	5,240	90
St. Peters Bank					4,860	54	1,770	26
Cape Shore					2,210	33		
West of 66° W. longitude								
Browns Bank	795	6			7,315	83		
Georges Bank	38,815	356			39,060	452	4,370	70
South Channel	379,035	4,063			28,895	359		
Nantucket Shoals	46,775	496			5,500	69		
Shore, general	2,745	88			111,119	2,998	34	1
Total	468,165	5,009			251,099	4,794	20,134	350
LANDED AT PORTLAND								
East of 66° W. longitude								
Western Bank	8,650	66	1,365	$27	160	2		
St. Peters Bank					500	35		
West of 66° W. longitude								
Cashes Bank	14,430	72						
Fippenies Bank	1,315	7						
Middle Bank	2,715	19			1,120	45		
Platts Bank	72,690	518			8,125	212		
Jeffreys Ledge	184,957	1,738			1,035	56		
Shore, general	149,070	1,403			8,835	427		
Total	433,827	3,823	1,365	27	19,775	777		
Grand total	11,925,740	199,359	1,365	27	859,541	24,674	20,134	350

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Hake—Continued: Small (under 6 pounds): Fresh		Small (under 6 pounds): Salted		Pollock: Fresh		Pollock: Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
East of 66° W. longitude								
La Have Bank	22, 200	$520			7, 560	$287		
Western Bank	10, 360	244			170, 050	6, 564		
Quereau Bank	4, 000	130						
Grand Bank	11, 950	514						
St. Peters Bank	850	26						
Cape Shore	9, 870	150			2, 330	74		
West of 66° W. longitude								
Browns Bank	66, 870	1, 896			101, 829	3, 920		
Georges Bank	78, 915	2, 054			399, 166	15, 189		
Cashes Bank	65. 675	1, 209			12, 743	353		
Clark Bank					930	37		
Fippenies Bank	4, 780	67			3, 170	55		
Middle Bank	360, 161	9, 208			57, 700	2, 047		
Jeffreys Ledge	813, 190	23, 058			142, 510	4, 537		
South Channel	3, 269, 424	78, 622			931, 384	37, 431		
Nantucket Shoals	137, 625	3, 755			147, 585	6, 411		
Off Chatham	95, 700	4, 095			49, 885	2, 223		
Shore, general	158, 457	3, 808	1, 150	$32	117, 677	5, 159		
Total	5, 110, 027	129, 356	1, 150	32	2, 144, 519	84, 287		
LANDED AT GLOUCESTER								
East of 66° W. longitude								
La Have Bank					2, 125	25	1, 315	$25
Western Bank					83, 345	1, 096	2, 375	41
Quereau Bank					660	6	760	16
Green Bank							360	9
Grand Bank							795	16
St. Peters Bank							50	1
Cape Shore					880	9		
West of 66° W. longitude								
Browns Bank					20, 715	239	765	14
Georges Bank					33, 335	377	4, 970	92
South Channel					4, 520	57		
Nantucket Shoals					1, 245	16		
Shore, general					2, 142, 768	58, 815		
Total					2, 289, 593	60, 640	11, 390	214
LANDED AT PORTLAND								
East of 66° W. longitude								
La Have Bank	2, 570	30			300	4		
Western Bank	5, 335	74			181, 275	2, 463	6, 555	109
Quereau Bank	5, 000	63					85	2
St. Peters Bank	600	6						
West of 66° W. longitude								
Cashes Bank	62, 935	1, 399	430	9	19, 820	375		
Fippenies Bank	6, 525	202			615	12		
Middle Bank	4, 490	62			255	7		
Platts Bank	537, 007	11, 252			35, 463	833	310	7
Jeffreys Ledge	313, 546	9, 599			95, 762	2, 792		
Shore, general	355, 161	8, 990	160	3	299, 336	7, 693		
Total	1, 293, 169	31, 677	590	12	632, 826	14, 179	6, 950	118
Grand total	6, 403, 196	161, 033	1, 740	44	5, 066, 938	159, 106	18, 340	332

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Cusk				Halibut			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
East of 66° W. longitude								
La Have Bank	59,935	$1,184			167,282	$34,075		
Western Bank	6,525	130			283,306	49,976		
Quereau Bank	3,735	114			959,096	141,427		
Green Bank					116,533	22,358		
Grand Bank	4,435	89			712,572	117,975		
St. Peters Bank	700	14			358,787	58,369		
Burgeo Bank					32,186	5,992		
Cape Shore	34,950	554			2,191	503		
The Gully					51,386	9,833		
Labrador Coast					13,429	1,296		
West of 66° W. longitude								
Browns Bank	366,161	6,521			280,561	60,815		
Georges Bank	109,450	2,177			766,116	159,566		
Cashes Bank	85,595	1,449			1,246	382		
Clark Bank					817	613		
Fippenies Bank	14,455	265			278	42		
Middle Bank	192,520	3,935			5,145	1,551		
Jeffreys Ledge	425,842	9,982			7,173	1,972		
South Channel	473,198	10,270			161,322	41,726		
Nantucket Shoals	12,480	227			6,024	1,390		
Off Chatham	18,080	584			3,076	955		
Seal Island	4,115	57			120	36		
Shore, general	48,400	891			5,981	1,094		
Total	1,860,576	38,443			3,934,627	711,946		
LANDED AT GLOUCESTER								
East of 66° W. longitude								
La Have Bank	45,170	707	1,260	$20				
Western Bank	110,920	1,772	10,650	219	10,475	943	340	$34
Quereau Bank	77,415	1,313	9,010	217				
Green Bank	140	3						
Grand Bank	31,320	339	6,135	138			105	13
St. Peters Bank	2,250	28	4,160	67			85	11
Cape Shore	15,230	194						
West of 66° W. longitude								
Browns Bank	120,740	1,827	3,765	84				
Georges Bank	232,845	3,948	20,535	564	130	11		
Cashes Bank	16,000	299						
South Channel	14,775	202						
Shore, general	24,590	377						
Total	691,395	11,009	55,515	1,309	10,605	954	530	58
LANDED AT PORTLAND								
East of 66° W. longitude								
La Have Bank	7,475	105			13,583	2,140		
Western Bank	9,635	135	4,870	131	64,215	12,737		
Quereau Bank	18,000	263			83,210	15,168		
Green Bank					23,553	4,306		
Grand Bank					24,563	3,169		
St. Peters Bank	1,670	28			75,588	8,969		
Burgeo Bank					29,880	4,820		
Gulf of St. Lawrence					7,937	1,166		
St. Anns Bank					34,072	6,284		
The Gully	4,440	67			33,859	3,926		
West of 66° W. longitude								
Browns Bank	1,900	29			60,641	9,869		
Georges Bank	3,060	69			7,709	1,291		
Cashes Bank	80,945	1,191	300	6	4,032	636		
Fippenies Bank	1,920	38			45	10		
Middle Bank	1,370	26			6	1		
Platts Bank	234,495	4,438	775	16	6,244	1,071		
Jeffreys Ledge	183,516	4,718	125	1	3,253	574		
Shore, general	243,609	6,092			3,994	514		
Total	792,035	17,199	6,070	154	476,384	76,651		
Grand total	3,344,006	66,651	61,585	1,463	4,421,616	789,551	530	58

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Mackerel				Miscellaneous			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
East of 66° W. longitude								
La Have Bank					6,158	$1,472		
Western Bank					37,942	1,600		
Quereau Bank					5,004	1,181		
Grand Bank					8,318	1,702		
St. Peters Bank					711	158		
Off Newfoundland							180,000	$4,500
Cape Shore	796,413	$48,707	12,000	$1,120	110,129	28,249		
West of 66° W. longitude								
Browns Bank					51,456	6,781		
Georges Bank	22,144	3,632			1,977,118	390,051		
Cashes Bank	38,090	2,059			100	10		
Tillies Bank	100,255	5,921						
Middle Bank	1,834,214	66,545	40,500	2,560	21,186	915		
Jeffreys Ledge	271,916	32,519	8,700	856	198,446	9,327		
South Channel	676,352	34,417	4,400	242	1,085,664	64,502		
Nantucket Shoals	84,370	4,085			303,629	19,708		
Off Chatham	675,288	25,082	38,800	2,329	91,291	5,487		
Shore, general	1,682,397	114,966	32,670	2,876	2,742,612	98,042		
Total	6,181,439	337,933	137,070	9,983	6,639,764	629,185	180,000	4,500
LANDED AT GLOUCESTER								
East of 66° W. longitude								
Off Newfoundland							2,763,480	103,871
Cape Shore			62,700	4,389				
West of 66° W. longitude								
Middle Bank	142,650	2,982	303,800	17,796	13,000	98		
South Channel	84,560	1,692	55,540	2,847				
Shore, general	1,608,651	86,419	683,084	55,362	621,458	12,339		
Total	1,835,861	91,093	1,105,124	80,394	634,458	12,437	2,763,480	103,871
LANDED AT PORTLAND								
East of 66° W. longitude								
La Have Bank					20,222	4,678		
Western Bank					8,412	400		
Burgeo Bank					170	10		
Cape Shore	106,630	4,244			42,763	10,835		
West of 66° W. longitude								
Browns Bank					1,173	229		
Georges Bank					85,114	16,790		
Cashes Bank					59	2		
Middle Bank					250	13		
Platts Bank					572	31		
Jeffreys Ledge					6,653	345		
Shore, general	350,392	17,053	40,993	1,084	1,259,441	17,669		
Total	457,022	21,297	40,993	1,084	1,424,829	51,002		
Grand total	8,474,322	450,323	1,283,187	91,461	8,699,051	692,624	2,943,480	108,371

NOTE.—The items under "Miscellaneous" include bluebacks, 106,000 pounds, value $823; butterfish, 29,741 pounds, value $5,134; flounders, 4,335,227 pounds, value $191,515; herring, fresh, 1,467,256 pounds, value $19,496; herring, salted, 2,943,480 pounds, value $108,371; rosefish, 76,695 pounds, value $1,630; salmon, 23 pounds, value $5; shad, 178,659 pounds, value $3,802; sharks, 7,507 pounds, value $223; skates, 21,210 pounds; value $356; smelt, 3,554 pounds, value $475; sturgeon, 1,369 pounds, value $302; swordfish, 2,023,416 pounds, value $449,837; tuna, 2,088 pounds, value $103; wolf fish, 223,037 pounds, value $5,743; lobster, 30 pounds, value $8; scallops, 308 pounds, value $129; livers, 6,049 pounds, value $139; spawn, 216,792 pounds, value $12,900; and tongues, 90 pounds, value $4. In this report vessels include only craft of 5 net tons and upward.

Statement, by fishing grounds, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the calendar year 1924—Continued

Fishing grounds	Total				Grand total	
	Fresh		Salted			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON						
East of 66° W. longitude						
La Have Bank	1, 231, 017	$77, 695			1, 231, 017	$77, 695
Western Bank	5, 536, 115	221, 505	11, 000	$358	5, 547, 115	221, 863
Quereau Bank	1, 004, 085	144, 014	6, 000	255	1, 010, 085	144, 269
Green Bank	116, 533	22, 358			116, 533	22, 358
Grand Bank	757, 205	121, 200			757, 205	121, 200
St. Peters Bank	366, 248	58, 742			366, 248	58, 742
Burgeo Bank	32, 186	5, 992			32, 186	5, 992
Off Newfoundland			180, 000	4, 500	180, 000	4, 500
Cape Shore	1, 513, 793	102, 556	12, 000	1, 120	1, 525, 793	103, 676
The Gully	51, 386	9, 833			51, 386	9, 833
Labrador Coast	13, 429	1, 296			13, 429	1, 296
West of 66° W. longitude						
Browns Bank	10, 067, 654	397, 192			10, 067, 654	397, 192
Georges Bank	33, 018, 102	1, 480, 416			33, 018, 102	1, 480, 416
Cashes Bank	432, 304	15, 329			432, 304	15, 329
Clark Bank	37, 147	2, 276			37, 147	2, 276
Fippenies Bank	71, 713	2, 734			71, 713	2, 734
Tillies Bank	100, 255	5, 921			100, 255	5, 921
Middle Bank	4, 246, 084	162, 851	40, 500	2, 560	4, 286, 584	165, 411
Jeffreys Ledge	6, 205, 775	276, 114	8, 700	856	6, 214, 475	276, 970
South Channel	49, 950, 900	1, 573, 213	4, 400	242	46, 955, 300	1, 573, 455
Nantucket Shoals	8, 853, 435	271, 828			8, 853, 435	271, 828
Off Chatham	2, 177, 386	91, 952	38, 800	2, 329	2, 216, 186	94, 281
Seal Island	113, 835	2, 683			113, 835	2, 683
Shore, general	7, 734, 449	338, 762	33, 820	2, 908	7, 768, 269	341, 670
Total	130, 631, 036	5, 386, 462	335, 220	15, 128	130, 966, 256	5, 401, 590
LANDED AT GLOUCESTER						
East of 66° W. longitude						
La Have Bank	591, 535	12, 439	138, 157	6, 714	729, 692	19, 153
Western Bank	10, 272, 916	209, 420	1, 172, 648	52, 148	11, 445, 564	261, 568
Quereau Bank	138, 695	3, 231	289, 625	13, 194	428, 320	16, 425
Green Bank	7, 390	94	35, 830	1, 871	43, 220	1, 965
Grand Bank	92, 450	1, 655	282, 249	12, 730	374, 699	14, 385
St. Peters Bank	19, 170	350	185, 275	8, 671	204, 445	9, 021
Off Newfoundland			2, 763, 480	103, 871	2, 763, 480	103, 871
Cape Shore	165, 095	3, 124	62, 700	4, 389	227, 795	7, 513
Labrador Coast			4, 875	242	4, 875	242
West of 66° W. longitude						
Browns Bank	1, 426, 980	26, 113	83, 305	3, 915	1, 510, 285	30, 028
Georges Bank	6, 781, 835	135, 669	519, 890	24, 034	7, 301, 725	159, 703
Cashes Bank	16, 000	299			16, 000	299
Middle Bank	155, 650	3, 080	303, 800	17, 796	459, 450	20, 876
South Channel	1, 483, 865	23, 399	55, 540	2, 847	1, 539, 405	26, 246
Nantucket Shoals	339, 510	4, 416			339, 510	4, 416
Shore, general	7, 772, 232	310, 311	685, 223	55, 454	8, 457, 455	365, 765
Total	29, 263, 323	733, 600	6, 582, 597	307, 876	35, 845, 920	1, 041, 476
LANDED AT PORTLAND						
East of 66° W. longitude						
La Have Bank	85, 930	7, 878	14, 700	638	100, 630	8, 516
Western Bank	5, 889, 035	129, 956	114, 535	5, 136	6, 003, 570	135, 092
Quereau Bank	106, 210	15, 494	10, 745	531	116, 955	16, 025
Green Bank	23, 553	4, 306			23, 553	4, 306
Grand Bank	24, 563	3, 169			24, 563	3, 169
St. Peters Bank	88, 033	9, 343	5, 300	207	93, 333	9, 550
Burgeo Bank	30, 050	4, 830			30, 050	4, 830
Cape Shore	149, 393	15, 079			149, 393	15, 079
Gulf of St. Lawrence	7, 937	1, 166			7, 937	1, 169
St. Anns Bank	34, 072	6, 284			34, 072	6, 284
The Gully	40, 799	4, 056			40, 799	4, 056
West of 66° W. longitude						
Browns Bank	74, 094	10, 358	9, 635	477	83, 729	10, 835
Georges Bank	95, 883	18, 150			95, 883	18, 150
Cashes Bank	391, 411	10, 144	2, 630	105	394, 041	10, 249
Fippenies Bank	34, 095	1, 511			34, 095	1, 511
Middle Bank	33, 466	1, 128			33, 466	1, 128
Platts Bank	1, 578, 995	49, 285	5, 655	262	1, 584, 650	49, 547
Jeffreys Ledge	1, 956, 976	75, 561	125	1	1, 957, 101	75, 562
Shore, general	5, 282, 695	173, 555	45, 503	1, 276	5, 328, 198	174, 831
Total	15, 927, 190	541, 253	208, 828	8, 633	16, 136, 018	549, 886
Grand total	175, 821, 549	6, 661, 315	7, 126, 645	331, 637	182, 948, 194	6, 992, 952

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924

Month	Number of trips	Cod							
		Large (10 pounds and over)				Market (under 10 and over 2½ pounds)			
		Fresh		Salted		Fresh		Salted	
		Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON									
January	280	1, 246, 265	$88, 621			565, 865	$26, 270		
February	299	3, 895, 864	114, 602			728, 575	20, 884		
March	297	3, 270, 788	121, 099			531, 930	20, 325		
April	245	2, 071, 026	67, 248			791, 250	19, 520		
May	233	1, 920, 940	65, 076			1, 047, 385	24, 722		
June	304	1, 907, 795	86, 377	6, 000	$255	1, 168, 801	31, 393		
July	355	1, 686, 423	78, 440			1, 193, 095	30, 477		
August	372	2, 075, 949	72, 948			1, 245, 580	26, 759		
September	370	2, 561, 518	106, 909			1, 282, 328	33, 019		
October	353	2, 190, 750	111, 100			1, 014, 410	32, 015		
November	311	883, 686	65, 151	11, 000	358	537, 500	23, 332		
December	316	1, 182, 288	92, 871			852, 707	35, 751		
Total	3, 735	24, 893, 292	1, 070, 442	17, 000	613	10, 959, 426	324, 467		
LANDED AT GLOUCESTER									
January	45	44, 895	4, 154			19, 275	313		
February	115	1, 943, 290	47, 977	4, 520	215	67, 140	1, 158	45	$2
March	202	1, 640, 545	49, 425	8, 655	393	75, 225	1, 307	1, 895	66
April	261	1, 421, 140	44, 134	102, 561	4, 569	202, 710	3, 481	18, 900	661
May	205	1, 489, 720	37, 990	219, 228	9, 867	463, 781	8, 307	51, 237	1, 805
June	171	1, 450, 215	35, 937	372, 675	18, 106	787, 520	14, 851	395, 522	15, 263
July	175	2, 784, 720	64, 833	338, 905	16, 363	1, 211, 950	21, 645	99, 372	3, 719
August	116	2, 201, 595	51, 868	240, 993	12, 133	895, 795	17, 193	40, 445	1, 574
September	236	891, 960	28, 077	396, 585	20, 715	301, 090	5, 832	100, 250	4, 337
October	206	167, 020	4, 727	156, 955	8, 579	99, 675	1, 982	21, 660	976
November	274	69, 410	4, 167	21, 145	1, 216	34, 490	797	3, 580	170
December	151	125, 140	12, 620			2, 710	58		
Total	2, 157	14, 229, 650	385, 909	1, 862, 222	92, 156	4, 161, 361	76, 924	732, 906	28, 573
LANDED AT PORTLAND									
January	116	134, 625	9, 380			62, 320	2, 497		
February	113	120, 685	4, 509	3, 065	92	44, 785	1, 580		
March	132	762, 703	19, 325	2, 660	133	63, 475	2, 009	1, 915	77
April	139	565, 714	11, 912	16, 565	734	53, 504	1, 165	4, 900	184
May	103	318, 056	8, 904	1, 475	70	21, 441	491	395	14
June	167	348, 670	16, 970	15, 390	749	28, 331	662	3, 510	113
July	191	278, 822	14, 323	7, 580	379	23, 562	683	1, 280	51
August	174	203, 913	9, 524	200	10	17, 012	444		
September	112	246, 930	8, 901	28, 155	1, 345	58, 015	1, 207	6, 970	285
October	135	210, 271	8, 404	44, 530	2, 537	86, 596	2, 235	4, 240	190
November	112	238, 054	10, 495	1, 740	78	97, 468	2, 538	515	21
December	89	94, 541	6, 876			49, 878	1, 755		
Total	1, 583	3, 522, 984	129, 523	121, 360	6, 127	606, 387	17, 266	23, 725	935
Grand total	7, 475	42, 645, 926	1, 585, 874	2, 000, 582	98, 896	15, 727, 174	418, 657	756, 631	29, 508
Grounds east of 66° W. long.	548	10, 863, 004	305, 298	1, 508, 609	74, 470	4, 039, 261	88, 270	657, 564	25, 731
Grounds west of 66° W. long.	6, 927	31, 782, 922	1, 280, 576	491, 973	24, 426	11, 687, 913	330, 387	99, 067	3, 777
Landed at Boston in 1923	3, 368	23, 514, 769	1, 063, 881	29, 940	1, 253	14, 367, 255	379, 712		
Landed at Gloucester in 1923	1, 579	9, 642, 130	278, 467	2, 652, 059	126, 698	6, 148, 642	111, 398	1, 282, 491	49, 377
Landed at Portland in 1923	1, 588	3, 406, 136	124, 369	295, 646	14, 521	847, 222	25, 906	54, 325	2, 112

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Cod—Continued				Haddock			
	Scrod (1 to 2½ pounds)				Large (over 2½ pounds)			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
January	28,105	$606			4,723,300	$233,849		
February	6,210	81			6,580,140	193,580		
March	5,050	90			6,374,855	241,363		
April	9,300	115			4,640,749	125,084		
May	4,215	43			3,898,015	113,418		
June	2,940	38			3,586,565	93,663		
July	6,105	55			3,366,552	73,833		
August	1,805	13			2,907,200	73,342		
September	1,960	16			4,746,030	122,979		
October	57,320	765			5,705,005	174,911		
November	7,005	105			4,947,315	157,965		
December	46,375	1,712			5,642,835	243,147		
Total	176,390	3,639			57,118,561	1,847,134		
LANDED AT GLOUCESTER								
January	3,300	25			5,155	180		
February					201,616	3,445		
March					161,535	3,208		
April	1,680	13	285	$7	1,213,115	27,325		
May	3,990	30	25	1	907,170	17,594		
June	1,365	11	26,193	786	631,060	9,187	173	$4
July	2,650	21	295	7	590,250	7,353	150	4
August	1,270	13	90	3	371,465	5,032		
September	1,430	15	3,035	106	239,180	2,957		
October	200	2	1,050	33	133,790	4,781		
November	1,630	16			204,885	3,407		
December					14,400	216		
Total	17,515	146	30,973	913	4,673,621	84,685	323	8
LANDED AT PORTLAND								
January	10,455	67			327,944	19,663		
February	8,628	63			419,113	15,900		
March	6,235	61	200	6	1,526,927	36,421		
April	7,305	39	3,460	87	1,716,064	34,473		
May	4,350	22			572,620	12,304		
June	6,572	33	140	3	118,510	4,261		
July	555	3			100,552	2,897		
August	2,320	13			100,437	4,604		
September	5,305	26			151,041	5,493	2,525	51
October	16,460	87			364,356	13,170		
November	10,650	54	880	18	423,630	12,295	570	11
December	10,047	61			357,876	15,849		
Total	88,882	529	4,680	114	6,179,070	177,330	3,095	62
Grand total	282,787	4,314	35,653	1,057	67,971,252	2,109,149	3,418	70
Grounds east of 66° W. long	17,215	204	35,398	1,050	8,146,268	173,465	3,363	69
Grounds west of 66° W. long	265,572	4,110	255	7	59,824,984	1,935,684	55	1
Landed at Boston in 1923	130,155	1,837			56,124,378	2,052,121		
Landed at Gloucester in 1923	34,115	262	108,895	3,219	7,711,991	98,411	41,610	922
Landed at Portland in 1923	121,436	698	20,058	431	5,037,849	177,242		

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Haddock—Continued				Hake			
	Scrod (1 to 1½ pounds)				Large (6 pounds and over)			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
January	1, 175, 570	$35, 274			24, 525	$1, 284		
February	1, 094, 260	16, 904			5, 250	215		
March	843, 790	25, 107			3, 155	165		
April	727, 480	10, 417			12, 850	649		
May	708, 680	9, 822			4, 935	205		
June	740, 265	7, 578			6, 350	317		
July	472, 248	4, 323			166, 855	3, 852		
August	495, 255	5, 306			2, 570	59		
September	993, 285	11, 353			1, 727	34		
October	1, 281, 265	16, 423			65, 375	1, 251		
November	1, 125, 865	17, 187			75, 020	1, 477		
December	1, 366, 785	30, 833			220, 055	9, 595		
Total	11, 023, 748	190, 527			588, 667	19, 103		
LANDED AT GLOUCESTER								
January					7, 700	420		
February	6, 015	38			10, 280	513	55	$1
March	1, 525	76			2, 410	111		
April	795	6			3, 645	37	1, 430	21
May	10, 380	78			1, 940	20	324	5
June	38, 770	388			25, 130	314	2, 655	41
July	56, 920	549			21, 714	403	4, 315	68
August	63, 655	555			39, 475	464	3, 765	75
September					31, 845	476	3, 215	53
October	277, 685	3, 167			59, 035	882	2, 975	51
November	12, 420	152			37, 355	704	1, 400	35
December					10, 570	450		
Total	468, 165	5, 009			251, 099	4, 794	20, 134	350
LANDED AT PORTLAND								
January	47, 281	644			3, 300	132		
February	48, 724	794			5, 195	314		
March	33, 555	516			1, 120	45		
April	9, 938	88			55	2		
May	7, 160	47			1, 015	30		
June	22, 671	137						
July	18, 760	94			555	36		
August	22, 193	119			200	3		
September	21, 230	136	1, 365	$27	50	1		
October	50, 160	262			560	5		
November	82, 796	470			4, 400	76		
December	69, 359	516			3, 325	133		
Total	433, 827	3, 823	1, 365	27	19, 775	777		
Grand total	11, 925, 740	199, 359	1, 365	27	859, 541	24, 674	20, 134	350
Grounds east of 66° W. long	66, 425	936	1, 365	27	60, 870	900	15, 730	279
Grounds west of 66° W. long	11, 859, 315	198, 423			798, 671	23, 774	4, 404	71
Landed at Boston in 1923	4, 416, 268	90, 726	1, 975	35	122, 644	6, 062		
Landed at Gloucester in 1923	100, 585	670			571, 985	8, 747	16, 255	284
Landed at Portland in 1923	326, 867	3, 050			38, 795	806	1, 184	25

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Hake—Continued, Small (under 6 pounds)				Pollock			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
January	435, 081	$17, 229			198, 052	$9, 896		
February	324, 305	13, 500			117, 916	6, 203		
March	334, 270	12, 881			77, 427	4, 606		
April	190, 625	8, 539			95, 535	4, 792		
May	74, 435	2, 741			105, 580	4, 351		
June	182, 060	4, 735	150	$7	129, 752	5, 420		
July	33, 200	850			109, 499	4, 888		
August	159, 650	3, 557			158, 008	6, 685		
September	712, 586	14, 080			256, 483	7, 776		
October	1, 221, 540	19, 564	1, 000	25	241, 428	6, 207		
November	1, 000, 805	17, 638			251, 075	6, 815		
December	441, 470	14, 042			403, 764	16, 648		
Total	5, 110, 027	129, 356	1, 150	32	2, 144, 519	84, 287		
LANDED AT GLOUCESTER								
January					67, 230	4, 035		
February					21, 752	879		
March					9, 080	424	600	$9
April					35, 355	1, 572	980	15
May					10, 923	110	920	16
June					21, 965	237	50	1
July					42, 023	585	3, 355	65
August					22, 810	450	1, 010	20
September					154, 890	3, 507	2, 615	43
October					879, 840	18, 260	1, 860	45
November					853, 410	20, 658		
December					170, 315	9, 923		
Total					2, 289, 593	60, 640	11, 390	214
LANDED AT PORTLAND								
January	177, 509	6, 135			63, 018	2, 010		
February	87, 323	3, 904			45, 973	1, 649		
March	37, 458	1, 460			70, 186	1, 488	6, 000	98
April	70, 178	2, 252			100, 164	1, 008		
May	54, 559	1, 358			25, 872	336	60	1
June	35, 874	621	590	12	52, 638	1, 445		
July	71, 284	994			67, 854	1, 607	85	2
August	24, 830	338			46, 699	1, 256		
September	27, 564	628			54, 406	1, 194		
October	319, 490	5, 370			47, 788	921	695	15
November	260, 935	4, 494			40, 202	704	110	2
December	126, 165	4, 123			18, 026	561		
Total	1, 293, 169	31, 677	590	12	632, 826	14, 179	6, 950	118
Grand total	6, 403, 196	161, 033	1, 740	44	5, 066, 938	159, 106	18, 340	332
Grounds east of 66° W. long	72, 735	1, 757			448, 525	10, 528	12, 295	219
Grounds west of 66° W. long	6, 330, 461	159, 276	1, 740	44	4, 618, 413	148, 578	6, 045	113
Landed at Boston in 1923	4, 377, 145	92, 001	1, 500	24	3, 076, 671	104, 125		
Landed at Gloucester in 1923					1, 122, 362	35, 392	36, 345	764
Landed at Portland in 1923	1, 204, 841	34, 350	3, 428	68	566, 608	11, 860	2, 340	48

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Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Cusk				Halibut			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED IN BOSTON								
January	122, 565	$3, 503			30, 214	$10, 267		
February	100, 215	3, 429			60, 073	16, 087		
March	215, 085	5, 450			234, 752	44, 325		
April	237, 615	4, 127			487, 000	89, 916		
May	128, 153	1, 991			681, 147	127, 155		
June	64, 335	967			495, 963	86, 250		
July	38, 545	815			489. 390	81, 450		
August	31, 370	590			723, 911	97, 498		
September	98, 330	1, 776			503, 564	104, 080		
October	222, 640	4, 030			165, 972	35, 787		
November	279, 515	4, 602			43, 438	11, 379		
December	322, 208	7, 163			19, 203	7, 752		
Total	1, 860, 576	38, 443			3, 934, 627	711, 946		
LANDED AT GLOUCESTER								
January	1, 200	15						
February	450	14	55	$1				
March	1, 920	48						
April	38, 230	500	1, 430	23				
May	118, 620	1, 729	3, 730	84			105	$13
June	26, 570	406	3, 780	84			340	34
July	110, 115	1, 960	8, 095	166			85	11
August	160, 580	2, 367	22, 315	535	10, 605	954		
September	93, 195	1, 499	9, 685	230				
October	115, 300	2, 027	6, 380	185				
November	24, 735	437	45	1				
December	480	7						
Total	691, 395	11, 009	55, 515	1, 309	10, 605	954	530	58
LANDED AT PORTLAND								
January	83, 665	2, 429			1, 850	353		
February	99, 197	2, 882			1, 087	210		
March	69, 660	1, 873	125	1	3, 999	660		
April	134, 560	2, 176			86, 091	12, 154		
May	44, 490	805	600	12	60, 377	10, 099		
June	8, 521	201	300	6	128, 166	19, 099		
July	26, 819	454			90, 522	12, 993		
August	13, 213	270			21, 235	3, 212		
September	23, 056	512	3, 630	100	25, 541	6, 298		
October	139, 065	2, 210	1, 415	35	54, 567	11, 140		
November	85, 796	1, 658			1, 687	266		
December	63, 993	1, 729			1, 262	167		
Total	792, 035	17, 199	6, 070	154	476, 384	76, 651		
Grand total	3, 344, 006	66, 651	61, 585	1, 463	4. 421, 616	789, 551	530	58
Grounds east of 66° W. long	433, 945	7. 039	36, 085	792	3, 097, 703	505, 432	530	58
Grounds west of 66° W long	2, 910, 061	59, 612	25, 500	671	1, 323, 913	284, 119		
Landed at Boston in 1923	1, 516, 969	31, 408	23, 000	690	3, 560, 375	679, 259		
Landed at Gloucester in 1923	290, 110	3, 545	37, 570	743	106, 884	22, 113	1. 510	108
Landed at Portland in 1923	1, 103, 817	24, 667	726, 740	675	1, 205, 735	221, 174		

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Mackerel				Miscellaneous [1]			
	Fresh		Salted		Fresh		Salted	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON								
January					293, 118	$20, 727		
February					461, 737	23, 099		
March					522, 961	23, 572		
April					569, 448	19, 030		
May	79, 986	$12, 376			444, 165	13, 830	180, 000	$4, 500
June	1, 300, 619	90, 839	12, 000	$1, 120	374, 246	50, 051		
July	1, 122, 907	48, 413	33, 800	1, 916	1, 524, 751	224, 409		
August	2, 034, 589	70, 727	77, 300	5, 352	851, 657	138, 323		
September	1, 172, 312	69, 348	13, 970	1, 595	573, 584	55, 409		
October	350, 866	28, 449			413, 962	23, 128		
November	120, 160	17, 781			313, 088	17, 912		
December					297, 047	19, 695		
Total	6, 181, 439	337, 933	137, 070	9, 983	6, 639, 764	629, 185	180, 000	4, 500
LANDED AT GLOUCESTER								
January							248, 000	10, 688
February							529, 080	17, 830
May	1, 380	179						
June	48, 162	4, 722	62, 700	4, 389	232, 400	3, 474		
July	481, 087	11, 372	153, 034	8, 341	106, 200	1, 758		
August	199, 308	3, 600	407, 960	25, 503	68, 800	660		
September	734, 054	32, 805	395, 600	32, 821	56, 000	840		
October	202, 434	12, 703	25, 000	2, 197	44, 000	610		
November	153, 791	22, 784	60, 830	7, 143	2, 080	42		
December	15, 645	2, 928			124, 978	5, 053	1, 986, 400	75, 353
Total	1. 835. 861	91, 093	1, 105, 124	80, 394	634, 458	12, 437	2, 763, 480	103, 871
LANDED AT PORTLAND								
January					3, 119	184		
February					14, 221	454		
March					33, 829	533		
April					1, 857	75		
May					855	33		
June	78, 684	5, 358			70, 744	929		
July	33, 521	604	2, 400	24	494, 683	15, 084		
August	198, 529	9, 405	38, 435	1, 052	498, 036	20, 773		
September	128, 304	3, 919			61, 941	9, 900		
October	15, 750	1, 654	158	8	162, 513	2, 044		
November	2, 234	357			82, 092	967		
December					939	26		
Total	457, 022	21, 297	40, 993	1, 084	1, 424, 829	51, 002		
Grand total	8, 474, 322	450, 323	1, 283, 187	91, 461	8, 699, 051	692, 624	2, 943, 480	108, 371
Grounds east of 66° W. long	903, 043	52, 951	74, 700	5, 509	239, 829	50, 285	2, 943, 480	108, 371
Grounds west of 66° W. long	7, 571, 279	397, 372	1, 208, 487	85, 952	8, 459, 222	642, 339		
Landed at Boston in 1923	6, 580, 066	316, 489	187, 600	12, 719	6, 175, 724	601, 131	8, 600	258
Landed at Gloucester in 1923	3, 187, 263	85, 424	621, 800	38, 834	95, 946	4, 500	1, 219, 300	40, 861
Landed at Portland in 1923	917, 094	31, 882	71, 405	2, 289	445, 061	30, 511		

[1] Includes herring from Newfoundland, 2,943,480 pounds salted, value $108,371.

Statement, by months, of quantities and values of certain fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by American fishing vessels during the year 1924—Continued

Months	Total				Grand total	
	Fresh		Salted			
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
LANDED AT BOSTON						
January	8, 842, 660	$447, 526			8, 842, 660	$447, 526
February	13, 374, 545	408, 584			13, 374, 545	408, 584
March	12, 414, 063	498, 983			12, 414, 063	498, 983
April	9, 832, 878	349, 437			9, 832, 878	349, 437
May	9, 097, 636	375, 730	180, 000	$4, 500	9, 277, 636	380, 230
June	9, 959, 691	457, 628	18, 150	1, 382	9, 977, 841	459, 010
July	10, 209, 570	551, 805	33, 800	1, 916	10, 243, 370	553, 721
August	10, 686, 544	495, 807	77, 300	5, 352	10, 763, 844	501, 159
September	12, 903, 707	526, 779	13, 970	1, 595	12, 917, 677	528, 374
October	12, 930, 533	453, 630	1, 000	25	12, 931, 533	453, 655
November	9, 584, 472	341, 344	11, 000	358	9, 595, 472	341, 702
December	10, 794, 737	479, 209			10, 794, 737	479, 209
Total	130, 631, 036	5, 386, 462	335, 220	15, 128	130, 966, 256	5, 401, 590
LANDED AT GLOUCESTER						
January	148, 755	9, 142	248, 000	10, 688	396, 755	19, 830
February	2, 250, 543	54, 024	533, 755	18, 049	2, 784, 298	72, 073
March	1, 892, 240	54, 599	11, 150	468	1, 903, 390	55, 067
April	2, 916, 670	77, 068	125, 586	5, 296	3, 042, 256	82, 364
May	3, 007, 904	66, 037	275, 569	11, 791	3, 283, 473	77, 828
June	3, 263, 157	69, 527	864, 088	38, 708	4, 127, 245	108, 235
July	5, 407, 629	110, 479	607, 606	28, 744	6, 015, 235	139, 223
August	4, 035, 358	83, 156	716, 578	39, 843	4, 751, 936	122, 999
September	2, 503, 644	76, 008	910, 985	58, 305	3, 414, 629	134, 313
October	1, 978, 979	49, 141	215, 880	12, 066	2, 194, 859	61, 207
November	1, 394, 206	53, 164	87, 000	8, 565	1, 481, 206	61, 729
December	464, 238	31, 255	1, 986, 400	75, 353	2, 450, 638	106, 600
Total	29, 263, 323	733, 600	6, 582, 597	307, 876	35, 845, 920	1, 041, 476
LANDED AT PORTLAND						
January	915, 086	43, 494			915, 086	43, 494
February	894, 931	32, 259	3, 065	92	897, 996	32, 351
March	2, 609, 147	64, 391	10, 900	315	2, 620, 047	64, 706
April	2, 745, 430	65, 344	24, 925	1, 005	2, 770, 355	66, 349
May	1, 110, 795	34, 429	2, 530	97	1, 113, 325	34, 526
June	899, 381	49, 716	19, 930	883	919, 311	50, 599
July	1, 207, 489	49, 772	11, 345	456	1, 218, 834	50, 228
August	1, 148, 617	49, 961	38, 635	1, 062	1, 187, 252	51, 023
September	803, 383	38, 215	42, 645	1, 808	846, 028	40, 023
October	1, 467, 576	47, 502	51, 038	2, 785	1, 518, 614	50, 287
November	1, 329, 944	34, 374	3, 815	130	1, 333, 759	34, 504
December	795, 411	31, 796			795, 411	31, 796
Total	15, 927, 190	541, 253	208, 828	8, 633	16, 136, 018	549, 886
Grand total	175, 821, 549	6, 661, 315	7, 126, 645	331, 637	182, 948, 194	6, 992, 952
Grounds east of 66° W. long	28, 388, 823	1, 197, 065	5, 289, 119	216, 575	33, 677, 942	1, 413, 640
Grounds west of 66° W. long	147, 432, 726	5, 464, 250	1, 837, 526	115, 062	149, 270, 252	5, 579, 312
Landed at Boston in 1923	123, 962, 419	5, 418, 752	252, 615	14, 979	124, 215, 034	5, 433, 731
Landed at Gloucester in 1923	29, 012, 013	648, 929	6, 017, 835	261, 810	35, 029, 848	910, 739
Landed at Portland in 1923	15, 221, 461	686, 515	475, 126	20, 169	15, 696, 587	706, 684

The fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by fishing vessels each year are taken chiefly from fishing grounds off the coast of the United States. In the calendar year 1924, 81.53 per cent of the quantity and 79.75 per cent of the value landed by fishing vessels were from these grounds; 2.75 per cent of the quantity and 5.22 per cent of the value, consisting principally of cod, halibut, and herring, were from fishing banks off the coast of Newfoundland; and 15.72 per cent of the quantity and 15.03 per cent of the value were from fishing grounds off the Canadian Provinces. There was some increase, compared with the previous year, in the percentage of products from grounds off the coast of the United States and a decrease in the percentage from grounds off the Canadian Provinces. There was very little change in the percentage from off the coast of Newfoundland. Newfoundland herring constituted 1.61 per cent of the quantity and 1.55 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 the following table:

Quantity and value of fish landed by American fishing vessels at Boston and Gloucester, Mass., and Portland, Me., in 1924, from fishing grounds off the coasts 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	43, 699, 307	$1, 613, 828	89, 930	$2, 653	14, 866, 650	$392, 364	58, 655, 887	$2, 008, 845
Salted	591, 295	28, 210	494, 109	23, 332	1, 707, 462	77, 919	2, 792, 866	129, 461
Haddock:								
Fresh	71, 611, 799	2, 132, 762	425	5	8, 284, 768	175, 741	79, 896, 992	2, 308, 508
Salted	55	1	40	1	4, 688	95	4, 783	97
Hake:								
Fresh	7, 129, 132	183, 050	43, 650	1, 052	89, 955	1, 605	7, 262, 737	185, 707
Salted	6, 144	115	7, 690	133	8, 040	146	21, 874	394
Pollock:								
Fresh	4, 618, 413	148, 578			448, 525	10, 528	5, 066, 938	159, 106
Salted	6, 045	113	1, 205	26	11, 090	193	18, 340	332
Cusk:								
Fresh	2, 905, 946	59, 555	40, 515	501	397, 545	6, 595	3, 344, 006	66, 651
Salted	25, 500	671	10, 295	205	25, 790	587	61, 585	1, 463
Halibut:								
Fresh	1, 323, 793	284, 083	1, 387, 091	227, 254	1, 710, 732	278, 214	4, 421, 616	789, 551
Salted			190	24	340	34	530	58
Mackerel:								
Fresh	7, 571, 279	397, 372			903, 043	52, 951	8, 474, 322	450, 323
Salted	1, 208, 487	85, 952			74, 700	5, 509	1, 283, 187	91, 461
Herring:								
Fresh	1, 467, 256	19, 496					1, 467, 256	19, 496
Salted			2, 943, 480	108, 371			2, 943, 480	108, 371
Swordfish: Fresh	1, 825, 742	400, 636	9, 029	1, 860	188, 645	47, 341	2, 023, 416	449, 837
Miscellaneous: Fresh	5, 166, 224	222, 207	170	10	41, 985	1, 074	5, 208, 379	223, 291
Total	149, 156, 417	5, 576, 629	5, 027, 819	365, 427	28, 763, 958	1, 050, 896	182, 948, 194	6, 992, 952

SPECIES

COD

In 1924 there was an increase of 37 vessels, or 12.09 per cent, in the fishing fleet landing fish at Boston, Gloucester, and Portland, as compared with 1923. There were 5 vessels in the salt-bank fishery and 102 in the market fishery. These vessels landed their fares of cod and other ground fish at the above-named ports during the year, and large quantities were also landed by vessels fishing on the shore grounds. The catch of cod landed at these ports during the year was 61,448,753 pounds, valued at $2,138,306, of which 58,655,887 pounds, valued at $2,008,845, were landed fresh and 2,792,866 pounds, valued at $129,461, were landed salted. Cod ranked second in both quantity and value among the various species landed.

HADDOCK

Haddock ranked first in both quantity and value, the catch exceeding that of cod by 18,453,022 pounds in quantity and $170,299 in value. The quantity of haddock landed at these ports by fishing vessels during the year was 79,901,775 pounds, valued at $2,308,605, all landed fresh except 4,783 pounds, valued at $97, landed salted. These fish were taken chiefly from Western Bank, Browns Bank, Georges Bank, South Channel, and Nantucket Shoals, and about 44 per cent of the quantity and 38 per cent of the value were taken in the otter-trawl fishery. The greater part of the catch (68,142,309 pounds, valued at $2,037,661) was landed at Boston.

HAKE

The catch of hake amounted to 7,284,611 pounds, valued at $186,101, all landed fresh except 21,874 pounds, valued at $394, landed salted. Of this catch 5,699,844 pounds, valued at $148,491, were landed at Boston; 271,233 pounds, valued at $5,144, at Gloucester; and 1,313,534 pounds, valued at $32,466, at Portland. About half of the catch was taken in South Channel, and about 78 per cent was landed at Boston.

POLLOCK

The catch of pollock amounted to 5,085,278 pounds, valued at $159,438, all landed fresh except 18,340 pounds salted, valued at $332. The catch was obtained largely from Georges Bank, South Channel, and the shore grounds, and most of it was landed at Boston and Gloucester.

CUSK

The catch of cusk amounted to 3,405,591 pounds, valued at $68,114, all landed fresh except 61,585 pounds salted, valued at $1,463. More than half of the catch was landed at Boston. There was an increase in the catch, as compared with the previous year, of 407,385 pounds, valued at $6,386.

HALIBUT

The catch of halibut amounted to 4,422,146 pounds, valued at $789,609, all landed fresh except 530 pounds salted, valued at $58. There was a decrease of 9.28 per cent in the quantity and 14.44 per cent in the value of the halibut landed in 1924, as compared with the previous year. The quantity landed at Boston was 3,934,627 pounds, valued at $711,946; at Gloucester, 11,135 pounds, valued at $1,012; and at Portland, 476,384 pounds, valued at $76,651.

MACKEREL

The total catch of fresh mackerel taken by the American fishing fleet in 1924 was 102,067 barrels, or 15,310,050 pounds, compared with 121,982 barrels, or 18,297,300 pounds, in 1923, a decrease of

19,915 barrels, or 2,987,250 pounds. The total catch of salted mackerel landed by the fishing fleet was 10,841 barrels, or 2,168,200 pounds, compared with 3,864 barrels, or 772,800 pounds, in 1923, an increase of 6,977 barrels, or 1,395,400 pounds. In 1924 about 8,000 barrels of salted mackerel were prepared from mackerel landed fresh, as compared with about 15,000 barrels in 1923. The quantity of mackerel landed at Boston, Gloucester, and Portland by fishing vessels during the year was 9,757,509 pounds, valued at $541,784, of which 8,474,322 pounds, valued at $450,323, were fresh and 1,283,187 pounds, valued at $91,461, were salted. There was a decrease of 1,807,719 pounds in the total catch of mackerel landed by fishing vessels at these ports and an increase of $54,147 in value as compared with 1923.

In 1924 the catch of mackerel up to July 3 was 38,916 barrels fresh and 860 barrels salted, compared with 25,879 barrels fresh and 346 barrels salted for the same period in 1923. The southern mackerel seiners had the best season for many years, but the gill-netters had a comparatively poor season. The mackerel taken by the seiners weighed about 1 pound each. The fleet was about the same size as last year. The first catch was landed at Cape May on April 8 and consisted of one barrel of blink mackerel, weighing three fish to the pound. These fish were landed one day earlier than the first mackerel were landed the previous season.

A large body of small mackerel was reported in the south. Large schools of large mackerel were also seen off Block Island late in the spring, but they were "wild", and it was impossible to seine them. The small mackerel landed by the southern fleet sold at from 7 to 15 cents per pound and the large ones at 9 to 25 cents per pound, according to market conditions. The first arrival of mackerel at Boston direct from the fleet was on May 16 and consisted of 5,000 pounds of large fresh fish, which were sold at 22 cents per pound. The Cape Shore mackerel fleet was about the same size as in 1923, but there was a decline in the catch. A considerable quantity of small mackerel was landed from the Cape Shore, which was unusual. The first arrivals of mackerel at Boston from the Cape Shore were two fares on July 9, consisting of 56,000 pounds of fish weighing 1¼ pounds each and 30,000 pounds of large mackerel. The mackerel sold at from 8 to 8½ cents per pound.

The quantity of mackerel salted by the Cape fleet was small but larger than last year. They were about half mediums, and counted from 260 to 300 fish to a barrel. They sold from the vessel at $14 per barrel, as compared with $11 per barrel the previous year.

The Cape Shore catch of mackerel for the past five years, shown in pounds, was as follows:

Year	Trips	Fresh	Salted
1924	24	996,000	170,800
1923	31	1,240,680	42,200
1922	38	1,353,900	468,800
1921	29	2,160,100	628,400
1920	30	1,290,000	443,400

SWORDFISH

The catch of swordfish amounted to 2,023,416 pounds, valued at $449,837. There were 45 vessels engaged in this fishery, or 7 less than in the previous year. There was a decrease in the catch of 17.59 per cent in quantity but an increase of 0.38 per cent in value.

FLOUNDERS

The catch of flounders in the vessel fisheries amounted to 4,335,227 pounds, valued at $191,515, an increase of 898,407 pounds, or 26.14 per cent, in quantity and of $27,832, or 17 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 4,410,736 pounds, valued at $127,867. Of this quantity 1,467,256 pounds, valued at $19,496, were taken off the coast of the United States and landed fresh, and the remainder, consisting of 2,943,480 pounds salted, valued at $108,371, were Newfoundland herring.

OTTER-TRAWL FISHERY

In 1924 there were 543 trips landed at Boston, Gloucester, and Portland by 32 otter-trawl vessels, amounting to 46,703,035 pounds of fish, valued at $1,327,731, or 25.53 per cent of the quantity and 19.99 per cent of the value of the total catch landed by fishing vessels at these ports during the year. The catch included cod, 8,231,430 pounds, valued at $286,562; haddock, 35,197,940 pounds, valued at $867,756; hake, 616,853 pounds, valued at $18,210; pollock, 1,028,032 pounds, valued at $39,467; cusk, 10,720 pounds, valued at $460; halibut, 94,221 pounds, valued at $22,069; and other species, 1,523,839 pounds, valued at $93,207. The catch by otter trawls consists principally of haddock, which in 1924 amounted to 44.05 per cent of the quantity and 37.59 per cent of the value of the entire catch of this species landed by fishing vessels at these ports. The otter-trawl catch was taken chiefly from Western Bank, Georges Bank, South Channel, and Nantucket Shoals.

Compared with the previous year, there was one vessel less engaged in this fishery and a decrease of 122 trips, or 18.35 per cent, and of 7,595,254 pounds, or 13.99 per cent, in the quantity, and of $368,590, or 21.73 per cent, in the value of the products landed.

The following tables give, by fishing grounds and months, the catch landed by otter trawlers at these ports in 1924 and also the catch of cod, haddock, and hake landed by them in various years.

Fishery products landed at Boston and Gloucester, Mass., and Portland, Me., by otter trawlers in 1924

	Trips	Cod		Haddock		Hake		Pollock	
	No.	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
BY FISHING GROUNDS									
East of 66° W. longitude									
Western Bank	89	3,915,383	$117,935	6,890,167	$140,472	7,220	$184	382,824	$9,291
West of 66° W. longitude									
Georges Bank	95	2,035,160	71,626	5,522,130	138,317	16,495	506	61,480	3,718
South Channel	247	1,977,102	79,782	15,430,565	402,226	438,503	13,270	435,128	19,920
Nantucket Shoals	107	279,935	15,765	7,151,748	179,234	139,525	3,795	119,300	5,279
Off Chatham	5	23,850	1,454	203,330	7,507	15,110	455	29,300	1,259
Total	543	8,231,430	286,562	35,197,940	867,756	616,853	18,210	1,028,032	39,467
BY MONTHS									
January	62	492,660	31,727	2,829,195	119,519	81,775	3,290	129,497	6,775
February	60	947,924	27,207	3,818,480	86,133	31,050	1,333	57,125	3,313
March	53	1,189,690	44,182	3,869,788	125,819	22,250	933	68,143	2,993
April	43	1,129,914	27,495	3,824,485	73,583	10,840	606	140,840	3,470
May	42	503,230	11,979	3,499,890	73,770	42,820	1,553	50,055	1,327
June	39	171,055	6,584	2,759,815	53,279	153,120	3,853	9,940	363
July	34	525,025	13,208	2,149,843	34,917	30,045	687	28,910	787
August	23	808,945	22,194	1,357,140	23,282	12,445	276	25,936	1,050
September	31	589,892	17,017	1,972,225	32,860	56,400	1,144	51,178	1,416
October	53	508,642	17,736	2,757,680	53,052	58,228	918	28,800	892
November	44	553,581	24,021	2,844,769	71,132	51,950	964	136,814	3,969
December	59	810,872	43,212	3,514,630	120,410	65,930	2,653	300,794	13,112
Total	543	8,231,430	286,562	35,197,940	867,756	616,853	18,210	1,028,032	39,467

	Cusk		Halibut		Miscellaneous		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
BY FISHING GROUNDS								
East of 66° W. longitude								
Western Bank	205	$4	28,817	$5,325	40,785	$1,038	11,265,401	$274,249
West of 66° W. longitude								
Georges Bank	6,100	305	20,660	5,438	250,300	17,393	7,912,325	237,303
South Channel	3,885	124	41,223	10,359	924,363	56,458	19,250,769	582,139
Nantucket Shoals	530	27	3,324	855	288,525	16,257	7,982,887	221,212
Off Chatham			197	92	19,866	2,061	291,653	12,828
Total	10,720	460	94,221	22,069	1,523,839	93,207	46,703,035	1,327,731
BY MONTHS								
January	150	3	7,077	1,954	92,125	9,508	3,632,479	172,776
February			12,819	3,492	88,580	7,591	4,955,978	129,069
March	200	3	10,168	2,643	127,671	8,289	5,287,910	184,862
April	6,155	306	20,175	3,773	169,731	7,034	5,302,140	116,267
May	2,150	80	9,411	1,818	167,710	6,009	4,275,266	96,536
June	1,340	34	5,021	976	112,809	3,804	3,213,100	68,893
July			3,440	610	120,963	3,490	2,858,226	53,699
August			6,228	1,377	126,626	6,069	2,337,320	54,248
September			8,162	1,916	117,446	8,246	2,795,303	62,599
October	400	24	5,517	1,354	138,510	10,879	3,497,777	84,855
November			2,049	610	171,220	13,080	3,760,383	113,776
December	325	10	4,154	1,546	90,448	9,208	4,787,153	190,151
Total	10,720	460	94,221	22,069	1,523,839	93,207	46,703,035	1,327,731

Cod, haddock, and hake landed at Boston and Gloucester, Mass., and Portland, Me., by otter trawlers in various years, 1908 to 1924

Year	Trips	Cod	Haddock	Hake	Year	Trips	Cod	Haddock	Hake
	No.	Pounds	Pounds	Pounds		No.	Pounds	Pounds	Pounds
1908	44	209,800	1,542,000	46,600	1914	387	1,149,595	15,383,550	259,913
1909	47	159,800	1,719,000	74,400	1920	646	6,311,389	51,962,457	
1910	59	125,850	2,775,000	46,600	1921	346	2,482,833	26,734,893	241,650
1911	178	564,500	7,367,100	151,700	1922	578	11,161,947	35,878,524	576,370
1912	295	1,952,950	12,966,700	105,500	1923	665	14,961,590	35,527,297	471,660
1913	326	1,667,806	12,488,992	209,485	1924	543	8,231,430	35,197,940	616,853

DAYS' ABSENCE

In order to provide more accurate information on the fishing effort, statistics on the number of days' absence from ports of vessels on fishing trips were taken during 1924. The days' absence on each trip was reckoned as including the date of departure and date of arrival. Unfortunately, these data were not collected at Boston during the entire month of January, 1924, and it was therefore impossible to incorporate them in the general tables on New England vessel fisheries. They are presented by months, grounds, and ports for all vessels, including otter trawlers, and for otter trawlers separately, in the following tables:

Days' absence from port of fishing vessels landing fish at Boston and Gloucester, Mass., and Portland, Me., 1924

Fishing grounds	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
BOSTON													
East of 66° W. longitude													
La Have Bank	-----	-----	21	89	28	36	22	101	48	22	22	128	-----
Western Bank	-----	44	40	96	144	263	436	192	-----	80	60	308	-----
Quereau Bank	-----	60	53	91	38	91	17	139	218	52	6	-----	-----
Green Bank	-----	30	8	21	-----	-----	-----	-----	-----	21	-----	-----	-----
Grand Bank	-----	-----	19	51	78	172	156	60	40	32	-----	-----	-----
St. Peters Bank	-----	-----	-----	-----	60	91	92	22	-----	-----	64	-----	-----
Burgeo Bank	-----	-----	-----	-----	-----	-----	-----	-----	22	-----	-----	-----	-----
Off Newfoundland	-----	-----	-----	-----	46	-----	-----	-----	-----	-----	-----	-----	-----
Cape Shore	-----	-----	-----	-----	20	378	-----	-----	422	17	53	7	-----
The Gully	-----	-----	30	25	-----	-----	-----	-----	-----	-----	-----	-----	-----
Labrador Coast	-----	-----	-----	-----	-----	-----	-----	32	-----	-----	-----	-----	-----
West of 66° W. longitude													
Browns Bank	-----	37	74	387	405	67	141	112	115	119	33	236	-----
Georges Bank	-----	1,188	907	403	390	433	1,636	1,324	723	195	69	29	-----
Cashes Bank	-----	-----	3	-----	-----	4	-----	-----	25	37	-----	-----	-----
Clark Bank	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	9	-----
Fippenies Bank	-----	-----	-----	-----	-----	-----	-----	-----	4	4	4	-----	-----
Tillies Bank	-----	-----	-----	-----	-----	-----	-----	-----	8	-----	-----	-----	-----
Middle Bank	-----	37	86	41	21	7	23	241	29	80	134	106	-----
Jeffreys Ledge	-----	122	131	73	-----	-----	-----	-----	26	114	380	369	-----
South Channel	-----	341	354	272	201	524	541	329	735	885	540	405	-----
Nantucket Shoals	-----	-----	-----	-----	133	162	185	92	19	124	185	224	-----
Off Chatham	-----	32	32	21	22	8	98	67	19	12	-----	49	-----
Seal Island	-----	-----	-----	-----	-----	-----	-----	-----	-----	7	7	-----	-----
Shore, general	-----	148	130	269	283	385	201	221	262	263	156	174	-----
Total	-----	2,039	1,888	1,839	1,869	2,621	3,548	2,932	2,715	2,064	1,713	2,044	-----
GLOUCESTER													
East of 66° W. longitude													
La Have Bank	-----	-----	31	87	-----	14	-----	70	105	23	11	-----	341
Western Bank	13	32	34	52	208	432	578	494	96	-----	65	-----	2,004
Quereau Bank	-----	-----	27	76	92	57	83	152	92	60	40	-----	679
Green Bank	-----	-----	-----	22	-----	-----	-----	-----	-----	51	-----	-----	73
Grand Bank	-----	-----	-----	183	96	306	186	101	-----	13	-----	-----	885
St. Peters Bank	-----	-----	-----	-----	59	94	172	20	-----	-----	30	-----	375
Off Newfoundland	82	174	-----	-----	-----	-----	-----	-----	-----	-----	-----	267	523
Cape Shore	-----	-----	-----	-----	10	238	-----	-----	-----	-----	9	-----	257
West of 66° W. longitude													
Browns Bank	-----	-----	-----	201	190	20	-----	-----	55	61	9	-----	536
Georges Bank	16	285	334	297	244	27	166	233	358	182	9	-----	2,151
Cashes Bank	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	6	-----	6
Middle Bank	-----	-----	-----	-----	-----	-----	45	132	26	-----	-----	-----	203
South Channel	-----	-----	-----	-----	19	61	151	18	20	81	25	-----	375
Nantucket Shoals	-----	-----	-----	-----	-----	13	17	-----	-----	-----	8	-----	38
Shore, general	41	82	172	211	230	181	156	177	696	301	538	286	3,071
Total	152	573	598	1,129	1,148	1,443	1,554	1,397	1,448	772	750	553	11,517

Days' absence from port of fishing vessels landing fish at Boston and Gloucester, Mass., and Portland, Me., 1924—Continued

Fishing grounds	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
PORTLAND													
East of 66° W. longitude													
La Have Bank	-----	-----	-----	17	-----	-----	-----	30	-----	5	-----	-----	52
Western Bank	24	27	129	99	29	-----	-----	24	54	44	12	18	460
Quereau Bank	-----	-----	-----	-----	13	7	43	-----	-----	22	-----	-----	85
Green Bank	-----	-----	-----	-----	-----	9	-----	-----	-----	-----	-----	-----	9
Grand Bank	-----	-----	-----	-----	-----	33	38	-----	-----	-----	-----	-----	71
St. Peters Bank	-----	-----	-----	-----	-----	24	56	-----	-----	-----	-----	-----	80
Burgeo Bank	-----	-----	-----	20	-----	-----	-----	-----	-----	-----	-----	-----	20
Cape Shore	-----	-----	-----	-----	-----	67	-----	16	213	-----	-----	-----	296
Gulf of St. Lawrence	-----	-----	-----	-----	10	-----	-----	-----	-----	-----	-----	-----	10
St. Anns Bank	-----	-----	-----	-----	-----	28	-----	-----	-----	-----	-----	-----	28
The Gulley	-----	-----	-----	26	-----	-----	-----	-----	-----	-----	-----	-----	26
West of 66° W. longitude													
Browns Bank	-----	-----	-----	-----	45	19	-----	18	-----	-----	-----	-----	82
Georges Bank	-----	-----	-----	-----	-----	-----	81	52	-----	-----	-----	-----	133
Cashes Bank	-----	-----	-----	7	5	15	-----	-----	12	31	-----	-----	70
Fippenies	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	2	2
Middle Bank	-----	-----	3	-----	-----	-----	-----	-----	-----	4	-----	-----	7
Platts Bank	31	5	16	28	16	-----	-----	3	-----	91	56	21	267
Jeffreys Ledge	92	53	36	17	-----	-----	-----	39	45	33	58	42	415
Shore, general	67	81	106	122	112	220	249	194	89	113	78	46	1,477
Total	214	166	290	336	230	422	467	376	413	343	204	129	3,590
Grand total	-----	2,778	2,776	3,304	3,247	4,486	5,569	4,705	4,576	3,179	2,667	2,726	-----

NOTE.—Data for Boston for January are not available.

Days' absence from port of otter trawlers landing fish at Boston and Gloucester, Mass., and Portland, Me., 1924

Fishing grounds	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Tota
BOSTON													
East of 66° W. longitude													
Western Bank	-----	44	10	96	86	-----	54	-----	-----	80	60	300	-----
West of 66° W. longitude													
Georges Bank	-----	313	137	58	5	-----	11	108	27	-----	-----	12	-----
South Channel	-----	169	170	150	92	80	73	14	189	192	150	147	-----
Nantucket Shoals	-----	-----	-----	-----	120	95	93	31	-----	30	162	224	-----
Off Chatham	-----	-----	8	-----	-----	-----	-----	-----	-----	12	-----	20	-----
Total	-----	526	325	304	303	175	231	153	216	314	372	703	-----
GLOUCESTER													
East of 66° W. longitude													
Western Bank	-----	-----	-----	27	59	-----	47	23	-----	-----	-----	-----	156
West of 66° W. longitude													
Georges Bank	-----	8	-----	-----	-----	-----	-----	32	-----	-----	-----	-----	40
South Channel	-----	-----	-----	-----	19	61	29	8	-----	39	-----	-----	156
Nantucket Shoals	-----	-----	-----	-----	-----	13	17	-----	-----	-----	8	-----	38
Total	-----	8	-----	27	78	74	93	63	-----	39	8	-----	390
PORTLAND													
East of 66° W. longitude													
Western Bank	24	-----	129	99	29	-----	-----	-----	12	-----	12	18	323
Grand total	-----	534	454	439	410	249	324	216	228	353	392	721	-----

NOTE.—Data for Boston for January are not available.

VESSEL FISHERIES AT SEATTLE, WASH.

In 1924 there was a decrease in quantity in the vessel fisheries at Seattle, Wash., as compared with 1923, but an increase in the value of the products landed by the fishing fleet, and there was an increase in both the quantity and value of products landed by collecting vessels, which was due chiefly to an increase in the landings of salmon. 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 1924 the fishing fleet at Seattle landed 854 trips, amounting to 10,066,010 pounds of fish, having a value to the fisherman of $1,329,957. The catch was taken chiefly from fishing grounds along the coast from Oregon to Portlock Bank, Alaska. The fishing areas from which the largest quantities were taken were Flattery Banks and Hecate Strait. The products included halibut, 7,362,960 pounds, valued at $1,197,229; sablefish, 2,030,300 pounds, valued at $110,971; "lingcod," 465,975 pounds, valued at $14,403; and rockfishes, 206,775 pounds, valued at $7,354. Compared with 1923 there was a decrease of 65 trips by fishing vessels and of 171,580 pounds, or 1.68 per cent, in the quantity, and an increase of $8,370, or 0.63 per cent, in the value of the products landed. There was a decrease in the catch of halibut of 442,030 pounds, or 5.66 per cent, but an increase in value of $8,351, or 0.70 per cent. The catch of sablefish also decreased 78,300 pounds, or 3.71 per cent, and $12,543, or 10.16 per cent in value. There was an increase in the catch of "lingcod" of 271,875 pounds, or 140.07 per cent and of $10,048, or 230.72 per cent in value, and the catch of rockfishes also increased 76,875 pounds, or 59.18 per cent, and $2,514, or 51.94 per cent in value.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year amounted to 18,166,710 pounds, valued at $1,389,265. The products included salmon, 16,313,010 pounds, valued at $1,290,093; herring, 316,600 pounds, valued at $2,871; sturgeon, 23,800 pounds, valued at $2,198; steelhead trout, 88,860 pounds, valued at $8,886; smelt, 318,600 pounds, valued at $24,622; perch, 69,900 pounds, valued at $4,902; rockfishes, 128,600 pounds, valued at $8,044; "lingcod," 51,110 pounds, valued at $1,678; flounders, 96,300 pounds, valued at $1,921; sole, 254,750 pounds, valued at $9,560; and crabs, 505,600 pounds, valued at $34,490. Compared with 1923 there was an increase of 779,232 pounds, or 4.48 per cent, in the products landed by collecting vessels with an increase in value of $80,534, or 6.15 per cent. The quantity and value of fishery products landed at Seattle by fishing and collecting vessels in 1924 are given in detail in the following tables:

Statement, by fishing grounds and months, of quantities and values of certain fishery products landed at Seattle, Wash., by American fishing vessels, 1924

	Number of trips	Halibut, fresh		Sablefish, fresh	
		Pounds	*Value*	*Pounds*	*Value*
FISHING GROUNDS					
Oregon Coast	10	48,800	$9,336	67,500	$3,915
Flattery Banks	443	1,935,460	330,827	1,585,300	87,084
Hecate Strait	384	4,863,900	772,328	367,800	19,323
Forrester Island Grounds	3	19,500	3,690	1,700	89
Coronation Island	2	81,000	12,150		
Yakutat Grounds	7	249,500	42,450	8,000	560
Portlock Bank	5	164,800	26,448		
Total	854	7,362,960	1,197,229	2,030,300	110,971
MONTHS					
January	9	112,800	19,450	22,000	1,360
February	20	70,400	14,193	20,100	1,447
March	59	364,100	61,191	34,500	2,085
April	90	617,600	94,081	19,300	1,311
May	141	1,238,300	174,950	70,100	4,087
June	103	1,094,400	164,202	151,800	7,560
July	97	1,161,300	196,427	290,800	14,540
August	105	1,101,810	167,646	515,000	26,230
September	90	796,300	143,009	364,500	19,310
October	86	483,000	97,763	372,500	21,659
November	51	322,950	64,317	167,700	11,207
December	3			2,000	175
Total	854	7,362,960	1,197,229	2,030,300	110,971

	"Lingcod," fresh		Rockfishes, fresh		Total, fresh	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISHING GROUNDS						
Oregon Coast	1,700	$34			118,000	$13,285
Flattery Banks	341,825	11,430	137,375	$5,225	3,999,960	434,566
Hecate Strait	118,450	2,779	69,400	2,129	5,419,550	796,559
Forrester Island Grounds					21,200	3,779
Coronation Island					81,000	12,150
Yakutat Grounds					257,500	43,010
Portlock Bank	4,000	160			168,800	26,608
Total	465,975	14,403	206,775	7,354	10,066,010	1,329,957
MONTHS						
January					134,800	20,810
February	11,000	440			101,500	16,080
March	55,500	2,145	18,000	720	472,100	66,141
April	61,900	2,484	53,900	2,684	752,700	100,560
May	80,200	2,488	33,000	940	1,421,600	182,465
June	45,050	901	11,350	235	1,302,600	172,898
July	43,075	862	7,875	158	1,503,050	211,987
August	57,150	1,053	17,350	347	1,691,310	195,276
September	26,800	536	28,600	592	1,216,200	163,447
October	43,500	905	15,000	355	914,000	120,682
November	19,300	904	11,200	488	521,150	76,916
December	22,500	1,685	10,500	835	35,000	2,695
Total	465,975	14,403	206,775	7,354	10,066,010	1,329,957

Fishery products, by months, taken in Puget Sound and landed at Seattle, Wash., by collecting vessels, 1924

Species	January		February		March		April		May	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sturgeon									12,000	$120
Herring	30,000	$600	31,600	$316	65,000	$325	122,000	$610		
Salmon:										
King or spring									663,000	79,930
Coho or silver									32,000	3,500
Trout: Steelhead									16,000	1,600
Smelt	32,000	3,200					14,800	1,480		
Perch	11,500	960	8,000	560	7,000	500	21,000	1,050		
Rockfishes	8,000	160	7,300	584	12,600	1,008	5,800	464		
"Lingcod"	14,000	288	12,400	872	2,400	72				
Flounders	4,000	120	7,500	150	9,500	145	4,350	87	12,800	256
Sole	38,500	1,440	17,800	712	23,000	690	21,100	844	18,400	536
Crabs	79,200	5,400	66,000	4,600	48,000	3,280	98,340	6,705	53,460	3,645
Total	217,200	12,168	150,600	7,794	167,500	6,020	287,390	11,240	807,660	89,587

Species	June		July		August		September	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sturgeon	2,380	$238			4,800	$960		
Salmon:								
Humpback or pink			24,600	$584	13,600	272	42,000	$1,680
Chum or keta			6,000	120	12,800	274	36,300	989
King or spring	2,652,310	265,231	3,671,500	367,150	1,716,000	171,600	192,000	19,200
Coho or silver	157,400	11,018	406,100	20,305	564,000	22,560	2,160,000	129,600
Sockeye or red	33,000	3,330	27,000	1,350	57,900	5,790		
Trout: Steelhead	23,610	2,361	22,350	2,235	16,400	1,640		
Smelt			61,000	6,100	9,500	760	41,100	3,288
Perch					14,000	1,160		
Rockfishes	11,600	1,160	14,300	858	15,000	1,050	16,000	320
"Lingcod"	4,310	86	18,000	360				
Flounders	8,100	162	13,350	267	14,600	292	8,350	167
Sole	16,000	640			17,350	594	14,000	560
Total	2,908,710	284,226	4,264,200	399,329	2,455,950	206,952	2,509,750	155,804

Species	October		November		December		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sturgeon	4,200	$880					23,380	$2,198
Herring					68,000	$1,020	316,600	2,871
Salmon:								
Humpback or pink							80,200	2,536
Chum or keta	920,000	36,800	750,000	$26,250			1,725,100	64,433
King or spring	86,000	8,600	18,500	1,850			8,999,310	913,561
Coho or silver	1,828,000	109,680	243,000	2,430			5,390,500	299,093
Sockeye or red							117,900	10,470
Trout: Steelhead	10,500	1,050					88,860	8,886
Smelt	18,200	1,274	86,000	5,160	56,000	3,360	318,600	24,622
Perch					8,400	672	69,900	4,902
Rockfishes	8,000	160	18,000	1,440	12,000	840	128,600	8,044
"Lingcod"							51,110	1,678
Flounders	4,100	82	4,850	97	4,800	96	96,300	1,921
Sole	10,600	424	16,000	640	62,000	2,480	254,750	9,560
Crabs	34,320	2,340	73,480	5,020	52,800	3,500	[1] 505,600	34,490
Total	2,923,920	161,290	1,209,830	42,887	264,000	11,968	18,166,710	1,389,265

[1] 49,119 dozen.

FISHERY PRODUCTS RECEIVED AT MUNICIPAL FISH WHARF AND MARKET, WASHINGTON, D. C.[2]

The receipts of fishery products at the municipal fish wharf and market, Washington, D. C., in 1924, amounted to 8,007,704 pounds, an increase of 2,329,547 pounds, or 42.79 per cent, as compared with 1923. The most important products in quantity were river herring, including roe, 1,327,020 pounds; squeteagues or "sea trout," 1,240,450 pounds; croaker, 999,000 pounds; oysters, 710,916 pounds; shad, including roe, 555,154 pounds; and haddock, 469,280 pounds. The species ranking next in importance include butterfish, catfish, flounders, halibut, mackerel, perch, striped bass, and crabs.

[2] 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., 1924

Species	January	February	March	April	May	June	July
Bass, black or sea	18,800	20,500	9,600	600	3,500	9,527	5,700
Bluefish		700	4,900	5,300	1,800	2,300	1,400
Bowfin			100				
Butterfish	2,100	600		4,000	21,400	49,800	54,100
Carp	7,075	8,975	10,350	7,265	20,500	11,353	6,525
Catfish	12,875	6,950	28,000	40,200	22,200	23,851	10,100
Cod:							
Fresh	2,400	5,900	7,725	3,550	4,900	6,475	3,500
Salted	1,000						
Croaker	21,000	2,900	2,400	230,400	164,000	152,300	210,600
Eels	400		230	2,050	600	1,191	300
Flounders	10,800	29,200	34,100	13,900	11,800	9,600	5,400
Gizzard shad	2,025						
Haddock:							
Fresh	41,450	82,800	76,930	43,750	18,170	15,350	10,950
Smoked	90	860	280				
Hake	4,400						
Halibut	34,950	6,250	10,150	10,375	8,250	11,725	12,375
Herring, river:							
Fresh	38,600	25,650	90,500	580,000	151,800	1,900	
Salted				22,000	279,250	52,500	
Roe					11,820		
Hickory shad or "jacks"	4,475	3,725	5,400	4,400	1,400		
Kingfish	3,200	400		1,300	2,000	300	600
Mackerel:							
Fresh	24,800	23,200	4,950	11,600	10,500	30,150	19,500
Salted	300	420	60	300		600	
Mullet	30	800	500		200		
Perch	14,825	15,525	88,300	44,400	10,500	7,475	3,300
Pike or pickerel	2,360	3,350	3,175	200	200	550	50
Pollock	1,000					250	850
Pompano		100			200		
Redfish or red drum				625		200	
Red snapper	1,000	200	200		200		
Salmon:							
Fresh	5,000	6,100			200	2,200	2,800
Smoked	30	550	400				
Sergeant fish	50						
Scup or porgy					300	1,300	2,500
Shad	23,904	29,000	89,250	275,000	126,700	6,000	
Shad roe	225	350	225				
Sheepshead						100	
Smelt	6,940	2,970	1,080				
Spot	1,600				1,300	4,000	6,400
Squeteagues or "sea trout"	35,400	20,800	25,100	31,100	271,800	122,400	129,400
Squid					3,200		
Striped bass	875	4,950	22,300	66,600	17,000	11,050	9,400
Sturgeon				175	1,174		
Swordfish							600
Tilefish	800	800		850	300		
Whiting			500		600		2,000
Clams, hard	2,240	3,068	4,360	3,936	7,072	7,328	6,176
Oysters:							
In the shell	62,734	38,451	53,900	8,911	1,225	224	
Opened	58,773	39,237	39,658	14,710	99		
Scallops	1,048	1,120	880	2,488	1,440	1,280	640
Crabs, hard				225	11,010	40,950	107,835
Crab meat		75	400	925	6,110	12,600	12,920
Frogs				15	55	121	
Lobsters			50	274	550	300	200
Shrimp	730	1,150	1,800	1,500	750	3,450	3,600
Turtles	1,280	648	286	290	349	1,116	78
Total	451,584	388,274	618,039	1,433,214	1,196,424	601,816	629,799

Fishery products, in pounds, received at Municipal Fish Wharf and Market, Washington, D. C., 1924—Continued

Species	August	September	October	November	December	Total
Bass, black or sea	1,800	600	3,800	14,100	29,156	117,683
Bluefish	3,800	6,600	8,800	200	----------	35,800
Bowfin	----------	----------	----------	----------	200	300
Butterfish	70,500	52,250	26,400	10,300	1,150	292,600
Carp	2,300	5,850	7,450	6,600	9,380	103,623
Catfish	7,900	19,940	42,250	21,700	9,435	245,401
Ciscoes	----------	100	600	600	200	1,500
Cod:						
Fresh	6,500	4,550	3,300	3,200	3,550	55,550
Salted	----------	----------	----------	----------	----------	1,000
Crappie	----------	----------	----------	400	----------	400
Croaker	144,300	24,000	8,300	10,500	28,300	999,000
Eels	300	550	2,500	1,200	1,300	10,621
Flounders	4,200	10,075	23,100	20,100	7,200	179,475
Gars	----------	----------	200	----------	----------	200
Gizzard shad	----------	275	5,700	5,550	8,600	22,150
Haddock:						
Fresh	17,000	31,250	44,800	49,900	35,700	468,050
Smoked	----------	----------	----------	----------	----------	1,230
Hake	----------	----------	7,800	70,000	6,600	88,800
Halibut	10,650	10,650	11,560	14,400	33,100	174,435
Herring, river:						
Fresh			----------	51,000	22,000	961,450
Salted	----------	----------	----------	----------	----------	353,750
Roe	----------	----------	----------	----------	----------	11,820
Hickory shad or "jacks"	----------	----------	----------	----------	----------	19,400
Kingfish	----------	----------	200	4,700	25,400	38,100
Mackerel:						
Fresh	15,700	12,200	7,800	9,300	26,600	196,300
Salted	----------	----------	----------	----------	----------	1,680
Menhaden	----------	----------	200	----------	----------	200
Mullet	----------	----------	----------	100	150	1,780
Perch	5,300	7,400	9,400	12,600	20,775	239,800
Pigfish	200	----------	400	----------	----------	600
Pike or pickerel	200	300	1,300	1,500	3,070	16,255
Pollock	----------	800	1,900	3,900	21,200	29,900
Pompano	----------	----------	----------	200	----------	500
Redfish or red drum	----------	----------	200	200	----------	1,225
Red snapper	----------	----------	----------	----------	1,200	2,800
Salmon:						
Fresh	1,700	6,400	10,200	2,500	----------	37,100
Smoked	----------	----------	----------	----------	----------	980
Sergeant fish	----------	----------	----------	----------	----------	50
Scup or porgy	600	500	200	----------	----------	5,400
Shad	----------	----------	----------	2,500	2,000	554,354
Shad roe	----------	----------	----------	----------	----------	800
Sheepshead	----------	----------	----------	----------	150	250
Skates	----------	----------	----------	200	----------	200
Smelt	----------	----------	----------	----------	----------	10,990
Spot	5,200	34,000	47,000	5,500	----------	105,000
Squeteagues or "sea trout"	139,000	150,200	177,400	78,000	59,850	1,240,450
Squid	100	----------	200	100	----------	3,600
Striped bass	13,600	22,855	58,300	20,700	9,595	257,225
Sturgeon	95	----------	260	125	----------	1,829
Sunfish	----------	----------	----------	200	----------	200
Swordfish	115	200	----------	----------	----------	915
Tarpon	----------	70	----------	----------	----------	70
Tilefish	----------	----------	400	300	200	3,650
Whitefish	----------	----------	1,400	100	----------	1,500
Whiting	----------	----------	5,600	9,600	4,800	23,100
Clams, hard	7,360	5,440	4,672	2,688	3,776	[1] 58,116
Oysters:						
In the shell	----------	13,349	52,661	87,605	71,771	[2] 390,831
Opened	----------	12,821	51,307	51,802	51,678	[3] 320,085
Scallops	480	320	1,280	800	960	12,736
Crabs, hard	43,650	10,770	750	----------	----------	215,190
Crab meat	12,025	5,545	2,325	755	265	53,945
Frogs	----------	----------	----------	----------	----------	191
Lobsters	50	200	200	50	100	1,974
Shrimp	7,200	2,400	1,500	3,450	1,200	28,730
Turtles	56	142	96	222	302	4,865
Total	521,881	452,602	633,711	579,447	500,913	8,007,704

[1] 2,265 bushels. [2] 55,833 bushels. [3] 38,798 gallons.

NOTE.—The clams have been reduced to pounds on the basis of 8 pounds of meat to a bushel, the oysters on the basis of 7 pounds of meat to a bushel and 8¼ pounds to a gallon.

SHAD AND ALEWIFE FISHERY OF THE POTOMAC RIVER

The regular annual statistics of the shad and alewife fisheries of the Potomac River were taken for the season of 1924. They show that in 1924 the shad fishery yielded 172,310 shad, weighing 578,210 pounds and valued at $88,450 to the fishermen. This marks an unprecedentedly small catch, amounting to only 49 per cent in number and 45 per cent in value of the 1923 catch, which itself was less than half as large as the previous year's catch.

The catch of alewives, amounting to 15,133,388 fish weighing 6,052,756 pounds and valued at $56,552 to the fishermen, was greater than the 1923 catch by 32 per cent in number and 14 per cent in value and was the largest catch in recent years.

The following tables give the detailed statistics for 1924 and comparative statistics on the shad and alewife catch of the Potomac River for the years on which statistics are available.

Shad and alewife fisheries of the Potomac River, 1924

Item	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
Fishermen	269			586			855		
Rowboats and scows	117		$4,320	194		$6,680	311		$11,000
Gasoline boats	52		14,575	221		71,960	273		86,535
Pound nets	83		9,150	308		97,325	391		106,475
Gill nets	107		10,225	290		12,239	397		22,464
Haul seines	2		1,100				2		1,100
Shore and accessory property			2,775			7,050			9,825
Total			42,145			195,254			237,399
Shad caught:									
With pound nets	4,570	15,406	2,326	105,103	348,031	51,570	109,673	363,437	53,896
With gill nets	30,185	104,082	16,895	29,702	102,894	16,411	59,887	206,976	33,306
With haul seines	2,750	7,797	1,248				2,750	7,797	1,248
Total	37,505	127,285	20,469	134,805	450,925	67,981	172,310	578,210	88,450
Alewives caught:									
With pound nets	1,634,000	653,600	6,085	12,978,388	5,190,956	46,972	14,612,388	5,844,556	53,057
With gill nets				321,000	128,200	2,695	321,000	128,200	2,695
With haul seines	200,000	80,000	800				200,000	80,000	800
Total	1,834,000	733,600	6,885	13,299,388	5,319,156	49,667	15,133,388	6,052,756	56,552

Production of shad in the Potomac River in various years, 1896 to 1924

Year	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
1924	37,505	127,285	$20,469	134,805	450,925	$67,981	172,310	578,210	$88,450
1923	93,619	308,729	52,917	257,927	878,653	145,702	351,546	1,187,382	198,619
1922	203,682	706,501	95,140	680,494	2,409,070	324,882	884,176	3,115,571	420,022
1921	49,681	138,207	25,191	356,191	1,022,231	182,179	405,872	1,160,438	207,370
1920	80,944	302,237	55,963	448,414	1,677,543	278,501	529,358	1,979,780	334,464
1919	94,512	354,420	56,833	449,957	1,687,339	275,564	544,469	2,041,759	332,397
1915	17,196	64,485	6,827	165,206	619,523	65,300	182,402	684,008	72,127
1909	31,158	116,843	9,232	172,813	648,049	44,500	203,971	764,892	53,732
1904	83,147	311,801	16,343	289,500	1,085,625	51,709	372,647	1,397,426	68,052
1901	146,000	547,500	14,800	648,462	2,431,733	104,566	794,462	2,979,233	119,366
1896	233,238	874,643	20,524	450,825	1,690,594	43,084	684,063	2,565,237	63,608

Production of alewives in the Potomac River in various years, 1909 to 1924

Year	Maryland			Virginia			Total		
	Number	*Pounds*	*Value*	*Number*	*Pounds*	*Value*	*Number*	*Pounds*	*Value*
1924	1,834,000	733,600	$6,885	13,299,388	5,319,156	$49,667	15,133,388	6,052,756	$56,552
1923	2,119,787	847,916	8,764	9,308,782	3,722,912	40,657	11,428,569	4,570,828	49,421
1922	1,292,500	517,000	3,700	10,074,500	4,029,800	34,642	11,367,000	4,546,800	38,342
1921	1,395,000	558,000	9,010	8,908,510	3,563,404	35,031	10,303,510	4,121,404	44,041
1920	1,077,775	538,888	13,940	7,681,561	3,813,780	41,197	8,759,336	4,352,668	55,137
1919	1,488,583	772,867	15,508	7,379,319	2,904,054	45,508	8,867,902	3,676,921	61,016
1915	335,000		1,420	7,276,428		30,741	7,611,428		32,161
1909	4,883,000		10,369	24,601,040		42,854	29,484,040		53,223

FLORIDA SPONGE FISHERY

In 1924 the quantity of sponges sold at the sponge exchange, Tarpon Springs, Fla., was 425,305 pounds, valued at $714,760, of which 265,392 pounds, valued at $599,221, were large wool; 58,021 pounds, valued at $72,652, small wool; 81,420 pounds, valued at $37,996, yellow; 14,898 pounds, valued at $2,661, grass, and 5,574 pounds, valued at $2,230, wire. It is estimated that sponges to the value of $50,000 were sold outside of the exchange at Tarpon Springs.

Compared with the production in 1923, this indicates a decrease of 13 per cent in total quantity and 3 per cent in total value. When compared with the annual production in the years 1919 to 1923, however, it is apparent that the 1924 production is only slightly below normal in quantity and above normal in value. The production of large wool sponges shows a gratifying increase and that of small wool and yellow sponges is being well maintained, but the production of grass and wire sponges has decreased considerably as compared with previous years. The unusually small yield of grass sponges in 1924 is attributed to the continued high winds, which caused unusual turbidity of inshore waters where these are fished and to some extent to the low prices that prevailed during the season.

The following table gives comparative statistics on the sponges sold at the Tarpon Springs Sponge Exchange from 1919 to 1924:

Sponges sold at the exchange, Tarpon Springs, Fla., 1919 to 1924

Year	Total		Large wool	Small wool	Yellow	Grass	Wire
	Pounds	*Value*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1924	425,305	$714,760	265,392	58,021	81,420	14,898	5,574
1923	490,200	734,391	243,230	54,292	87,878	88,772	16,028
1922	526,885	699,089	248,475	70,478	115,455	84,892	7,585
1921	386,390	540,093	173,723	63,786	70,218	65,745	12,918
1920	409,746	678,209	176,722	60,902	72 648	92,880	6,594
1919	424,075	707,964	205,462	76,309	73,051	62,547	6,706

FISHERIES OF THE PACIFIC COAST STATES IN 1922

The statistics of the fisheries of the Pacific Coast States for the calendar year 1922 were obtained from a canvass made during 1923. The canvass was conducted in a manner similar to that for the year 1915 in order that the statistics collected might be comparable to those of 1915 and previous canvasses. A summary has been published as Statistical Bulletin No. 647, but the detailed statistics are published herein for the first time.

COMMON AND SCIENTIFIC NAMES OF FISHES

Due to the confusion existing among the common names of fishes in the Pacific Coast States, it is difficult to secure a good separation of species in the statistics. The following list indicates the groupings which were necessary and the common names that have been used in the statistical tables to designate the various species of fish and shellfish:

Albacore and tuna	*Germo alalunga.* *Germo macropterus.* *Thunnus thynnus.*
Anchovies	*Engraulis mordax.* *Anchovialla delicatissimus.* *Anchovialla compressus.*
Barracuda	*Sphyræna argentea.*
Bonito and skipjack	*Sarda chilensis.* *Gymnosarda pelamis.*
Carp, German	*Cyprinus carpio.*
Catfish	*Ameiurus nebulosus.* *Ameiurus natalis.*
Cod	*Gadus macrocephalus.*
Dolly Varden trout	*Salvelinus malma.*
Flounders	*Pleuronectidæ* (species).
Flying fish	*Cypsilurus californicus.*
Grayfish	*Squalus sucklii*, and other sharks.
Hake	*Merluccius productus.*
Halfmoon	*Medialuna californiensis.*
Halibut	*Hippoglossus hippoglossus.*
Hardhead	*Othodon microlepidotus.*
Herring	*Clupea pallasii.*
Kingfish	*Genyonemus lineatus.*
Lingcod	*Ophiodon elongatus.*
Mackerel	*Scomber japonicus.*
Mullet	*Mugil cephalus.*
Perch	*Embiotocidæ* (species).
Pike, Sacramento	*Ptychocheilus oregonensis.*
Pilchard or sardine	*Sardinia cærulea.*
Pompano	*Peprilus simillimus.*
Rock bass	*Paralabrax clathratus.* *Paralabrax nebulifer.* *Paralabrax maculatofasciatus.*
Rockfishes	*Sebastodes* (species).
Sablefish	*Anaplopoma fimbria.*
Salmon:	
Blueback or sockeye	*Oncorhynchus nerka.*
Chinook	*Oncorhynchus tschawytscha.*
Chum or keta	*Onocrhynchus keta.*
Humpback or pink	*Oncorhynchus gorbuscha.*
Silver or coho	*Oncorhynchus kisutch.*
Sculpin	*Scorpæna guttata.* *Scorpænichthys marmoratus.*
Sea bass, black or jewfish	*Stereolepis gigas.*
Sea bass, white or squeteague	*Cynoscion nobilis.* *Cynoscion parvipinnis.*
Shad	*Alosa sapidissima.*
Sheepshead	*Pimelometopon pulcher.*
Skates	*Rhinobatidæ* (species). *Rajidæ* (species), and other skates and rays.
Smelt	*Atherindæ* (species). *Argentinidæ* (species).
Sole	*Pleuronectidæ* (species).
Splittail	*Pogonichthys macrolepidotus.*
Steelhead trout	*Salmo gairdneri.*

Striped bass	*Roccus lineatus.*
Sturgeon	*Acipenser transmontanus.* *Acipenser medirostris.*
Suckers	*Catostomus occidentalis.*
Swordfish	*Ziphias gladius.*
Tomcod	*Microgadus proximus.*
Whitebait	Small fry of any fish.
Whitefish	*Caulolatilus princeps.*
Yellowtail	*Seriola dorsalis.*
Crabs	*Cancer* (species). *Echnoceras setimanus.*
Crawfish	*Astacus* (species).
Spiny lobster	*Panulirus interruptus.*
Shrimp	*Crago* (species).
Abalone	*Haliotis* (species).
Clams, hard	*Saxidomus* (species).
Clams, Pismo	*Tivela stultorum.*
Clams, razor	*Siliqua patula.*
Clams, soft	*Mya arenaria.*
Cockles	*Cardium corbis.* *Paphia* (species). *Chione* (species).
Mussels	*Mytilus californianus.* *Mytilus edulis.*
Oysters, eastern	*Ostrea elongata.*
Oysters, native	*Ostrea lurida.*
Octopus	*Polypus hongkongensis.*
Squid	*Loligo opalescens.*
Turtles	*Chelonia agassizii.*

GENERAL STATISTICS

The Pacific Coast States, with their valuable salmon, halibut, tuna, and sardine fisheries, constitute one of our most important fishery sections. In 1922 there were 22,270 persons engaged in fishing and fishery industries, 698 vessels fishing and transporting fish, 4,173 power boats, and 1,041 sail and row boats fishing; $28,651,490 invested in vessels, boats, gear, and shore property connected with the fisheries, and a production of 282,968,421 pounds of fish, shellfish, and whale products valued at $12,983,583 to the fishermen.

According to the value of products, the salmon fishery, which is prosecuted all the way from Monterey, Calif., to Seattle, Wash., was the most important of the Pacific coast fisheries, producing 62,685,475 pounds, valued at $3,795,988 to the fishermen. Chinook salmon was the most important species, yielding 30,704,884 pounds, valued at $2,283,179. Next in importance was the halibut fishery, centering at Seattle. The fleets sailing out of ports in Washington and Oregon in 1922 landed 18,706,517 pounds, valued at $1,925,482. A portion of this catch was landed in British Columbia and Alaskan ports, as is explained in greater detail in the discussion of the fisheries of the State of Washington. Third in importance was the tuna fishery of California, which produced 36,900,805 pounds of albacore, tuna, bonito, and skipjack, valued at $1,847,567. The sardine fishery of southern California in 1922 landed 92,114,542 pounds, valued at $1,381,008.

The following table gives the statistics, by States, of the persons engaged, vessels, boats, gear, investment, and products of the fisheries of the Pacific Coast States in 1922:

Persons engaged, investment, and products of the fisheries of the Pacific Coast States in 1922

Items	Washington		Oregon		California		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Persons engaged	7,600		5,497		9,173		22,270	
Vessels fishing	313	$1,556,000	4	$18,000	209	$1,440,940	526	$3,014,940
Tonnage	6,330		48		3,887		10,265	
Outfit		705,536		10,500		347,330		1,063,366
Vessels transporting	91	493,318	28	196,095	53	614,670	172	1,304,083
Tonnage	1,489		268		2,906		4,663	
Outfit		190,493		26,817		45,263		262,573
Power boats	1,158	786,200	1,718	703,475	1,297	1,660,560	4,173	3,150,235
Rowboats, sailboats, etc	248	11,310	501	66,305	292	29,671	1,041	107,286
Haul seines	88	10,561	44	35,988	45	6,650	177	53,199
Purse seines	115	151,000			54	120,000	169	271,000
Gill nets	684	94,815	2,847	587,804	2,820	171,805	6,351	854,424
Pound nets	270	766,546	45	81,450			315	847,996
Trammel nets					1,906	61,086	1,906	61,086
Paranzella nets					29	7,293	29	7,293
Lampara nets					415	223,085	415	223,085
Hoop nets, crab traps, etc	7,250	21,750	1,608	4,199	3,222	6,710	12,080	32,659
Dip nets			50	142	12	24	62	166
Reef nets	3	1,400					3	1,400
Fyke nets					222	1,332	222	1,332
Bag nets	67	8,410			74	2,200	141	10,610
Lines		86,465		11,590		38,401		136,456
Beam trawls	12	3,650					12	3,650
Otter trawls	1	1,000					1	1,000
Wheels	2	5,000	29	66,200			31	71,200
Pots and traps			1,534	4,053	4,549	12,415	6,083	16,468
Tongs, hoes, rakes, etc	363	1,376	84	682	271	486	718	2,544
Shrimp nets					30	700	30	700
Brush weirs	1	800					1	800
Clam forks	566	862					566	862
Abalone outfit					5	4,600	5	4,600
Whaling apparatus		3,600				26,800		30,400
Shore and accessory property		5,388,633		2,922,276		7,290,269		15,601,178
Cash capital		422,775		157,000		935,124		1,514,899
Total		10,711,500		4,892,576		13,047,414		28,651,490
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna					25,252,392	$1,269,417	25,252,392	$1,269,417
Anchovies					652,516	13,049	652,516	13,049
Barracuda					6,284,065	439,817	6,284,065	439,817
Bonito					11,648,413	578,150	11,648,413	578,150
Carp, German	375,160	$12,054			55,054	1,649	430,214	13,703
Catfish					7,361	1,005	7,361	1,005
Cod, fresh	72,741	2,182					72,741	2,182
Cod, salted	1,175,875	86,395			1,680,000	84,000	2,855,875	170,395
Dolly Varden trout	300	48					300	48
Flounder	85,211	2,454			4,742,819	470,813	4,828,030	473,267
Flyingfish					8,495	174	8,495	174
Grayfish	6,359	22			314,176	6,709	320,535	6,731
Hake					78,763	1,576	78,763	1,576
Halfmoon					27,791	832	27,791	832
Halibut	18,467,422	1,904,915	239,095	$20,567			18,706,517	1,925,482
Hardhead					18,206	1,183	18,206	1,183
Herring	260,338	2,605			341,614	6,832	601,952	9,437
Kingfish					579,754	11,595	579,754	11,595
"Lingcod"	236,019	4,654	21,198	513	569,821	33,936	827,038	39,103
Mackerel	1,360	95			2,498,197	75,455	2,499,557	75,550
Mullet					148,628	16,341	148,628	16,341
Perch	50,927	2,616			236,431	9,056	287,358	11,672
Pike, Sacramento					7,370	230	7,370	230
Pilchard or sardine					92,114,542	1,381,008	92,114,542	1,381,008
Pompano					16,494	5,049	16,494	5,049
Rock bass					285,494	16,449	285,494	16,449
Rockfish	51,726	2,351	2,270	88	4,219,650	205,239	4,273,646	207,678
Sablefish	1,021,700	42,866	57,108	2,528	268,905	8,067	1,347,713	53,461

Persons engaged, investment, and products of the fisheries of the Pacific Coast States in 1922—Continued

Items	Washington		Oregon		California		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Salmon:								
Blueback or sockeye	5,104,380	$543,743	935,789	$114,980			6,040,169	$658,723
Chinook	10,969,802	946,422	12,650,132	757,546	7,084,950	$579,211	30,704,884	2,283,179
Chum	6,319,808	137,190	128,385	1,413			6,448,193	138,603
Humpback	144,683	5,262					144,683	5,262
Silver	14,816,994	546,495	4,378,922	125,428	151,630	11,298	19,347,546	683,221
Sculpin					44,176	889	44,176	889
Sea bass:								
Black or Jewfish					87,559	4,502	87,559	4,502
White or squeteague	596	47			2,904,054	176,993	2,904,650	177,040
Shad	48,039	769	578,003	11,332	1,133,270	55,513	1,759,312	67,614
Sheepshead					18,245	194	18,245	194
Skates	4,227	27			121,753	2,437	125,980	2,464
Smelts	1,392,416	31,488	217,350	2,174	728,406	51,908	2,338,172	85,570
Sole	130,886	3,931	25	1	6,949,557	211,800	7,080,468	215,732
Splittail					10,408	310	10,408	310
Steelhead trout	475,687	34,075	1,820,734	136,802	2,490	174	2,298,911	171,051
Striped bass					678,820	62,747	678,820	62,747
Sturgeon	267,782	18,670	216,765	13,257			484,547	31,927
Suckers					1,348	27	1,348	27
Swordfish					24,363	506	24,363	506
Tomcod					31,344	1,251	31,344	1,251
Whitebait					84,007	8,828	84,007	8,828
Whitefish					32,184	1,609	32,184	1,609
Yellowtail					3,416,572	68,671	3,416,572	68,671
Other fish			5,343	267	217,781	7,657	223,124	7,924
Crabs	981,440	50,309	730,802	36,499	844,472	66,543	2,556,714	153,351
Crawfish			68,935	9,226			68,935	9,226
Spiny lobster					966,632	86,302	966,632	86,302
Shrimp	62,000	7,439			990,349	94,534	1,052,349	101,973
Abalone					1,523,543	60,943	1,523,543	60,943
Clams:								
Hard	693,245	11,424			34,189	2,280	[1] 727,434	13,704
Pismo					191,980	9,599	[2] 191,980	9,599
Razor	2,636,351	106,905	163,110	7,290			[3] 2,799,461	114,195
Soft			82,800	8,278	341,173	22,114	[4] 423,973	30,392
Mussels					13,212	580	[5] 13,212	580
Oysters:								
Eastern, market	45,710	24,416			94,598	101,351	[6] 140,308	125,767
Native, market	377,678	284,047	74,998	7,500			[7] 452,676	291,547
Native, seed	19,593	1,590					[8] 19,593	1,590
Octopus	20,225	64			99,274	3,409	119,499	3,473
Squid					208,875	9,200	208,875	9,200
Cockles					860	51	860	51
Turtles					1,452	64	1,452	64
Sperm oil	260,625	12,163			37,875	2,525	298,500	14,688
Whale oil	1,762,500	94,000			6,862,500	366,000	8,625,000	460,000
Other whale products	1,130,000	30,180			3,136,000	64,330	4,266,000	94,510
Total	69,469,805	4,953,913	22,371,764	1,255,689	191,126,852	6,773,981	282,968,421	12,983,583

[1] 90,929 bushels.
[2] 23,997 bushels.
[3] 279,946 bushels.
[4] 42,397 bushels.
[5] 1,321 bushels.
[6] 20,044 bushels.
[7] 64,668 bushels.
[8] 2,799 bushels.

NOTE.—In this report all craft of 5 net tons and upward are classed as vessels and all under 5 net tons are classed as boats.

COMPARISON WITH PREVIOUS STATISTICS

An examination of statistics available for former years strikingly reveals the changes taking place in the Pacific coast fisheries. With the development during the last decade of her tuna and sardine fisheries, California has forged ahead to leading place among the Pacific Coast States. Between 1908 and 1915 the number of persons engaged increased from 4,129 to 8,452, with a further increase to 9,173 in 1922. The investment increased successively from $1,659,000 in 1908 to $5,824,263 in 1915 and to $13,047,414 in 1922. The value of her products increased from $1,970,000 in 1908 to $2,506,702 in 1915 and to $6,773,981 in 1922.

Washington, having passed the peak of development in her salmon and halibut fisheries, took second place in 1922. The number of persons engaged dropped from 14,645 in 1915 to 7,600 in 1922, her investment from $14,129,553 to $10,711,500, and her production from $5,320,725 to $4,953,913.

The decline in Oregon fisheries was less severe. The number of persons engaged was somewhat lower in 1922 than in 1915, the investment slightly higher and the value of products was lower.

The following table gives a summary of the comparative statistics on these States for various years from 1888 to 1922.

Summary of persons engaged, capital invested, and value of products in the fisheries of the Pacific Coast States in certain years from 1888 to 1922

Items and States	1888	1892	1895	1899	1904	1908	1915	1922
PERSONS ENGAGED								
Washington	3,363	4,310	6,212	9,911	8,829	4,954	14,645	7,600
Oregon	3,619	4,332	6,323	5,643	5,299	4,772	5,900	5,497
California	4,684	5,403	4,770	3,974	5,530	4,129	8,452	9,173
Total	11,666	14,045	17,305	19,528	19,658	13,855	28,997	22,270
CAPITAL INVESTED								
Washington	$1,261,078	$1,593,567	$2,024,469	$6,601,243	$5,319,201	$3,442,000	$14,129,553	$10,711,500
Oregon	1,859,299	2,272,351	2,637,412	3,497,643	3,756,692	1,367,000	4,064,151	4,892,576
California	2,081,950	2,526,746	2,612,298	2,774,493	3,764,056	1,659,000	5,824,263	13,047,414
Total	5,202,327	6,392,664	7,274,179	12,873,379	12,839,949	6,468,000	24,017,967	28,651,490
VALUE OF PRODUCTS								
Washington	810,326	931,568	1,402,433	2,871,438	2,972,633	3,513,000	5,320,725	4,953,913
Oregon	733,867	872,405	1,284,136	855,750	1,185,092	1,356,000	1,479,021	1,255,689
California	2,465,317	3,022,991	1,786,479	2,551,451	2,523,141	1,970,000	2,506,702	6,773,981
Total	4,009,510	4,826,964	4,473,048	6,278,639	6,680,866	6,839,000	9,306,448	12,983,583

CATCH OF INTRODUCED SPECIES

Several species of fish that have been introduced into waters of the Pacific Coast States from eastern sections of the United States have become well-established and yield an appreciable portion of the commercial catch. In order that the size of this catch may be readily followed through the years, the available statistics are presented in the table following.

Comparative statement of the catch of introduced species in the Pacific Coast States in 1899, 1904, 1908,[1] 1915, and 1922

State	Carp		Catfish		Shad		Striped bass		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
1899—Washington			105, 700	$2, 114	85, 000	$1, 275			190, 700	$3, 389
Oregon			54, 360	1, 087	32, 000	320			86, 360	1, 407
California	283, 514	$2, 400	465, 911	12, 734	1, 137, 801	14, 303	1, 234, 320	$61, 814	3, 121, 546	91, 251
Total	283, 514	2, 400	625, 971	15, 935	1, 254, 801	15, 898	1, 234, 320	61, 814	3, 398, 606	96, 047
1904—Washington			6, 000	300	125, 287	1, 753			131, 287	2, 053
Oregon	20, 000	200	180, 000	6, 000	36, 846	1, 433			236, 846	7, 633
California	70, 374	1, 407	737, 144	20, 992	327, 372	9, 960	1, 570, 404	92, 116	2, 705, 294	124, 475
Total	90, 374	1, 607	923, 144	27, 292	489, 505	13, 146	1, 570, 404	92, 116	3, 073, 427	134, 161
1908—Washington					100, 000	1, 900			100, 000	1, 900
Oregon	30, 000	300	201, 000	9, 000	431, 000	8, 000			662, 000	17, 300
California	427, 000	4, 300	1, 069, 000	56, 000	1, 169, 000	12, 000	1, 776, 000	135, 000	4, 441, 000	207, 300
Total	457, 000	4, 600	1, 270, 000	65, 000	1, 700, 000	21, 900	1, 766, 000	135, 000	5, 203, 000	226, 500
1915—Washington	200, 000	4, 000			96, 298	1, 164			296, 298	5, 164
Oregon	50, 000	750			488, 625	4, 945			538, 625	5, 695
California	350, 815	6, 366	517, 054	24, 299	6, 858, 008	67, 107	1, 784, 448	146, 928	9, 510, 325	244, 700
Total	600, 815	11, 116	517, 054	24, 299	7, 442, 931	73, 216	1, 784, 448	146, 928	10, 345, 248	255, 559
1922—Washington	375, 160	12, 054			48, 039	769			423, 199	12, 823
Oregon					578, 003	11, 332			578, 003	11, 332
California	55, 054	1, 649	7, 361	1, 005	1, 133, 270	55, 513	678, 820	62, 747	1, 874, 505	120, 914
Total	430, 214	13, 703	7, 361	1, 005	1, 759, 312	67, 614	678, 820	62, 747	2, 875, 707	145, 069

[1] The statistics for 1908 in this table are from data published by the Bureau of the Census.

SALMON CANNING

In 1922 the salmon-canning industry was the most important of the fish-canning industries of the Pacific Coast States, producing 745,751 cases of salmon, valued at $8,716,164. The chinook was the most important species, representing nearly 53 per cent in value of the entire salmon pack. Following the chinook, in order of importance, were blueback or sockeye, silver or coho, chum or keta, steelhead, and humpback or pink.

The following table gives the statistics for 1922 on this industry. Of the 58 canneries listed 16 were engaged in other branches of the canning or packing trade also. In two of them salmon canning was merely incidental. All of the products in the table were reduced to the basis of forty-eight 1-pound cans to the case.

Salmon-canning industry of the Pacific Coast States in 1922

Items	Washington		Oregon and California		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*
Canneries	34	$3, 110, 084	24	$1, 577, 470	58	$4, 687, 554
Cash capital		305, 800		110, 100		415, 900
Persons engaged	1, 552		977		2, 529	
Wages paid		721, 381		602, 154		1, 323, 535
PRODUCTS						
Blueback or sockeye ... cases	84, 640	1, 580, 673	13, 287	236, 228	97, 927	1, 816, 901
Chinook ... do	119, 724	1, 696, 119	198, 013	2, 897, 509	317, 737	4, 593, 628
Chum ... do	83, 090	345, 570	5, 015	21, 922	88, 105	367, 492
Humpback or pink ... do	3, 551	18, 546			3, 551	18, 546
Silver ... do	143, 499	1, 079, 668	69, 135	512, 935	212, 634	1, 592, 603
Steelhead trout ... do	7, 163	102, 598	18, 634	224, 396	25, 797	326, 994
Total	441, 667	4, 823, 174	304, 084	3, 892, 990	745, 751	8, 716, 164

Comparative statistics, by States, of the number of cases of salmon canned in the Pacific Coast States in certain years, from 1892 to 1922

States	Blue-back	Chinook	Chum	Hump-back	Silver	Steel-head trout	Total
1892—Washington	19, 441	134, 253	29, 411		28, 708	26, 945	238, 758
Oregon	51, 106	237, 684			60, 293	45, 403	394, 486
California		14, 334			1, 550		15, 884
Total	70, 547	386, 271	29, 411		90, 551	72, 348	649, 128
1893—Washington	55, 237	129, 078	23, 480	17, 530	31, 707	25, 663	282, 695
Oregon	23, 074	176, 024	9, 230		62, 913	39, 563	310, 804
California		26, 436			500		26, 936
Total	78, 311	331, 538	32, 710	17, 530	95, 120	65, 226	620, 435
1894—Washington	53, 717	156, 549	33, 952	9, 049	32, 118	23, 209	308, 594
Oregon	25, 523	216, 507	3, 162		100, 087	38, 829	384, 108
California		31, 663			500		32, 163
Total	79, 240	404, 719	37, 114	9, 049	132, 705	62, 038	724, 865
1895—Washington	70, 304	157, 187	48, 686	23, 633	81, 957	18, 985	400, 752
Oregon	12, 854	316, 284	27, 027		138, 981	30, 693	525, 839
California		28, 635			400		29, 035
Total	83, 158	502, 106	75, 713	23, 633	221, 338	49, 678	955, 626
1899—Washington	503, 950	95, 147	42, 656	252, 733	145, 139	2, 258	1, 041, 883
Oregon	19, 665	214, 821	18, 345		78, 730	9, 736	341, 297
California		34, 180					34, 180
Total	523, 615	344, 148	61, 001	252, 733	223, 869	11, 994	1, 417, 360
1904—Washington	112, 911	140, 695	94, 265		168, 069	3, 050	518, 990
Oregon	9, 264	223, 646	15, 150		65, 557	6, 818	320, 435
California		17, 807					17, 807
Total	122, 175	382, 148	109, 415		233, 626	9, 868	857, 232
1908—Washington							460, 229
Oregon							340, 396
California							3, 938
Total							804, 563
1915—Washington	91, 720	178, 464	450, 409	590, 378	206, 508	10, 270	1, 527, 749
Oregon	4, 510	292, 765	40, 728		53, 405	18, 783	410, 191
California		19, 508			3, 578		23, 086
Total	96, 230	490, 737	491, 137	590, 378	263, 491	29, 053	1, 961, 026
1922—Washington	84, 640	119, 724	83, 090	3, 551	143, 499	7, 163	441, 667
Oregon and California	13, 287	198, 013	5, 015		69, 135	18, 634	304, 084
Total	97, 927	317, 737	88, 105	3, 551	212, 634	25, 797	745, 751

FISHERY PRODUCTS EXCLUSIVE OF FRESH, FROZEN, AND CANNED FISH

The production of dried, salted, smoked, and miscellaneous products, other than fresh, frozen, and canned fish, in the Pacific Coast States in 1922 amounted to 63,716,144 pounds, valued at $3,979,043. Most important of these products was the mild-cured fish, of which 6,798,470 pounds, valued at $1,515,266, were produced. This is a small increase in quantity and a large increase in value as compared with 1915, when 6,032,727 pounds, valued at $713,527, were produced. The various species of salmon constituted 97 per cent of the fish cured in this manner, the remainder being shad.

The production of smoked fish, of which kippered salmon was by far the most, important item, amounted to 2,730,858 pounds, valued at $422,073. The dried and salted fish products were of minor importance.

Fish scrap and meal, including that from whales, totaled 37,550,000 pounds, valued at $1,109,812, making it the most important by-product of the fisheries. The production of fish oil amounted to 1,925,085 gallons, valued at $712,837. The pronounced growth of the by-products industry may be realized when the production of 1922 is compared with that of 1915, when only 6,668,000 pounds of fish scrap and meal, valued at $139,035, and 266,812 gallons of fish oil, valued at $79,103, were produced.

The following table gives the detailed statistics of the above-mentioned products:

Quantity and value of various fishery products prepared, exclusive of canning, in the Pacific Coast States in 1922

Methods and products	Washington		Oregon		California		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
DRIED								
Barracuda					65, 000	$4, 650	65, 000	$4, 650
Rockfishes and Spanish mackerel					12, 000	840	12, 000	840
Sardines					600	120	600	120
Sea bass					61, 000	4, 435	61, 000	4, 435
Yellowtail					105, 000	8, 450	105, 000	8, 450
Total					243, 600	18, 495	243, 600	18, 495
MILD-CURED								
Salmon:								
Chinook			686, 620	$223, 327			686, 620	223, 327
Miscellaneous	4, 059, 750	$956, 930	250, 000	40, 000	1, 602, 200	275, 390	5, 911, 950	1, 272, 320
Shad			72, 000	6, 300	127, 900	13, 319	199, 900	19, 619
Total	4, 059, 750	956, 930	1, 008, 620	269, 627	1, 730, 100	288, 709	6, 798, 470	1, 515, 266
SALTED								
Anchovies					6, 400	256	6, 400	256
Mackerel					20, 000	1, 300	20, 000	1, 300
Sablefish	50, 000	5, 000					50, 000	5, 000
Salmon:								
Chinook			28, 850	5, 710			28, 850	5, 710
Silver			26, 500	2, 730			26, 500	2, 730
Mixed			31, 000	2, 325	32, 600	3, 260	63, 600	5, 585
Salmon eggs			300	60			300	60
Sardines					381, 700	31, 370	381, 700	31, 370
Sardines (Salacchini)					80, 000	32, 000	80, 000	32, 000
Yellowtail					52, 730	5, 873	52, 730	5, 873
Miscellaneous species					3, 000	60	3, 000	60
Total	50, 000	5, 000	86, 650	10, 825	576, 430	74, 119	713, 080	89, 944
SMOKED								
Bonito					24, 000	1, 200	24, 000	1, 200
Cod (kippered)	176, 457	28, 562					176, 457	28, 562
Herring	89, 009	7, 431					89, 009	7, 431
Sablefish					98, 760	7, 550	98, 760	7, 550
Salmon:								
Chinook			60, 868	21, 690			60, 868	21, 690
Mixed	145, 746	21, 804	7, 154	2, 146	1, 086	184	153, 986	24, 134
Mixed (kippered)	2, 114, 978	328, 946					2, 114, 978	328, 946
Sardines					12, 800	2, 560	12, 800	2, 560
Total	2, 526, 190	386, 743	68, 022	23, 836	136, 646	11, 494	2, 730, 858	422, 073
MISCELLANEOUS								
Fish scrap and meal dried	17, 382, 000	551, 770	200, 000	5, 000	19, 968, 000	553, 042	37, 550, 000	1, 109, 812
Oil:								
Salmon			97, 500	4, 420			[1] 97, 500	4, 420
Sardine					3, 216, 442	145, 868	[2] 3, 216, 442	145, 868
Tuna					645, 742	23, 617	[3] 645, 742	23, 617
Sperm	260, 625	12, 163			37, 875	2, 525	[4] 298, 500	14, 688
Whale	1, 762, 500	94, 000			6, 862, 500	366, 000	[5] 8, 625, 000	460, 000
Miscellaneous	1, 306, 762	53, 736			248, 190	10, 508	[6] 1, 554, 952	64, 244
Total	3, 329, 887	159, 899	97, 500	4, 420	11, 010, 749	548, 518	[7] 14, 438, 136	712, 837
Other products [8]					1, 242, 000	110, 616	1, 242, 000	110, 616
Grand total	27, 347, 827	2, 060, 342	1, 460, 792	313, 708	34, 907, 525	1, 604, 993	63, 716, 144	3, 979, 043

[1] 13,000 gallons.
[2] 428,859 gallons.
[3] 86,099 gallons.
[4] 39,800 gallons.
[5] 1,150,000 gallons.
[6] 207,327 gallons.
[7] 1,925,085 gallons.
[8] Includes agar-agar, whalebones (skeletons), whale tails, and abalone jewelry.

NOTE.—The statistics of by-products for Washington in the above table have been revised in accordance with reports received since the publication of Statistical Bulletin No. 570, entitled "Canned Fishery Products and By-products of the United States and Alaska, 1922," resulting in a considerable increase in the quantity and value of fish scrap and meal, dried, and miscellaneous oil.

FISHERIES OF WASHINGTON

The fisheries of Washington in 1922 employed 7,600 persons, 404 vessels, 1,158 power boats, and 248 sail and row boats. The investment in vessels, boats, gear, and shore property amounted to $10,711,500, and the products of the fisheries amounted to 69,469,805 pounds, valued at $4,953,913 to the fishermen.

The various species of salmon were the most important of Washington's fishes, yielding 37,355,667 pounds, valued at $2,179,112. Chinook salmon ranked highest in value, yielding 10,969,802 pounds, valued at $946,422, and silver salmon ranked highest in quantity, yielding 14,816,994 pounds, valued at $546,495. It is estimated that about 83 per cent of the salmon catch was canned, 10 per cent mild cured, salted, and smoked, and the remainder sold fresh or frozen.

Next to salmon in importance is the halibut. The fleet of halibut vessels registered and sailing from ports in Washington caught 18,467,422 pounds, valued at $1,904,915. Of this catch 9,011,333 pounds, valued at $993,622, were landed in the State of Washington, 1,348,213 pounds, valued at $108,054, in Alaska, and 7,936,700 pounds, valued at $786,528, in British Columbia. Practically all of the halibut is sold fresh or frozen and is shipped to many distant points in the United States. The following table gives statistics showing the landings of halibut in Washington, Alaska, and British Columbia by vessels registered in the State of Washington:

Landings of halibut, by counties, by vessels registered in the State of Washington

Counties	Alaska		British Columbia		Washington		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clallam					27,500	$2,704	27,500	$2,704
Island					2,600	256	2,600	256
King	1,210,366	$95,182	6,194,900	$610,508	7,811,306	870,788	15,216,572	1,576,478
Kitsap	9,747	576	233,500	22,952	440,800	47,150	684,047	70,678
Pacific					3,000	308	3,000	308
Pierce	128,100	12,296	1,508,300	153,068	720,450	71,962	2,356,850	237,326
Skagit					5,677	454	5,677	454
Total	1,348,213	108,054	7,936,700	786,528	9,011,333	993,622	18,296,246	1,888,204

The cod fishery, next in importance to the halibut fishery, was for the most part carried on by a few large vessels sailing from ports in the State of Washington to the cod banks in Alaskan waters, where they fished during the summer months, bringing back their cargoes of salted cod at the end of the season. In this year 1,175,875 pounds of salted cod, valued at $86,395, were reported, which is estimated to be the equivalent of about 2,940,000 pounds of fresh cod. In addition to the salted cod there were 72,741 pounds of fresh cod, valued at $2,182. This makes a total of about 3,000,000 pounds on the fresh basis, as compared with 13,745,710 pounds on the fresh basis reported for 1915.

The production of other fish in 1922 was 4,408,733 pounds, valued at $158,772, of which sablefish, steelhead trout, smelts, and carp were most important.

The production of shellfish amounted to 4,836,242 pounds, valued at $486,194. The item contributing most to the value of the shellfish was the oyster, of which 442,981 pounds, valued at $310,053, were produced. The razor clam, largely used in canning, amounted to 2,636,351 pounds, valued at $106,905 to the fishermen. The catch of other shellfish, including hard clams, crabs, shrimp, and octopus, amounted to 1,756,910 pounds, valued at $69,236.

The products of the whale fishery, which is prosecuted by vessels operating from shore stations, amounted to 3,153,125 pounds, valued at $136,343, and consisted largely of oil, scrap, and meal. In 1915 whale products amounting to 3,933,125 pounds, valued at $141,441, were reported.

The counties bordering on Puget Sound support the most important fisheries, producing 49,755,483 pounds, in 1922, valued at $3,810,646. Practically all of the halibut, cod, sablefish, and other marine fishes caught by fishermen of these counties are taken on the banks of the North Pacific Ocean, from the State of Washington north to Alaska. The salmon is fished to a great extent in Puget Sound.

King County, with the important port of Seattle, is by far the most important in the Puget Sound district as well as in the State. In 1922 there were 1,733 persons engaged, an investment of $3,346,812, and a production of 24,825,865 pounds of fishery products, valued at $2,066,694. Based on the value of products, this amounts to over two-fifths of the State's total production and is six times as great as the production of any other county. Halibut was the most important fishery resource, yielding 15,216,793 pounds, valued at $1,576,499; the various species of salmon were next in importance, yielding 7,676,472 pounds, valued at $376,502; while cod, sablefish, and other less important marine products made up the balance of fishery production in this county.

Whatcom was second to King County in the value of fishery products, yielding 7,228,672 pounds, valued at $486,871, practically all of which consisted of salmon, although quantities of herring, smelts, steelhead trout, and crabs were caught also. Pierce County, with its important port of Tacoma, produced 7,629,580 pounds of fishery products, valued at $479,882. Salmon and halibut were the most valuable of her fishes, though other marine fish, smelts, hard clams, and shrimps were caught in limited quantities also. Thurston County's production of 334,953 pounds, valued at $210,288, consisted almost exclusively of oysters, with a few fish, shrimp, and hard clams making up the remainder of the catch.

Kitsap County produced 3,077,109 pounds of products, valued at $168,795, the major portion of which consisted of salmon and halibut. A few marine fish, smelts, and crabs made up the remainder. Skagit County produced 2,943,424 pounds, valued at $144,452. Salmon was the most important product, although there was a considerable quantity of cod, other fish, and crabs. Island County produced principally salmon, its entire production amounting to 1,835,836 pounds, valued at $113,146. Each of the remaining counties bordering Puget Sound produced less than $100,000 worth of fishery products. San Juan and Snohomish Counties produced chiefly salmon, although the latter included in its production a goodly quantity of crabs, while Mason County's production consisted almost exclusively of oysters.

Clallam County, with its seaboard on Puget Sound and the Pacific Ocean, produced 2,910,070 pounds of fishery products, valued at $172,276. Most of the catch consisted of salmon, with a limited quantity of halibut, crabs, and hard clams.

The seacoast counties of Washington produced 12,936,092 pounds of fishery products, valued at $732,098, which constitute about one-sixth of the production of the State. Grays Harbor County was most important, producing 8,782,595 pounds, valued at $405,170. About half of this catch was salmon, one-third was whale products, and one-sixth razor clams, with a limited amount of other fish and crabs. Pacific County was accredited with the production of 3,772,374 pounds, valued at $316,951, about two-thirds of which was salmon, one-sixth oysters, one-tenth razor clams, and the remainder steelhead trout, sturgeon, and crabs. Jefferson County produced 381,123 pounds, valued at $9,977, consisting chiefly of salmon, hard clams, and razor clams.

The counties bordering on the Columbia River produced 3,652,926 pounds, valued at $228,726, which was approximately 4 per cent of the State's production. Salmon, steelhead trout, a few sturgeon, and smelts constituted the bulk of this production. Wahkiakun County was the leading Columbia River county, with a production of 1,072,131 pounds, valued at $101,749.

Other counties in the interior of Washington produced approximately $10,000 worth of fishery products, consisting mostly of carp and salmon.

The following tables give in detail the statistics of the fisheries of Washington in 1922.

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties

Items	Clallam		Clarke		Cowlitz		Grays Harbor	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing	18						42	
On vessels transporting					3		11	
In shore or boat fisheries	165		87		112		608	
Shoresmen	48				19		391	
Total	231		87		134		1,052	
INVESTMENT								
Vessels, fishing, steam							3	$90,000
Tonnage							195	
Outfit								15,000
Vessels, fishing, gasoline	9	$15,800					8	11,750
Tonnage	67						59	
Outfit		3,718						1,285
Vessels, transporting, gasoline					2	$4,500	5	24,500
Tonnage					15		65	
Outfit						2,000		4,000
Power boats	77	69,300	44	$32,500	81	61,800	80	38,175
Rowboats	3	150	2	100			109	4,475
Apparatus, vessel fisheries:								
Hoop nets							50	150
Lines		595						45
Whaling apparatus								3,600
Apparatus, shore fisheries:								
Haul seines			3	1,200				
Length in yards			500					
Gill nets	23	1,725	49	6,264	71	8,382	176	10,105
Length in yards	2,300		15,791		20,935		23,351	
Pound nets					13	10,200	32	105,215
Hoop nets							280	840
Pots	280	840						
Lines		3,195						170
Drag-bag nets					31	155		
Tongs, forks, hoes, etc		18						592
Shore and accessory property		45,600		3,500		39,899		422,960
Cash capital		5,000				1,500		60,000
Total		145,941		43,564		128,436		792,862
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp			215,140	$6,454				
Cod: Fresh	3,370	$118						
Halibut	100,176	9,836						
"Lingcod"	147	3						
Salmon:								
Blueback or sockeye			74,384	9,670	163,157	$19,693	1,350,000	$121,500
Chinook	1,362,355	108,837	138,581	16,630	308,467	37,014	648,750	32,515
Chum			7,935	80	94,805	949	748,505	7,014
Silver	1,314,252	49,413	7,949	278	150,205	5,255	917,752	27,605
Shad			8,060	81	10,692	111		
Smelt			15,450	155	1,137,452	11,376		
Steelhead trout	10,296	824	23,069	1,615	66,597	5,071	5,656	395
Sturgeon			15,190	1,064	28,359	1,985	39,450	2,370
Crabs	39,247	2,192					111,473	6,132
Clams:								
Hard	68,230	1,023						
Razor							1,807,884	71,296
Octopus	11,997	30						
Sperm oil							260,625	12,163
Whale oil							1,762,500	94,000
Other whale products							1,130,000	30,180
Total	2,910,070	172,276	505,758	36,027	1,959,734	81,454	8,782,595	405,170

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties—Continued

Items	Island		Jefferson		King		Kitsap	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing	13				930		172	
On vessels transporting					66		3	
In shore or boat fisheries	91		102		297		141	
Shoresmen			22		440		17	
Total	104		124		1,733		333	
INVESTMENT								
Vessels, fishing, gasoline	4	$7,000			140	$776,700	33	$103,000
Tonnage	30				2,652		463	
Outfit		2,100				516,250		29,450
Vessels, fishing, sail					2	30,000		
Tonnage					563			
Outfit						19,348		
Vessels, transporting, gasoline					21	136,300	1	1,200
Tonnage					382		9	
Outfit						79,472		350
Power boats	36	22,850	11	$4,550	104	89,950	55	31,650
Rowboats	10	500	1	50	42	2,100	1	35
Apparatus, vessel fisheries:								
Purse seines	1	1,200			30	36,000	22	32,400
Length, in yards	600				18,000		13,200	
Haul seines					3	215	1	72
Length, in yards					177		85	
Beam trawls							1	400
Drag-bag nets	1	250			2	900	1	250
Lines		105				60,700		4,255
Apparatus, shore fisheries:								
Haul seines	9	997	1	63	8	482	21	972
Length, in yards	800		25		615		1,752	
Gill nets					19	4,060	4	505
Length, in yards					9,200		917	
Pound nets					22	154,936		
Pots	120	360			150	450	25	75
Lines		910		455		2,640		555
Drag-bag nets	4	1,000			1	250	11	2,750
Beam trawls			1	250	1	250	3	1,200
Tongs, forks, hoes, etc		6		136		14		99
Shore and accessory property		1,450		13,310		1,358,020		17,193
Cash capital				10,500		77,775		5,000
Total		38,728		29,314		3,346,812		231,411
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod:								
Fresh	354	$12			27,011	$815	28,294	$764
Salted					409,875	56,395		
Flounders	461	14			7,325	147	10,147	279
Grayfish					1,500	4	33	1
Halibut	25,600	2,517			15,216,793	1,576,499	716,047	73,824
Herring	67	1			81,872	819	65,447	655
"Lingcod"					211,690	4,244	9,200	122
Mackerel					1,360	95		
Perch					13,621	677	16,872	843
Rockfishes					39,600	1,785	1,000	20
Sablefish					1,002,100	42,184	2,000	40
Salmon:								
Blueback or sockeye					589,899	65,069	72,485	7,777
Chinook	935,340	74,841	27,420	$2,192	1,639,975	131,210	303,778	24,104
Chum	15,576	1,246			1,702,589	40,657	512,367	12,501
Humpback					20,223	729	3,765	134
Silver	766,434	28,007	25,726	954	3,723,786	138,837	843,727	32,462
Sea bass, white, or squeteague					40	3	41	3
Shad					218	22		
Skates					2,100	8	1,580	7
Smelt	67,754	5,420	1,625	130	3,837	307	62,832	5,027
Sole			460	14	27,408	822	92,772	2,787
Steelhead trout					26,677	1,867	56	4
Sturgeon					3,100	383		
Crabs	18,230	997			40,150	2,208	80	5
Shrimp							21,771	2,612
Clams:								
Hard	6,020	91	246,015	3,691	29,850	896	312,516	4,820
Razor			79,877	2,996				
Octopus					3,266	12	299	4
Total	1,835,836	113,146	381,123	9,977	24,825,865	2,066,694	3,077,109	168,795

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties—Continued

Items	Klickitat		Mason		Pacific		Pierce	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing			13		20		335	
On vessels transporting					8		13	
In shore or boat fisheries	9		45		539		91	
Shoresmen					157		26	
Total	9		58		724		465	
INVESTMENT								
Vessels fishing, gasoline			2	$4,500	7	$22,800	66	$310,850
Tonnage			25		61		1,068	
Outfit				900		3,150		85,200
Vessels transporting, gasoline					4	15,800	6	40,000
Tonnage					31		130	
Outfit						4,100		20,040
Power boats	8	$6,400	5	2,700	228	148,090	45	67,000
Rowboats			3	150	5	250	1	50
Apparatus, vessel fisheries:								
Purse seines			2	3,000	1	1,200	30	36,000
Length, in yards			1,200		600		18,000	
Beam trawls			2	500				
Hoop nets					40	120		
Lines				100		535		7,900
Apparatus, shore fisheries:								
Haul seines			5	315	2	2,400	2	250
Length, in yards			495		1,000		185	
Gill nets	7	410			96	31,658	3	1,435
Length, in yards	670				35,056		1,100	
Pounds nets	7	5,500			120	178,700		
Hoop nets					955	2,865		
Lines		70		100		1,725		1,385
Drag bag nets			1	250				
Wheels	1	2,500			1	2,500		
Beam trawls							2	500
Tongs, forks, hoes, etc				224		909		2
Shore and accessory property		2,000		18,600		293,171		264,800
Cash capital						12,600		10,800
Total		16,880		31,339		722,573		846,212
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh			549	$17			2,015	$71
Flounders			35	1			1,013	33
Grayfish							210	1
Halibut					3.000	$308	2,396,350	241,174
"Lingcod"							11,600	218
Perch			12,161	596			1,654	85
Rockfishes			120	4			2,110	106
Sablefish							17,600	642
Salmon:								
Blueback or sockeye	14,106	$1,834			234,670	30,400	210,644	23,390
Chinook	7,465	896			1,190,961	139,358	987,915	79,205
Chum	5,526	56	65,977	1,658	173,439	2,444	1,200,288	28,610
Humpback	5	1			163	7	16,451	606
Silver	14,221	498	17,713	626	800,479	28,155	2,753,350	103,968
Shad					18,992	191		
Skates			47	2				
Smelt			12,646	1,012			12,784	1,023
Sole			179	5			9,350	281
Steelhead trout	20,677	1,448			196,556	13,738	70	5
Sturgeon	8,154	571			82,044	5,794		
Crabs					253,480	13,943		
Shrimp			17,854	2,142			3,712	445
Clams:								
Hard							1,009	15
Razor					748,590	32,613		
Oysters:								
Native, market			76,286	52,239	70,000	50,000		
Native, seed			18,487	1,432				
Octopus							1,455	4
Total	70,154	5,304	222,054	59,734	3,772,374	316,951	7,629,580	479,882

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties—Continued

Items	San Juan		Skagit		Skamania		Snohomish		Thurston	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing	4		75				70		3	
On vessels transporting	6		29		2		14		2	
In shore or boat fisheries	40		177		18		41		53	
Shoresmen	60		145				306		51	
Total	110		426		20		431		109	
INVESTMENT										
Vessels fishing, gasoline	2	$4,500	6	$22,800			12	$61,500	2	$1,300
Tonnage	14		121				198		11	
Outfit		405		2,900				5,500		250
Vessels fishing, sail			1	16,300						
Tonnage			413							
Outfit				12,500						
Vessels transporting, gasoline	3	12,600	14	40,500	1	$1,500	3	16,800	2	2,800
Tonnage	54		168		8		58		17	
Outfit		3,150		9,970		500		2,300		650
Vessels transporting, sail							1	25,000		
Tonnage							17			
Outfit								2,300		
Power boats	23	12,000	127	53,050	6	2,100	30	10,250	9	4,685
Rowboats	3	145	16	655	11	550	3	150	5	250
Apparatus, vessel fisheries:										
Purse seines			4	4,400			9	15,000		
Length, in yards			2,000				5,400			
Haul seines			1	145						
Length, in yards			54							
Gill nets							1	185		
Length, in yards							250			
Otter trawls							1	1,000		
Beam trawls			1	500					1	50
Drag bag nets									1	200
Pots			80	240			200	600		
Lines		45		190						
Apparatus, shore fisheries:										
Haul seines	2	135	6	870			7	530	5	275
Length, in yards	255		322				630		367	
Gill nets			68	4,735	12	955	10	3,638		
Length, in yards			8,430		2,035		5,650			
Pound nets	4	28,000	14	39,200	1	1,000				
Pots			3,720	11,160			470	1,410		
Lines		320		325		35		45		
Drag bag nets			5	900			1	100	5	1,000
Reef nets	3	1,400								
Tongs, forks, hocs, etc		2		2						234
Shore and accessory property		73,581		257,853		2,500		265,176		72,517
Cash capital		10,500		20,600				21,500		11,000
Total		146,783		499,795		9,140		432,984		95,211
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod:										
Fresh	5,844	$205	1,369	$42			3,935	$138		
Salted			766,000	30,000						
Dolly Varden trout							300	48		
Flounders			135	3			66,095	1,977		
Grayfish			250	1						
Halibut	3,409	273	6,047	484						
Herring	1,075	11	4,000	40			5,980	60		
"Lingcod"	773	15	2,609	52						
Perch			1,100	138			5,199	261	320	$16
Rockfishes	8,496	408					400	28		
Salmon:										
Blueback or sockeye	81,109	8,759	112,420	12,319	9,625	$1,252	15,729	1,738		
Chinook	262,740	21,019	607,660	48,612	17,480	2,086	58,340	4,667		
Chum	5,614	164	313,560	7,418	5,144	51	370,742	8,767		
Humpback	22,697	856	4,848	177			186	7		
Silver	246,329	9,416	827,140	31,098	1,428	50	344,441	13,012		
Sea bass, white, or squeteague	100	8					415	33		

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties—Continued

Items	San Juan		Skagit		Skamania		Snohomish		Thurston	
PRODUCTS—con.	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Shad					5,150	$314				
Skates							500	$10		
Smelt			25,329	$2,047			14,627	1,830	31,648	$2,532
Sole							717	22		
Steelhead trout	424	$34	7,452	682	1,352	92				
Sturgeon					4,970	347				
Crabs			249,080	9,999			119,500	6,574		
Shrimp			10,811	1,297			1,030	124	6,822	819
Clams, hard	10,650	319	1,000	30					17,955	539
Oysters:										
Eastern, market									45,710	24,416
Native, market									231,392	181,808
Native, seed									1,106	158
Octopus	594	1	2,614	13						
Total	649,854	41,488	2,943,424	144,452	45,149	4,192	1,008,136	39,296	334,953	210,288

Items	Wahkiakum		Whatcom		Other counties [1]		Total	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing			116				1,811	
On vessels transporting	12		68				237	
In shore or boat fisheries	287		186		20		3,109	
Shoresmen	166		595				2,443	
Total	465		965		20		7,600	
INVESTMENT								
Vessels, fishing, steam							3	$90,000
Tonnage							195	
Outfit								15,000
Vessels, fishing, gasoline			16	$77,200			307	1,419,700
Tonnage			390				5,159	
Outfit				7,580				658,688
Vessels, fishing, sail							3	46,300
Tonnage							976	
Outfit								31,848
Vessels, transporting, steam			5	56,500			5	56,500
Tonnage			138				138	
Outfit				15,999				15,999
Vessels, transporting, gasoline	6	$16,000	17	99,318			85	411,818
Tonnage	62		335				1,334	
Outfit		11,150		34,512				172,194
Vessels, transporting, sail							1	25,000
Tonnage							17	
Outfit								2,300
Power boats	156	113,400	21	10,500	12	$5,250	1,158	786,200
Rowboats	6	300	27	1,400			248	11,310
Apparatus, vessel fisheries:								
Purse seines			16	21,800			115	151,000
Length, in yards			9,600				68,600	
Haul seines							5	432
Length, in yards							316	
Gill nets							1	185
Length, in yards							250	
Otter trawls							1	1,000
Beam trawls							5	1,450
Drag bag nets							5	1,600
Hoop nets							90	270
Pots			200	600			480	1,440
Lines								74,470
Whaling apparatus								3,600
Apparatus, shore fisheries:								
Haul seines			4	325	8	1,315	83	10,129
Length, in yards			403		1,419		8,768	
Gill nets	144	20,608	1	150			683	94,630
Length, in yards	51,344		600				177,379	
Pound nets	29	36,400	28	207,395			270	766,546
Hoop nets							1,235	3,705
Pots			680	2,040			5,445	16,335

[1] Includes Asotin, Garfield, Grant, Okanogan, Walla Walla, and Whitman Counties.

Persons engaged, investment, and products of the fisheries of Washington in 1922, by counties—Continued

Items	Wahkiakum		Whatcom		Other counties [1]		Total	
INVESTMENT—continued								
Apparatus, shore fisheries—Con.	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Lines		$10		$5		$50		$11,995
Drag bag nets	1	5	2	400			62	6,810
Wheels							2	5,000
Beam trawls							7	2,200
Reef nets							3	1,400
Wiers			1	800			1	800
Tongs, forks, hoes, etc								2,238
Shore and accessory property		341,154		1,895,349				5,388,633
Cash capital		51,000		125,000				422,775
Total		590,027		2,556,873		6,615		10,711,500
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					160,020	$5,600	375,160	$12,054
Cod:								
Fresh							72,741	2,182
Salted							1,175,875	86,395
Dolly Varden trout							300	48
Flounders							85,211	2,454
Grayfish	4,366	$15					6,359	22
Halibut							18,467,422	1,904,915
Herring			101,897	$1,019			260,338	2,605
"Lingcod"							236,019	4,654
Mackerel							1,360	95
Perch							50,927	2,616
Rockfishes							51,726	2,351
Sablefish							1,021,700	42,866
Salmon:								
Blueback or sockeye	56,976	7,416	2,100,073	230,449	19,103	2,477	5,104,380	543,743
Chinook	635,638	76,046	1,836,897	146,946	2,040	244	10,969,802	946,422
Chum	35,681	358	1,061,875	25,215	185	2	6,319,808	137,190
Humpback	170	6	76,175	2,739			144,683	5,262
Silver	163,470	5,724	1,883,515	70,609	15,077	528	14,816,994	546,495
Sea bass, white, or squeteague							596	47
Shad	4,927	50					48,039	769
Skates							4,227	27
Smelt	1,100	13	5,332	618			1,392,416	31,488
Sole							130,886	3,931
Steelhead trout	92,633	6,481	12,708	1,017	11,464	802	475,687	34,075
Sturgeon	79,170	5,642			7,345	514	267,782	18,670
Crabs			150,200	8,259			981,440	50,309
Shrimp							62,000	7,439
Clams:								
Hard							693,245	11,424
Razor							2,636,351	106,905
Oysters:								
Eastern, market							45,710	24,416
Native, market							377,678	284,047
Native, seed							19,593	1,590
Octopus							20,225	64
Sperm oil							260,625	12,163
Whale oil							1,762,500	94,000
Other whale products							1,130,000	30,180
Total	1,072,131	101,749	7,228,672	486,871	215,234	10,167	69,469,805	4,953,913

VESSEL FISHERIES

In 1922 Washington's fisheries employed 313 fishing craft of 5 tons net and over, as measured by the United States Customs Service. This included 3 steamers, totaling 195 net tons, 307 gasoline vessels, totaling 5,159 net tons, and 3 sailing vessels, totaling 976 net tons, engaged in the fisheries of Washington, but does not include transporting vessels engaged principally in the carrying of fish. The total yield of fishing vessels was 36,013,631 pounds, valued at $2,657,390.

Lines, catching practically all of the halibut and cod and a considerable quantity of salmon, were the most important apparatus employed by fishing vessels, catching altogether 23,625,811 pounds of fish, valued at $2,190,465. Purse seines follow lines in importance, yielding 8,905,735 pounds of fish, valued at $315,108, practically all of which were salmon. The whale fishery, located in Grays Harbor County, yielded 3,153,125 pounds of whale products, valued at $136,343. Haul seines, gill nets, otter trawls, drag bag nets, beam trawls, hoop nets, and pots, which constitute the remainder of apparatus employed on vessels, yielded 283,960 pounds, valued at $15,474.

The following table shows, by counties, species, and apparatus, the yield of the vessel fisheries of Washington in 1922:

Yield of the vessel fisheries of Washington in 1922, by counties, species, and apparatus

Species	Clallam		Grays Harbor		Island		King	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Cod							224	$7
Flounders							706	14
Perch							2,858	143
Salmon—								
Blueback or sockeye							108,628	11,903
Chinook							10,560	846
Chum					15,576	$1,246	1,225,846	29,374
Humpback							2,571	94
Silver					33,013	1,221	759,004	29,110
Sole							681	20
Steelhead trout							84	6
Total					48,589	2,467	2,111,162	71,517
Haul seines:								
Cod							40	1
Herring							12,745	128
Perch							530	27
Smelt							812	65
Total							14,127	221
Lines:								
Cod—								
Fresh							5,300	59
Salted							409,875	56,395
Halibut	27,500	$2,704			2,600	256	15,216,572	1,576,478
"Lingcod"							211,650	4,243
Rockfishes							39,600	1,785
Sablefish							1,002,100	42,184
Salmon—								
Chinook	311,320	24,906	18,140	$907	146,600	11,728	164,025	13,115
Silver	372,750	13,790	21,582	719	85,260	3,185	192,155	7,295
Sturgeon							2,750	330
Total	711,570	41,400	39,722	1,626	234,460	15,169	17,244,027	1,701,884
Drag bag nets:								
Flounders							147	3
Herring							58,927	589
Mackerel							1,360	95
Perch							465	23
Smelt					247	20	746	60
Total					247	20	61,645	770
Hoop nets and pots: Crabs			20,430	1,124				
Harpoons:								
Sperm oil			260,625	12,163				
Whale oil			1,762,500	94,000				
Other whale products			1,130,000	30,180				
Total			3,153,125	136,343				
Grand total	711,570	41,400	3,213,277	139,093	283,296	17,656	19,430,961	1,774,392

Yield of the vessel fisheries of Washington in 1922, by counties, species, and apparatus—Continued

Species	Kitsap		Mason		Pacific		Pierce		San Juan	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:										
Salmon—										
Blueback or sockeye	70,875	$7,599			5,474	$605	192,745	$21,413		
Chinook	15,460	1,288			3,240	259	31,240	2,707		
Chum	512,193	12,497	65,977	$1,658	51,917	1,229	1,188,324	28,090		
Humpback	3,551	126			163	7	15,845	584		
Silver	397,314	15,258	17,713	626	18,217	655	1,935,265	73,626		
Steelhead trout	56	4					70	5		
Total	999,449	36,772	83,690	2,284	79,011	2,755	3,363,489	126,425		
Haul seines:										
Cod	484	17								
Flounders	74	2								
Grayfish	33	1								
Perch	1,089	54								
Sole	153	5								
Total	1,833	79								
Lines:										
Cod—										
Fresh	14,334	287	347	10						
Flounders	1,860	59								
Halibut	684,047	70,678			3,000	308	2,356,850	237,326		
"Lingcod"	9,200	122					11,600	218		
Rockfishes	1,000	20								
Sablefish	2,000	40					17,600	642		
Salmon—										
Chinook	234,638	18,521			99,817	8,307	353,605	28,255	90,000	$7,200
Silver	284,959	11,050			117,315	4,218	306,855	11,418	32,929	1,219
Skates	734	3								
Total	1,232,772	100,780	347	10	220,132	12,833	3,046,510	277,859	122,929	8,419
Drag-bag nets:										
Herring	1,116	11								
Smelt	96	8								
Total	1,212	19								
Beam trawls: Shrimp	3,287	394	17,854	2,142						
Hoop nets and pots: Crabs					26,980	1,484				
Grand total	2,238,553	138,044	101,891	4,436	326,123	17,072	6,409,999	404,284	122,929	8,419

Yield of the vessel fisheries of Washington in 1922, by counties, species, and apparatus—Continued

Species	Skagit		Snohomish		Thurston		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:										
Cod									224	$7
Flounders			1,656	$50					2,362	64
Perch			335	17					3,193	160
Salmon—										
Blueback or sockeye	31,101	$3,435					34,429	$3,801	443,252	48,756
Chinook	4,040	323	37,400	2,992			5,720	452	107,660	8,867
Chum	211,066	4,996	360,540	8,534			618,779	14,626	4,250,218	102,250
Humpback	676	27					744	25	23,550	863
Silver	108,079	4,113	310,571	11,723			495,185	17,772	4,074,361	154,104
Sole									681	20
Steelhead trout							24	2	234	17
Total	354,962	12,894	710,502	23,316			1,154,881	36,678	8,905,735	315,108
Haul seines:										
Cod									524	18
Flounders									74	2
Grayfish									33	1
Herring	4,000	40							16,745	168
Perch									1,619	81
Smelt									812	65
Sole									153	5
Total	4,000	40							19,960	340
Gill nets:										
Salmon—										
Chinook			260	21					260	21
Chum			8,131	184					8,131	184
Silver			348	13					348	13
Total			8,739	218					8,739	218
Lines:										
Cod—										
Fresh	519	12							20,500	368
Salted	766,000	30,000							1,175,875	86,395
Flounders	135	3							1,995	62
Grayfish	250	1							250	1
Halibut	5,677	454							18,296,246	1,888,204
"Lingcod"	761	15							233,211	4,598
Rockfishes									40,600	1,805
Sablefish									1,021,700	42,866
Salmon—										
Chinook									1,418,145	112,939
Silver									1,413,805	52,894
Skates									734	3
Sturgeon									2,750	330
Total	773,342	30,485							23,625,811	2,190,465
Otter trawls:										
Cod			3,800	133					3,800	133
Flounders			59,398	1,782					59,398	1,782
Rockfishes			400	28					400	28
Skates			500	10					500	10
Total			64,098	1,953					64,098	1,953
Drag-bag nets:										
Flounders									147	3
Herring									60,043	600
Mackerel									1,360	95
Perch									465	23
Smelt					4,615	$369			5,704	457
Total					4,615	369			67,719	1,178
Beam trawls: Shrimp	10,811	1,297			6,822	819			38,774	4,652
Hoop nets and pots: Crabs	18,620	1,024	33,900	1,865			29,740	1,636	129,670	7,133
Harpoons:										
Sperm oil									260,625	12,163
Whale oil									1,762,500	94,000
Other whale products									1,130,000	30,180
Total									3,153,125	136,343
Grand total	1,161,735	45,740	817,239	27,352	11,437	1,188	1,184,621	38,314	36,013,631	2,657,390

SHORE AND BOAT FISHERIES

Included in the statistics on shore and boat fisheries is the catch by all fishing craft of less than 5 tons net, as measured by the United States Customs Service, as well as all fish caught without the use of boats. In 1922 there were 1,158 power boats and 248 rowboats employed in the fisheries of Washington. The yield of boat and shore fisheries amounted to 33,456,174 pounds, valued at $2,296,523, which is slightly less than the yield of the vessel fisheries.

The largest catch, 14,340,781 pounds, valued at $957,450, was made by pound nets. The various species of salmon and steelhead trout constituted by far the greater portion of this catch, although cod, flounders, halibut, lingcod, sea bass, shad, skates, sturgeon, and octopus were also taken in small quantities.

Next to the pound nets, in value of yield, were the forks, tongs, etc., used in the clam and oyster fishery. The yield of these implements totaled 3,772,577 pounds, valued at $428,382, of which 3,329,596 pounds, valued at $118,329, were clams and 442,981 pounds, valued at $310,053, were oysters, both native and eastern.

Exceeding the yield of forks, tongs, etc., in amount but not value, was the yield of the gill nets, amounting to 5,312,069 pounds, valued at $403,334, of which the salmons and steelhead trout were the greater part. Of the other fish caught by gill nets, sturgeon, shad, and smelts were most important.

The catch by lines exceeded that by gill nets in amount but not in value, totaling 6,724,127 pounds, valued at $382,632, most of which was salmon. Among the other fish caught by lines halibut was most important, yielding 170,985 pounds, valued at $16,694.

The catch by haul seines amounted to 922,954 pounds, valued at $48,997. Of this amount 208,864 pounds, valued at $19,023, consisted of salmon and steelhead trout; 159,419 pounds, valued at $13,574, were smelts; and 375,160 pounds, valued at $12,054, were carp. Other species of lesser importance were also caught by haul seines.

Drag bag nets appeared in the statistics for the first time in 1922. This net may be described as a haul seine with a bag in the center, the bag being usually 40 feet long and the wings or leads from 120 to 900 feet long. One end is usually staked down, while the other is fastened to the boat, which makes a circle around and then hauls in. Sometimes each end of the net is fastened to a boat to make a haul. When used in this manner, this net greatly resembles a long-haul seine or sweep net recently developed in the North Carolina fisheries. The catch by drag bag nets in the shore and boat fisheries in 1922 amounted to 1,303,788 pounds, valued at $19,735, most of which was smelts. The drag bag net was used in the vessel fishery also, where its products consisted largely of herring, as shown in the previous section.

Hoop nets and pots yielded 851,770 pounds of crabs, valued at $43,176. The yield by fish wheels, reef nets, beam trawls, and wiers, none of which contributed products valued in excess of $7,000, makes up the remainder of the catch in the shore fisheries.

The following tables show, by counties and species, the catch of each kind of apparatus used in the shore and boat fisheries.

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus

BY HAUL SEINES

Species	Clarke		Island		Jefferson		King		Kitsap	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp	215,140	$6,454								
Cod							1,282	$45	3,285	$106
Flounders			461	$14			30	1	7,761	200
Herring			67	1			10,200	102	44,631	447
Perch							4,570	224	8,648	432
Salmon:										
Chum									44	1
Humpback									56	2
Skates							100	1	91	1
Smelt			56,031	4,482	1,625	$130	2,279	182	46,595	3.728
Sole							227	7	28,298	850
Octopus							73	1	109	2
Total	215,140	6,454	56,559	4,497	1,625	130	18,761	563	139,518	5.769

Species	Mason		Pacific		Pierce		San Juan		Skagit	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	72	$3								
Flounders	35	1			65	$5				
Herring							1,075	$11		
Perch	12,161	596			443	22			1,100	$138
Salmon:										
Blueback or sockeye			8,841	$1,149					54,299	5,998
Chinook			8,960	1,075					75,920	6,073
Humpback									2,692	97
Silver									4,385	180
Shad			6,582	66						
Skates	7	1								
Smelt	7,863	629			9,734	779			12,261	981
Sole	179	5								
Steelhead trout			4,830	318					968	77
Sturgeon			630	44						
Total	20,317	1,235	29,843	2,652	10,242	806	1,075	11	151,625	13,544

Species	Snohomish		Thurston		Whatcom		Other counties [1]		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp							160,020	$5,600	375,160	$12,054
Cod	135	$5							4,774	159
Dolly Varden trout	300	48							300	48
Flounders	5,041	145							13,393	366
Herring	5,980	60			27,897	$279			89,850	900
Perch	4,864	244	320	$16					32,106	1,672
Salmon:										
Blueback or sockeye							19,103	2,477	82,243	9,624
Chinook							2,040	244	86,920	7,392
Chum							185	2	229	3
Humpback									2,748	99
Silver							15,077	528	19,462	708
Sea bass, white, or squeteague	415	33							415	33
Shad									6,582	66
Skates									198	3
Smelt	14,223	1,778	4,808	385	4,000	500			159,419	13,574
Sole	717	22							29,421	884
Steelhead trout							11,464	802	17,262	1,197
Sturgeon							630	44	1,260	88
Octopus									182	3
Shrimp	1,030	124							1,030	124
Total	32,705	2,459	5,128	401	31,897	779	208,519	9,697	922,954	48,997

[1] Includes Garfield, Grant, Whitman, and Asotin Counties.

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus—Continued

BY GILL NETS

Species	Clallam		Clarke		Cowlitz		Grays Harbor		King	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod									4,180	$145
Flounders									109	3
Perch									478	24
Salmon:										
Blueback or sockeye			74,384	$9,670	162,170	$19,565	1,350,000	$121,500	40,509	4,474
Chinook			138,581	16,630	166,407	19,968	281,510	14,053	12,880	1,050
Chum			7,935	80	25,145	253	427,500	4,068	34,956	827
Humpback									900	30
Silver	21,141	$782	7,949	278	50,739	1,774	415,952	12,479	120,069	1,570
Shad			8,060	81	10,692	111				
Smelt			15,450	155						
Steelhead trout	10,296	824	23,069	1,615	45,702	3,199	5,624	393		
Sturgeon			15,190	1,064	28,299	1,981	30,150	1,811		
Total	31,437	1,606	290,618	29,573	489,154	46,851	2,510,736	154,304	214,081	8,123

Species	Kitsap		Klickitat		Pacific		Pierce		Skagit	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	122	$4					852	$30		
Flounders							948	28		
Perch	1,030	52					1,211	63		
Salmon:										
Blueback or sockeye	1,610	178	6,170	$802	9,079	$1,180	17,899	1,977	5,607	$619
Chinook			2,985	359	410,520	49,408	1,620	130	190,220	15,217
Chum	130	3	22	1	108,762	1,088	11,964	520	32,265	760
Humpback	158	6	5	1			606	22	168	6
Silver	409	29			36,046	1,258	20,610	781	107,991	4,116
Sea bass, white, or squeteague	41	3								
Shad					390	4				
Smelt							3,050	244		
Steelhead trout			2,087	147	2,646	184			2,796	309
Sturgeon			4,899	343	34,725	2,431				
Octopus	80	1					855	2		
Total	3,580	276	16,168	1,653	602,168	55,553	59,615	3,797	339,047	21,027

Species	Skamania		Snohomish		Wahkiakum		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod									5,154	$179
Flounders									1,057	31
Grayfish					4,366	$15			4,366	15
Perch									2,719	139
Salmon:										
Blueback or sockeye	9,625	$1,252	15,729	$1,738	53,410	6,952			1,746,192	169,907
Chinook	7,200	853	20,140	1,611	505,758	60,700			1,737,821	179,979
Chum	5,144	51	2,071	49	6,031	62			661,925	7,762
Humpback			186	7	170	6			2,193	78
Silver			16,218	618	18,630	655	1,021	$39	816,775	24,379
Sea bass, white, or squeteague									41	3
Shad	782	9			4,495	46			24,419	251
Smelt									18,500	399
Steelhead trout	1,352	92			38,862	2,718			132,434	9,481
Sturgeon	2,695	188			41,580	2,910			157,538	10,728
Octopus									935	3
Total	26,798	2,445	54,344	4,023	673,302	74,064	1,021	39	5,312,069	403,334

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus—Continued

BY POUND NETS

Species	Cowlitz		Grays Harbor		King		Klickitat	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod					15,874	$556		
Flounders					5,968	119		
Halibut					191	17		
"Lingcod"					40	1		
Salmon:								
Blueback or sockeye	987	$128			440,762	48,692	7,936	$1,032
Chinook	141,600	16,992	318,520	$16,026	1,258,380	100,670	4,480	537
Chum	69,660	696	321,005	2,946	441,787	10,456	5,504	55
Humpback					16,752	605		
Silver	99,205	3,472	419,984	12,600	1,624,090	61,809	8,131	285
Sea bass, white, or squeteague					40	3		
Shad					218	22		
Skates					2,000	7		
Steelhead trout	20,839	1,868	32	2	26,593	1,861	14,590	1,021
Sturgeon	60	4	9,300	559	350	53	980	69
Octopus					3,193	11		
Total	332,351	23,160	1,068,841	32,133	3,836,238	224,882	41,621	2,999

Species	Pacific		San Juan		Skagit		Skamania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Blueback or sockeye	170,942	$22,223	76,342	$8,232	21,413	$2,267		
Chinook	591,204	70,945	172,540	13,803	337,480	26,999	10,280	$1,233
Chum	12,760	127	3,314	110	70,229	1,662		
Humpback			22,650	854	1,312	47		
Silver	346,434	12,126	159,810	6,157	602,501	22,530	1,428	50
Shad	7,827	79					4,368	305
Steelhead trout	186,741	13,072	424	34	3,688	296		
Sturgeon	45,709	3,250						
Octopus					81	1		
Total	1,361,617	121,822	435,080	29,190	1,036,704	53,802	16,076	1,588

Species	Wahkiakum		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod					15,874	$556
Flounders					5,968	119
Halibut					191	17
"Lingcod"					40	1
Salmon:						
Blueback or sockeye	3,566	$464	2,065,644	$226,648	2,787,592	309,686
Chinook	127,880	15,346	1,831,060	146,485	4,793,424	409,036
Chum	29,650	296	443,096	10,589	1,397,005	26,937
Humpback			75,431	2,714	116,145	4,220
Silver	144,840	5,069	1,387,309	52,798	4,793,732	176,896
Sea bass, white, or squeteague					40	3
Shad	432	4			12,845	410
Skates					2,000	7
Steelhead trout	53,771	3,763	12,684	1,015	319,362	22,932
Sturgeon	36,890	2,683			93,289	6,618
Octopus					3,274	12
Total	397,029	27,625	5,815,224	440,249	14,340,781	957,450

BY HOOP NETS AND POTS

Species	Clallam		Grays Harbor		Island		King		Kitsap	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	39,247	$2,192	91,043	$5,008	18,230	$997	40,150	$2,208	80	$5

Species	Pacific		Skagit		Snohomish		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	226,500	$12,459	230,460	$8,975	85,600	$4,709	120,460	$6,623	851,770	$43,176

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus—Continued

BY LINES

Species	Clallam		Grays Harbor		Island		Jefferson	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	3,370	$118			354	$12		
Halibut	72,676	7,132			23,000	2,261		
"Lingcod"	147	3						
Salmon:								
Chinook	1,051,035	83,931	30,580	$1,529	788,740	63,113	27,420	$2,192
Silver	920,361	34,841	60,234	1,807	648,161	23,601	25,726	954
Octopus	11,997	30						
Total	2,059,586	126,055	90,814	3,336	1,460,255	88,987	53,146	3,146

Species	King		Kitsap		Klickitat		Mason		Pacific	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	111	$2	9,901	$345			130	$4		
Flounders	365	7	371	15						
Grayfish	1,500	4								
Halibut	30	4	32,000	3,146						
Perch	35	2	45	2						
Rockfishes							120	4		
Salmon:										
Chinook	194,130	15,529	53,680	4,295					71,200	$8,542
Silver	1,028,468	39,053	161,045	6,125					282,467	9,898
Skates			740	2			40	1		
Steelhead trout									848	60
Sturgeon					2,275	$159			140	10
Octopus			110	1						
Total	1,224,639	54,601	257,892	13,931	2,275	159	290	9	354,655	18,510

Species	Pierce		San Juan		Skagit		Skamania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	1,163	$41	5,844	$205	850	$30		
Grayfish	210	1						
Halibut	39,500	3,848	3,409	273	370	30		
"Lingcod"			773	15	1,848	37		
Rockfishes	2,110	106	8,496	408				
Salmon:								
Chinook	601,450	48,113	40	3				
Silver	490,620	18,143	28,230	1,075	4,184	159		
Sea bass, white, or squeteague			100	8				
Sturgeon							2,275	$159
Octopus	600	2	594	1	2,533	12		
Total	1,135,653	70,254	47,486	1,988	9,785	268	2,275	159

Species	Snohomish		Wahkaikum		Whatcom		Other counties [1]		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod									21,723	$757
Flounders									736	22
Grayfish									1,710	5
Halibut									170,985	16,694
"Lingcod"									2,768	55
Perch									80	4
Rockfishes									10,726	518
Salmon:										
Chinook	540	$43			117	$9			2,818,932	227,299
Silver	17,304	658							3,666,800	136,314
Sea bass, white, or squeteague									100	8
Skates									780	3
Steelhead trout									848	60
Sturgeon			700	$49			6,715	$470	12,105	847
Octopus									15,834	46
Total	17,844	701	700	49	117	9	6,715	470	6,724,127	382,632

[1] Includes Okanogan, Walla Walla, and Asotin Counties.

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus—Continued

BY DRAG BAG NETS

Species	Cowlitz		Island		King		Kitsap	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod							168	$5
Flounders							81	3
Herring							19, 700	197
Perch					4, 685	$234	6, 060	303
Salmon:								
Chinook	460	$54						
Silver	261	9						
Skates							15	1
Smelt	1, 137, 452	11, 376	11, 476	$918			16, 141	1, 291
Sole							64, 321	1, 932
Steelhead trout	56	4						
Total	1, 138, 229	11, 443	11, 476	918	4, 685	234	106, 486	3, 732

Species	Mason		Skagit		Snohomish		Thurston	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Smelt	4, 783	$383	13, 068	$1, 066	404	$52	22, 225	$1, 778

Species	Wahkiakum		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod					168	$5
Flounders					81	3
Herring					19, 700	197
Perch					10, 745	537
Salmon:						
Chinook					460	54
Silver					261	9
Skates					15	1
Smelt	1, 100	$11	1, 332	$118	1, 207, 981	16, 993
Sole					64, 321	1, 932
Steelhead trout					56	4
Total	1, 100	11	1, 332	118	1, 303, 788	19, 735

BY FISH WHEELS

Species	Pacific		Klickitat		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:						
Blueback or sockeye	40, 334	$5, 243			40, 334	$5, 243
Chinook	6, 020	822			6, 020	822
Silver			6, 090	$213	6, 090	213
Shad	4, 193	42			4, 193	42
Steelhead trout	1, 491	104	4, 000	280	5, 491	384
Sturgeon	840	59			840	59
Total	52, 878	6, 270	10, 090	493	62, 968	6, 763

BY BEAM TRAWLS

Species	Jefferson		King		Kitsap		Pierce		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Sole	460	$14	26, 500	$795			9, 350	$281	36, 310	$1, 090
Shrimp					18, 484	$2, 218	3, 712	445	22, 196	2, 663
Total	460	14	26, 500	795	18, 484	2, 218	13, 062	726	58, 506	3, 753

Yield of the shore fisheries of Washington in 1922, by counties, species, and apparatus—Continued

BY REEF NETS

Species	San Juan		Species	San Juan	
	Pounds	*Value*		*Pounds*	*Value*
Salmon:			Salmon-Continued.		
Blueback or sockeye	4,767	$527	Humpback	47	$2
Chinook	160	13	Silver	25,360	965
Chum	2,300	54	Total	32,634	1,561

BY WEIRS

Species	Whatcom	
	Pounds	*Value*
Herring	74,000	$740

BY FORKS, TONGS, ETC.

Species	Clallam		Grays Harbor		Island		Jefferson	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams:								
Hard	68,230	$1,023	----	----	6,020	$91	246,015	$3,691
Razor	----	----	1,807,884	$71,296	----	----	79,877	2,996
Total	68,230	1,023	1,807,884	71,296	6,020	91	325,892	6,687

Species	King		Kitsap		Mason		Pacific		Pierce	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams:										
Hard	29,850	$896	312,516	$4,820	----	----	----	----	1,009	$15
Razor	----	----			----	----	748,590	$32,613	----	----
Oysters:										
Native, market	----	----	----	----	76,286	$52,239	70,000	50,000	----	----
Native, seed	----	----	----	----	18,487	1,432	----	----	----	----
Total	29,850	896	312,516	4,820	94,773	53,671	818,590	82,613	1,009	15

Species	San Juan		Skagit		Thurston		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams:								
Hard	10,650	$319	1,000	$30	17,955	$539	693,245	$11,424
Razor	----	----	----	----	----	----	2,636,351	106,905
Oysters:								
Native, market	----	----	----	----	231,392	181,808	377,678	284,047
Native, seed	----	----	----	----	1,106	158	19,593	1,590
Eastern, market	----	----	----	----	45,710	24,416	45,710	24,416
Total	10,650	319	1,000	30	296,163	206,921	3,772,577	428,381

CANNING INDUSTRY

In 1920 there were 55 canneries in Washington, valued at $3,378,579, carrying cash capital of $354,600, employing 2,000 persons, and paying $809,997 in wages. Their total products were valued at $5,524,433. Salmon was by far the most important fish canned, the total production being 441,667 cases, valued at $4,823,174. Puget Sound was the most important district, producing $2,306,447 worth of products. The Columbia River was a close second, with a production amounting to $2,035,335, and the value of canned salmon on the Washington coast amounted to only $481,392. Next in importance to salmon was the production of canned razor clams, totaling

$640,875 in value. Following razor clams were hard clams, whole, minced, and juice, with a production valued at $55,447. Small amounts of shad, shad roe, sturgeon, and crabs were canned in Washington also.

The following table gives in detail the statistics concerning the canning industries in Washington in 1923, by districts:

Canning industry of Washington in 1922, by districts

Items	Puget Sound		Columbia River		Washington coast		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Establishments	20	$2,116,979	9	$736,019	26	$525,582	55	$3,378,579
Cash capital		186,700		81,800		86,100		354,600
Persons engaged	1,041		342		617		2,000	
Wages paid		441,165		211,358		157,474		809,997
PRODUCTS								
Salmon:								
Chinook—	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
1-pound tall	1,998	$8,199	7,825	$71,253	1,481	$8,249	11,304	$87,701
1-pound flat	9,639	95,782	26,397	350,706			36,036	446,488
1-pound oval			2,998	56,961			2,998	56,961
½-pound flat	11,002	151,307	56,998	937,742	1,086	8,480	69,086	1,097,529
½-pound oval			300	7,440			300	7,440
Blueback or sockeye—								
1-pound tall	500	8,500	75	1,050			575	9,550
1-pound flat	12,688	226,204			752	12,032	13,440	238,236
½-pound flat	35,366	694,143	16,572	289,284	18,687	349,460	70,625	1,332,887
Silver—								
1-pound tall	38,019	233,129	2,771	14,436	4,914	24,289	45,704	271,854
1-pound flat	34,365	226,666	14,879	110,654			49,244	337,320
½-pound flat	39,940	380,919	7,437	80,246	1,174	9,329	48,551	470,494
Humpback or pink—								
1-pound tall	811	3,555			1,234	5,212	2,045	8,767
½-pound flat	1,506	9,779					1,506	9,779
Chum—								
1-pound tall	60,567	246,317	2,048	8,239	15,772	63,189	78,387	317,745
1-pound flat			76	532			76	532
½-pound flat	3,718	21,947	669	4,194	240	1,152	4,627	27,293
Steelhead—								
1-pound tall			87	1,183			87	1,183
1-pound flat			1,551	21,714			1,551	21,714
½-pound flat			5,525	79,701			5,525	79,701
Total	250,119	2,306,447	146,208	2,035,335	45,340	481,392	441,667	4,823,174
Shad: ½-pound flat			271	1,146			271	1,146
Shad roe: ½-pound flat			25	591			25	591
Sturgeon: ½-pound flat			10	200			10	200
Crabs: ½-pound flat	125	3,000					125	3,000
Clams, hard:								
Whole—								
No. 1 (4 dozen)	2,048	15,144			78	604	2,126	15,748
No. 2 (2 dozen)	4,144	20,614					4,144	20,614
No. 10 (½ dozen)	1,754	10,528					1,754	10,528
Minced—								
No. 1 (4 dozen)	970	5,909					970	5,909
½-pound flat (4 dozen)	358	1,792					358	1,792
Juice—								
No. 2 (2 dozen)	130	429					130	429
No. 10 (½ dozen)	61	427					61	427
Total	9,465	54,843			78	604	9,543	55,447
Clams, razor:								
Whole—								
No. 1 (4 dozen)			305	3,355	8,829	74,830	9,134	78,185
No. 2 (2 dozen)			294	1,911	1,100	7,150	1,394	9,061
No. 10 (½ dozen)					138	966	138	966
Minced—								
No. 1 (4 dozen)			175	1,313	33,502	237,309	33,677	238,622
No. 2 (2 dozen)			175	1,120	3,034	17,907	3,209	19,027
½-pound flat			250	1,500	50,849	289,922	51,099	291,422
Juice—								
No. 2 (2 dozen)					1,076	3,228	1,076	3,228
No. 10 (½ dozen)					52	364	52	364
Total			1,199	9,199	98,580	631,676	99,779	640,875
Grand total	259,709	2,364,290	147,713	2,046,471	143,998	1,113,672	551,420	5,524,433

WHOLESALE FISH TRADE

The most important wholesale fish dealers of the State are located at Seattle, where a large business is done in the shipping of fresh and frozen halibut, salmon, and a few other kinds of fish to eastern points in the United States. In a recent market survey it was shown that 63 per cent of the quantity of fish received at Seattle was reshipped by rail, largely to points east of the Rocky Mountains.

In 1922 there were 22 establishments, employing 248 persons, with an investment of $573,295 and paying wages amounting to $332,961, engaged in the wholesale fresh and frozen fish trade in the State of Washington. In addition to these there were 12 establishments primarily engaged in the fish canning or curing business, which also handled fresh fish.

Wholesale fish trade of Washington in 1922

Locality	County	Establishments	Persons engaged	Buildings	Accessory property	Cash capital	Wages
		Number	*Number*	*Value*	*Value*		
Seattle	King	14	161	$351,524	$48,355	$30,500	$246,551
Olympia	Thurston	3	51	31,411	17,606	11,000	55,494
Other localities		5	36	63,000	12,999	6,900	30,916
Total		22	248	445,935	78,960	48,400	332,961

NOTE.—In addition to the above, 12 firms, shown elsewhere as preparing various fishery products, also handled fresh fish.

FISHERIES OF OREGON

The fisheries of Oregon in 1922 employed 5,497 persons, 32 vessels, 1,718 power boats, and 501 rowboats and scows. The investment in vessels, boats, gear, and shore property amounted to $4,892,576, and the products of the fisheries amounted to 22,371,764 pounds, valued at $1,255,689.

The various species of salmon were by far the most important of Oregon's commercial fishes, yielding 18,093,228 pounds, valued at $999,367. Steelhead trout contributed 1,820,734 pounds, valued at $136,802; halibut, 239,095 pounds, valued at $20,567; sturgeon, 216,765 pounds, valued at $13,257; shad, 578,003 pounds, valued at $11,332; sablefish, smelts, "lingcod," rockfishes, sole, and other fishes, 303,294 pounds, valued at $5,571. The various kinds of shellfish yielded 1,120,645 pounds, valued at $68,793.

Clatsop County, situated at the mouth of the Columbia River, by reason of her important salmon fisheries, took first place among the counties of Oregon in the value of her fishery products, yielding 9,510,246 pounds, valued at $506,429. Salmon and steelhead trout constituted over 85 per cent of the catch. In the production of sturgeon Clatsop County was also foremost, her catch being 97,860 pounds, valued at $5,878. Shad yielded 284,894 pounds, valued at $2,910, and smelts 2,350 pounds, valued at $24. The shellfish yield in the county was 242,276 pounds, valued at $15,495. Clatsop County was the sole producer of razor clams in Oregon, the catch amounting to 163,110 pounds, valued at $7,290. This county ranks third in production of crabs, with a yield of 70,496 pounds, valued at $7,049. Crawfish made up the remainder of the shellfish catch.

Other counties along the Columbia River produced 5,070,410 pounds of fishery products, valued at $384,130. Practically all of this production consisted of salmon and steelhead trout, with a small quantity of sturgeon. Multnomah County, in which the city of Portland is located, was foremost in production. In addition to the salmons, steelhead trout, and sturgeon, which constituted the bulk of her fishery production, her fishermen caught halibut, "lingcod," rockfishes, sablefish, other fish, and shellfish.

The coastal counties, exclusive of Clatsop County, produced 7,558,783 pounds, valued at $348,356. As in the other sections of Oregon, the salmon and steelhead trout yielded the bulk of fishery products. Tillamook County showed the greatest production, followed in order by Lincoln, Douglas, Coos, Curry, and Lane Counties. Lincoln County produced the greatest variety of fishes, included in her catch being halibut, "lingcod," rockfishes, sablefish, smelt, and sole, as well as the predominant salmons. Her shell fisheries were also of some importance, yielding 241,942 pounds, valued at $19,298, and consisted of soft clams, oysters, crawfish, and crabs. In the production of the last named, Lincoln County was first in the State. The interior counties of Oregon produced 232,325 pounds, valued at $16,774, consisting largely of salmon and fresh-water crawfish.

The following table gives in detail the statistics of the fisheries of Oregon in 1922:

Persons engaged, investment, and products of the fisheries of Oregon in 1922, by counties

Items	Clackamas		Clatsop		Columbia		Coos	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
PERSONS ENGAGED								
On vessels transporting			45		1			
In shore fisheries	21		2,356		301		121	
Shoresmen			947		54		43	
Total	21		3,348		356		164	
INVESTMENT								
Vessels, transporting, gasoline			26	$190,595	1	$3,500		
Tonnage			248		10			
Outfit				25,566		276		
Power boats	14	$5,150	969	496,200	208	66,150	55	$15,500
Rowboats and scows	2	50	103	51,465	28	1,260	28	1,475
Apparatus, shore fisheries:								
Haul seines			21	21,000	9	4,438	3	1,300
Length in yards			11,550		3,150		800	
Gill nets	15	2,625	1,235	360,905	235	45,752	140	16,200
Length in yards	3,500		473,300		60,740		12,040	
Pound nets			21	26,400	9	6,950		
Hoop nets			330	960			28	76
Wheels			1	3,500				
Dip nets			1	2	2	3		
Pots and traps	70	105	130	195	80	120	36	108
Lines		75		8,500				252
Tongs, hoes, etc			41	410			9	51
Shore and accessory property				2,017,981		75,600		32,200
Cash capital				79,600		4,500		6,700
Total		8,005		3,283,279		208,549		73,799

Persons engaged, investment, and products of the fisheries of Oregon in 1922, by counties—Continued

Items	Clackamas		Clatsop		Columbia		Coos	
PRODUCTS								
Salmon:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blueback or sockeye	6, 360	$763	258, 035	$30, 994	159, 674	$19, 160		
Chinook	112, 427	6, 745	6, 767, 441	357, 273	1, 239, 069	81, 806	367, 809	$28, 954
Chum			35, 977	379	25, 030	250	300	3
Silver	30, 758	923	1, 131, 665	45, 255	42, 366	1, 310	342, 327	6, 925
Shad	1, 787	64	284, 894	2, 910	145, 331	3, 614	17, 474	647
Smelt			2, 350	24				
Steelhead trout	11, 166	605	689, 748	48, 221	161, 098	9, 725	103, 434	10, 343
Sturgeon	1, 550	93	97, 860	5, 878	33, 941	2, 064	380	9
Clams:								
Razor			163, 110	7, 290				
Soft							28, 966	2, 897
Crabs			70, 496	7, 49			48, 960	1, 632
Crawfish	1, 500	200	8, 670	1, 156	11, 100	1, 480	500	50
Total	165, 548	9, 393	9, 510, 246	506, 429	1, 817, 609	119, 409	910, 150	51, 460

Items	Curry		Douglas		Hood River		Josephine	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
In shore fisheries	148		189		7		26	
Shoresmen	34		22				6	
Total	182		211		7		32	
INVESTMENT								
Power boats	69	$10, 350	92	$25, 450	1	$200		
Rowboats and scows	9	250	34	1, 895	5	200	13	$845
Apparatus, shore fisheries:								
Gill nets	85	31, 644	177	27, 910	14	240	13	1, 560
Length in yards	21, 395		25, 145		480		1, 040	
Pound nets					1	500		
Hoop nets			350	1, 050				
Pots and traps			325	1, 950				
Lines				415				
Shore and accessory property		106, 050		77, 265				22, 000
Cash capital		5, 000		8, 800				2, 000
Total		153, 294		144, 735		1, 140		26, 405
PRODUCTS								
Salmon:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Blueback or sockeye			12	$2	5, 844	$733		
Chinook	697, 257	$34, 863	291, 184	23, 044	27, 432	3, 092	44, 019	$4, 401
Chum			10, 099	152	5, 000	50		
Silver	686	21	942, 551	23, 334	1, 105	38		
Shad			85, 536	3, 165				
Steelhead trout	6, 044	603	86, 694	9, 536	1, 760	123		
Sturgeon			2, 551	127	1, 155	81		
Crabs			296, 340	9, 836				
Total	703, 987	35, 487	1, 714, 967	69, 196	42, 296	4, 117	44, 019	4, 401

Persons engaged, investment, and products of the fisheries of Oregon in 1922, by counties—Continued

Items	Lane		Lincoln		Multnomah		Tillamook	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing			4		16			
On vessels transporting					2			
In shore fisheries	78		166		252		275	
Shoresmen	9		41		165		41	
Total	87		211		435		316	
INVESTMENT								
Vessels, fishing, gasoline			1	$8,000	3	$10,000		
Tonnage			10		38			
Outfit				3,000		7,500		
Vessels, transporting, gasoline					1	2,000		
Tonnage					10			
Outfit						975		
Power boats	47	$7,050	39	7,200	121	40,550	99	$28,300
Rowboats and scows	3	130	115	3,515	47	2,350	103	2,415
Apparatus, vessel fisheries: Lines				450		900		
Apparatus, shore fisheries: Haul seines	1	500	1	250	7	7,600		
Length in yards	300		150		4,500			
Gill nets	109	15,060	213	15,054	133	29,667	474	40,900
Length in yards	10,390		20,545		14,355		56,160	
Pound nets					14	47,600		
Hoop nets	30	90	575	858	15	45	280	1,120
Wheels					18	46,700		
Dip nets					12	49		
Pots and traps	30	180	40	40	305	458	48	192
Lines		100		70		760		80
Tongs, hoes, etc	1	2	25	241			8	14
Shore and accessory property		10,500		41,441		366,700		100,456
Cash capital		800		7,500		21,700		15,400
Total		34,412		87,619		585,554		188,877
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Halibut			164,433	$13,155	74,662	$7,412		
"Lingcod"			17,536	351	3,662	162		
Rockfishes			146	3	2,124	85		
Sablefish			30,687	1,227	26,421	1,301		
Salmon: Blueback or sockeye			25	2	336,251	41,279		
Chinook	65,517	$3,299	499,292	21,442	1,049,642	83,753	1,035,005	$54,390
Chum	5,890	117	15,725	158	9,103	91	21,178	212
Silver	299,733	5,894	784,818	18,195	104,125	3,098	551,166	15,272
Shad	3,218	121	10	1	38,753	770	1,000	40
Smelt					215,000	2,150		
Sole			25	1				
Steelhead trout	35,721	4,280	97,722	7,607	240,658	14,049	155,071	15,503
Sturgeon	936	18	304	12	62,423	3,991	3,739	150
Other fish					5,343	267		
Clams: Soft	1,000	100	13,734	1,371			39,100	3,910
Oysters: Native, market—Private			50,001	5,000				
Public			24,997	2,500				
Crabs	12,960	432	152,460	10,327	3,806	200	145,780	7,023
Crawfish			750	100	24,857	3,314		
Total	424,975	14,261	1,852,665	81,452	2,196,830	161,922	1,952,039	96,500

Persons engaged, investment, and products of the fisheries of Oregon in 1922, by counties—Continued

Items	Wasco		Washington		Yamhill		Total	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing							20	
On vessels transporting							48	
In shore fisheries	53		3		3		3,999	
Shoresmen	68						1,430	
Total	121		3		3		5,497	
INVESTMENT								
Vessels, fishing, gasoline							4	$18,000
Tonnage							48	
Outfit								10,500
Vessels, transporting, gasoline							28	196,095
Tonnage							268	
Outfit								26,817
Power boats	1	$1,000	3	$375			1,718	703,475
Rowboats and scows	5	230	3	150	3	$75	501	66,305
Apparatus, vessel fisheries: Lines								1,350
Apparatus, shore fisheries:								
Haul seines	2	900					44	35,988
Length in yards	330						20,780	
Gill nets	1	40			3	247	2,847	587,804
Length in yards	100				330		699,520	
Pound nets							45	81,450
Hoop nets							1,608	4,199
Wheels	10	16,000					29	66,200
Dip nets	35	88					50	142
Pots and traps			450	675	20	30	1,534	4,053
Lines		15						10,240
Tongs, hoes, etc							84	682
Shore and accessory property		71,968		115				2,922,276
Cash capital		5,000						157,000
Total		95,241		1,315		352		4,892,576
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Halibut							239,095	$20,567
"Lingcod"							21,198	513
Rockfishes							2,270	88
Sablefish							57,108	2,528
Salmon:								
Blueback or sockeye	169,588	$22,047					935,789	114,980
Chinook	454,038	54,484					12,650,132	757,546
Chum	83	1					128,385	1,413
Silver	147,022	5,145			600	$18	4,378,922	125,428
Shad							578,003	11,332
Smelt							217,350	2,174
Sole							25	1
Steelhead trout	231,018	16,171			600	36	1,820,734	136,802
Sturgeon	11,926	834					216,765	13,257
Other fish							5,343	267
Clams:								
Razor							163,110	7,290
Soft							82,800	8,278
Oysters: Native, market—								
Private							50,001	5,000
Public							24,997	2,500
Crabs							730,802	36,499
Crawfish			20,808	$2,776	750	150	68,935	9,226
Total	1,013,675	98,682	20,808	2,776	1,950	204	22,371,764	1,255,689

VESSEL FISHERIES

In the vessel fishery of Oregon in 1922 only four vessels were actually engaged in fishing. Their catch, made up entirely of ocean fish caught by lines, amounted to 325,039 pounds, valued at $23,964, of which 239,095 pounds, valued at $20,567, were halibut. The remainder of the catch was made up of sablefish, "lingcod," and other fishes incidentally caught in the halibut fishery.

The following table gives the detailed statistics of the vessel fishery of Oregon in 1922.

Yield of the vessel fisheries of Oregon in 1922, by counties, species, and apparatus

Apparatus and species	Lincoln		Multnomah		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Lines:						
Halibut	164,433	$13,155	74,662	$7,412	239,095	$20,567
"Lingcod"	17,536	351	3,662	162	21,198	513
Rockfishes	146	3	2,124	85	2,270	88
Sablefish	30,687	1,227	26,421	1,301	57,108	2,528
Soles	25	1			25	1
Other fish			5,343	267	5,343	267
Total	212,827	14,737	112,212	9,227	325,039	23,964

SHORE AND BOAT FISHERIES

The shore and boat fisheries of Oregon in 1922 greatly exceeded the vessel fishery in importance, employing 1,718 power boats under five tons net and 501 rowboats and sailboats, manned by 3,999 fishermen and yielding 22,046,725 pounds, valued at $1,231,725.

Gill nets yielded 14,437,131 pounds, valued at $612,561, which was over half of the State's entire production. Haul seines produced 3,912,443 pounds, valued at $360,673; fish wheels, 1,242,303 pounds, valued at $125,592; pound nets, 471,335 pounds, valued at $31,416; and lines, 529,514 pounds, valued at $24,426. All of this gear was used principally in the salmon fisheries, and although a limited amount of sturgeon and shad also were caught the great bulk of the catch was in all cases salmon and steelhead trout. A small catch of silver salmon, steelhead trout, and smelts was made by dip nets, the entire amount being 333,354 pounds, valued at $8,264.

Crabs and crawfish were taken by hoop nets, traps, and pots, the entire catch amounting to 799,737 pounds, valued at $45,725; clams and oysters were taken by means of tongs, forks, etc., the entire catch amounting to 320,908 pounds, valued at $23,068.

The following tables show, by gear, the yield of the shore and boat fisheries of Oregon in 1922.

Yield in the shore fisheries of Oregon in 1922, by counties, species, and apparatus

BY HAUL SEINES

Species	Clatsop		Columbia		Coos		Lane	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Blueback or sockeye	145,708	$17,538	26,105	$3,132				
Chinook	1,890,832	226,900	109,007	12,126	212,470	$16,997	1,523	$76
Silver	165,891	6,636	82	3	51,180	1,023	5,947	119
Shad	254,378	2,544	57,202	572				
Steelhead trout	500,351	35,023	54,149	3,778				
Sturgeon	4,784	287	3,267	227			936	18
Total	2,961,944	288,928	249,812	19,838	263,650	18,020	8,406	213

Species	Lincoln		Multnomah		Wasco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Blueback or sockeye			149	$19	12,520	$1,628	184,482	$22,317
Chinook			105,735	8,540	104,520	12,542	2,424,087	277,181
Silver	2,000	$60	22,490	718	57,560	2,014	305,150	10,573
Shad							311,580	3,116
Steelhead trout	500	25	55,964	3,425	66,892	4,682	677,856	46,933
Sturgeon			301	21			9,288	553
Total	2,500	85	184,639	12,723	241,492	20,866	3,912,443	360,673

BY GILL NETS

Species	Clackamas		Clatsop		Columbia		Coos		Curry	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Blueback or sockeye	6,360	$763	98,410	$11,786	130,899	$15,707				
Chinook	112,427	6,745	4,720,262	111,611	1,119,863	68,815	153,413	$11,803	697,257	$34,863
Chum			31,249	332	22,325	223	300	3		
Silver	26,105	783	508,399	20,333	36,556	1,092	279,262	5,664	686	21
Shad	1,787	64	19,652	256	88,129	3,042	17,474	647		
Steelhead trout	11,166	605	124,054	8,625	98,307	5,431	103,434	10,343	6,044	603
Sturgeon	1,550	93	90,326	5,426	30,485	1,826	380	9		
Total	159,395	9,053	5,592,352	158,369	1,526,564	96,136	554,263	28,469	703,987	35,487

Species	Douglas		Hood River		Josephine		Lane		Lincoln	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Blueback or sockeye	12	$2	4,264	$554					25	$2
Chinook	288,434	22,824	19,450	2,334	44,019	$4,401	63,994	$3,223	499,292	21,442
Chum	10,099	152	5,000	50			5,890	117	15,725	158
Silver	931,190	23,279	1,105	38			257,759	5,055	781,804	18,105
Shad	85,536	3,165					3,218	121	10	1
Steelhead trout	86,694	9,536	876	61			35,721	4,280	97,222	7,582
Sturgeon	2,481	125	865	61					304	12
Total	1,404,446	59,083	31,560	3,098	44,019	4,401	366,582	12,796	1,394,382	47,302

Species	Multnomah		Tillamook		Wasco		Yamhill		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Blueback or sockeye	112,172	$13,865			2,647	$344			354,789	$43,023
Chinook	631,967	50,696	1,034,921	$54,385	2,830	339			9,388,129	393,481
Chum	1,728	18	21,178	212					113,494	1,265
Silver	11,761	284	550,476	15,255			600	$18	3,385,703	89,927
Shad	19,510	478	1,000	40					236,316	7,814
Steelhead trout	64,914	3,979	153,714	15,367	109	8	600	36	782,855	66,456
Sturgeon	45,715	2,893	3,739	150					175,845	10,595
Total	887,767	72,213	1,765,028	85,409	5,586	691	1,200	54	14,437,131	612,561

Yield in the shore fisheries of Oregon in 1922, by counties, species, and apparatus—Continued

BY POUND NETS

Species	Clatsop		Columbia		Hood River		Multnomah		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Blueback or sockeye	1,608	$193	2,670	$321	1,580	$179	12,624	$1,515	18,482	$2,208
Chinook	93,929	11,272	10,199	865	7,982	758	61,943	3,717	174,053	16,612
Chum	4,728	47	2,705	27			4,088	40	11,521	114
Silver	99,728	3,982	5,728	215			37,938	1,138	143,394	5,335
Shad	8,487	86					3,303	83	11,790	169
Steelhead trout	61,953	4,336	8,642	516	884	62	37,422	1,871	108,901	6,785
Sturgeon	1,508	90	189	11	290	20	1,207	72	3,194	193
Total	271,941	20,006	30,133	1,955	10,736	1,019	158,525	8,436	471,335	31,416

BY WHEELS

Species	Clatsop		Multnomah		Wasco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Blueback or sockeye	12,309	$1,477	211,306	$25,880	154,421	$20,075	378,036	$47,432
Chinook	9,426	1,131	247,396	20,641	346,688	41,603	603,510	63,375
Chum			3,287	33			3,287	33
Silver			3,112	93	30,880	1,081	33,992	1,174
Shad	2,377	24	15,940	209			18,317	233
Steelhead trout	3,271	229	82,358	4,774	105,889	7,412	191,518	12,415
Sturgeon	1,242	75	8,009	548	4,392	307	13,643	930
Total	28,625	2,936	571,408	52,178	642,270	70,478	1,242,303	125,592

BY DIP NETS

Species	Clatsop		Multnomah		Wasco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon: Silver					58,004	$2,030	58,004	$2,030
Smelt	2,350	$24	215,000	$2,150			217,350	2,174
Steelhead trout					58,000	4,060	58,000	4,060
Total	2,350	24	215,000	2,150	116,004	6,090	333,354	8,264

BY LINES

Species	Clackamas		Clatsop		Coos		Douglas		Lane	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Chinook			52,992	$6,359	1,926	$154	2,750	$220		
Chum										
Silver	4,653	$140	357,647	14,304	11,885	238	11,361	55	36,027	$720
Steelhead trout			119	8						
Sturgeon							70	2		
Total	4,653	140	410,758	20,671	13,811	392	14,181	277	36,027	720

Species	Lincoln		Multnomah		Tillamook		Wasco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:										
Chinook			2,601	$159	84	$5			60,353	$6,897
Chum							83	$1	83	1
Silver	1,014	$30	28,824	865	690	17	578	20	452,679	16,389
Steelhead trout					1,357	136	128	9	1,604	153
Sturgeon			7,191	457			7,534	527	14,795	986
Total	1,014	30	38,616	1,481	2,131	158	8,323	557	529,514	24,426

Yield in the shore fisheries of Oregon in 1922, by counties, species, and apparatus—Continued

BY HOOP NETS, TRAPS, AND POTS

Species	Clackamas		Clatsop		Columbia		Coos	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs			70,496	$7,049			48,960	$1,632
Crawfish	1,500	$200	8,670	1,156	11,100	$1,480	500	50
Total	1,500	200	79,166	8,205	11,100	1,480	49,460	1,682

Species	Douglas		Lane		Lincoln		Multnomah	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	296,340	$9,836	12,960	$432	152,460	$10,327	3,806	$200
Crawfish					750	100	24,857	3,314
Total	296,340	9,836	12,960	432	153,210	10,427	28,663	3,514

Species	Tillamook		Washington		Yamhill		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	145,780	$7,023					730,802	$36,499
Crawfish			20,808	$2,776	750	$150	68,935	9,226
Total	145,780	7,023	20,808	2,776	750	150	799,737	45,725

BY TONGS, FORKS, ETC.

Species	Clatsop		Coos		Lane		Lincoln		Tillamook		Total	
Clams:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Razor	163,110	$7,290									163,110	$7,290
Soft			28,966	$2,897	1,000	$100	13,734	$1,371	39,100	$3,910	82,800	8,278
Oysters, native, market:												
Private							50,001	5,000			50,001	5,000
Public							24,997	2,500			24,997	2,500
Total	163,110	7,290	28,966	2,897	1,000	100	88,732	8,871	39,100	3,910	320,908	23,068

CANNING INDUSTRY

In 1922 there were 29 canneries in Oregon valued at $1,563,337, with cash capital of $109,900, employing 897 persons and paying $569,994 in wages. Canned products produced were valued at $3,761,015, consisting largely of salmon, amounting to $3,696,680 in value, most of which was produced in the Columbia River district. A limited amount of canned shad and shad roe was also produced in the Columbia River district, while the pack of razor clams, valued at $54,074, was produced on the coast.

The following table gives in detail the statistics of the canning industry in Oregon in 1922, by districts:

Canning industry of Oregon in 1922, by districts

Items	Columbia River		Oregon coast		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*
Establishments	16	$1, 100, 396	13	$462, 941	29	$1, 563, 337
Cash capital		70, 400		39, 500		109, 900
Persons engaged	674		223		897	
Wages paid		432, 229		137, 765		569, 994
PRODUCTS						
Salmon:						
Blueback or sockeye—	*Cases*	*Value*	*Cases*	*Value*	*Cases*	*Value*
1-pound tall	315	$4, 473			315	$4, 473
½-pound flat	12, 972	231, 755			12, 972	231, 755
Chinook—						
2-pound tall	74	740			74	740
1-pound tall	5, 987	43, 895	51	$413	6, 038	44, 308
1-pound flat	46, 256	581, 709	8, 693	91, 826	54, 949	673, 535
1-pound oval	3, 138	59, 953	16, 414	147, 726	19, 552	207, 679
½-pound flat	91, 794	1, 538, 872	13, 699	234, 180	105, 493	1, 773, 052
½-pound oval	76	1, 885			76	1, 885
Chum—						
1-pound tall	1, 609	6, 475	2, 248	9, 442	3, 857	15, 917
1-pound flat			243	850	243	850
½-pound flat	636	3, 816	279	1, 339	915	5, 155
Silver or coho—						
1-pound tall	8, 103	46, 806	2, 608	14, 665	10, 711	61, 471
1-pound flat	22, 263	160, 347	8, 199	45, 906	30, 462	206, 253
½-pound flat	18, 956	161, 045	9, 006	84, 166	27, 962	245, 211
Steelhead—						
1-pound tall	15	156			15	156
1-pound flat	6, 675	61, 783			6, 675	61, 783
½-pound flat	11, 944	162, 457			11, 944	162, 457
Total	230, 813	3, 066, 167	61, 440	630, 513	292, 253	3, 696, 680
Shad:						
1-pound tall	1, 064	3, 661			1, 064	3, 661
½-pound flat	118	474			118	474
½-pound oval	87	3, 480			87	3, 480
Total	1, 269	7, 615			1, 269	7, 615
Shad roe:						
1-pound oval	150	2, 472			150	2, 472
½-pound flat	6	174			6	174
Total	156	2, 646			156	2, 646
Razor clams, whole:						
No. 1 (4 dozen)			500	5, 500	500	5, 500
No. 2 (2 dozen)			300	1, 950	300	1, 950
½-pound flat (4 dozen)			1, 907	11, 349	1, 907	11, 349
Razor clams, minced:						
No. 1 (4 dozen)			3, 971	29, 576	3, 971	29, 576
No. 2 (2 dozen)			909	5, 699	909	5, 699
Total			7, 587	54, 074	7, 587	54, 074
Grand total	232, 238	3, 076, 428	69, 027	684, 587	301, 265	3, 761, 015

NOTE.—All products except clams have been converted to the equivalent of forty-eight 1-pound cans to the case.

WHOLESALE FISH TRADE

The wholesale fish trade of Oregon was conducted by 28 firms, 7 of them located in Portland and the remainder in the various smaller towns of the State. These firms had a total investment amounting to $267,685, in addition to $37,300 cash capital; they employed 127 persons and paid $82,393 in wages.

The following table gives the statistics of the wholesale trade of Oregon in 1922:

Investment, persons engaged, and wages paid in the wholesale fish trade of Oregon in 1922

Localities	Establishments		Cash capital	Persons engaged	Wages paid
	Number	*Value*		*Number*	
Portland	7	$64,600	$7,700	36	$20,926
Other localities throughout the State	21	203,085	29,600	91	61,467
Total	28	267,685	37,300	127	82,393

FISHERIES OF CALIFORNIA

In 1922, California was the leading fish-producing State on the Pacific coast. There were 9,173 persons engaged in fishing and related industries; 209 vessels engaged in fishing; 53 vessels engaged in transporting fish; 1,297 power boats and 292 rowboats and sailboats engaged in fishing; an investment of $13,047,414 in vessels, boats, fishing apparatus, shore property, and canneries; and a production of 191,126,852 pounds of fishery products, with a value to the fisherman of $6,773,981. Of this production 175,779,868 pounds, valued at $5,884,156, were fish; 5,310,609 pounds, valued at $456,970, were shellfish; and the remaining 10,036,375 pounds were whale products, valued at $432,855.

Of the fishes pilchards or sardines, furnishing the raw material for a valuable canning industry, were most important, producing 92,114,542 pounds, valued at $1,381,008. Albacore and tuna, equally important as raw material for canning, produced 25,252,392 pounds, valued at $1,269,417. The production of salmon amounted to 7,236,580 pounds, valued at $590,509, consisting mostly of chinooks but including a few silver salmon. A portion of the salmon was canned, though considerable quantities entered the fresh-fish trade. Bonito and skipjack yielded 11,648,413 pounds, valued at $578,150, most of which was also canned. Flounders followed in importance, the production being 4,742,819 pounds, valued at $470,813. Included in this item is the flounder known to trade as "California halibut," of which there were reported 3,068,913 pounds, valued at $419,867. Barracuda yielded 6,284,065 pounds, valued at $439,817; sole, 6,949,557 pounds, valued at $211,800; rockfishes, 4,219,650 pounds, valued at $205,239; and white sea bass, or squeteague, 2,904,054 pounds, valued at $176,993. The yield of cod, caught by California vessels fishing in Alaska waters and landing their salted product in San Francisco, amounted to 1,680,000 pounds, valued at $84,000.

Mackerel, yellowtail, striped bass, shad, smelts, "lingcod," rock bass, mullet, anchovies, and kingfish, named in order of the value of their yield, each produced less than $76,000 and over $10,000 worth of products. Some 20 other kinds of fish, each having a yield valued at less than $10,000 and aggregating 2,056,318 pounds, valued at $70,746, made up the remainder of the fish production.

The production of shellfish amounted altogether to 5,310,609 pounds, valued at $456,970, most important of which, from the standpoint of value, were oysters, which yielded 94,598 pounds, valued at $101,351. Shrimps, spiny lobsters, crabs, abalones, clams, squid, octopus, mussels, and turtles, named in order of their value, made up the remainder of the yield of shellfish.

In addition to fish and shellfish, there were whale products to the value of $432,855, consisting of whale oil, 915,000 gallons, valued at $366,000; sperm oil, 5,050 gallons, valued at $2,525; and other products, 3,136,000 pounds, valued at $64,330.

Los Angeles, San Francisco, Monterey, and San Diego were the important centers of fishing. Los Angeles County, with its tuna and sardine fisheries, produced 86,803,137 pounds, valued at $2,771,177. San Francisco County, with an important market fishery, followed Los Angeles with a production of 24,939,899 pounds, valued at $1,101,288. Next in importance was Monterey County, with her large sardine fisheries, producing 49,351,971 pounds, valued at $1,087,858. San Diego County, with tuna and sardine fisheries similar to those of Los Angeles but of lesser magnitude, produced 18,241,117 pounds, valued at $852,620. The remaining counties, none of them with remarkably large catches, yielded 11,800,728 pounds, valued at $961,038.

The following table shows in detail the statistics of the fisheries of California in 1922:

Persons engaged, investment, and products of the fisheries of California in 1922, by counties

Items	Alameda		Colusa		Contra Costa		Del Norte	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels transporting					3			
In shore fisheries	26		9		187		143	
Shoresmen	31		14		63		119	
Total	57		23		253		262	
INVESTMENT								
Vessels, transporting					1	$5,050		
Tonnage					15			
Outfit						500		
Power boats	10	$15,000	1	$100	81	70,275	2	$550
Rowboats, scows, etc	2	80	10	796	15	1,400	90	2,060
Apparatus, shore fisheries:								
Gill nets	21	1,400	2	40	155	45,570	100	10,135
Length, in yards	2,800		170		81,690		19,090	
Lines		210				300		75
Haul seines	1	30	8	1,000			2	350
Length, in yards	80		895				660	
Tongs, forks, rakes, and hoes	27	52			19	38		
Fyke nets			15	90				
Miscellaneous apparatus							43	430
Shore and accessory property		45,950		200		246,829		35,500
Cash capital		30,700				42,000		10,000
Total		93,422		2,226		411,962		59,100

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Alameda		Colusa		Contra Costa		Del Norte	
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp, German					35,456	$1,063		
Catfish					243	9		
Flounders	1,500	$45			2,409	72	707	$64
Grayfish	1,160	23						
Herring	70,345	1,407						
Kingfish	25	1						
"Lingcod"							3,645	182
Perch	31	1			30	1	1,402	56
Pike, Sacramento					4,249	127		
Rockfishes							9,132	457
Salmon:								
Chinook	7,000	630	12,664	$2,026	792,795	71,351	1,085,820	76,008
Silver							19,288	1,350
Sea bass, white, or squeteague							133	11
Shad	50	3			799,985	40,744		
Smelt	14,783	1,182					2,447	147
Splittail	196	5			1,018	30		
Steelhead trout							2,490	174
Striped bass	13,454	1,883	166	26	331,792	11,504		
Other fish	109	3			978	30		
Crabs	1,804	250					15,862	721
Shrimp	44,124	4,412						
Clams, soft	14,575	874			184,737	9,236		
Mussels	2,724	109						
Octopus							83	4
Turtles			75	8				
Total	171,880	10,828	12,905	2,060	2,153,692	134,167	1,141,009	79,174

Items	Glenn		Humboldt		Imperial		Los Angeles	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels, fishing							869	
On vessels, transporting							114	
In shore fisheries	10		50		7		776	
Shoresmen	24		85		7		2,182	
Total	34		135		14		3,941	
INVESTMENT								
Vessels, fishing, gasoline							135	$789,345
Tonnage							1,910	
Outfit								196,250
Vessels, transporting							35	333,500
Tonnage							1,358	
Outfit								11,550
Power boats			29	$27,950	1	$400	223	463,875
Rowboats, scows, etc	10	$310			2	300	13	620
Apparatus, vessel, fisheries:								
Purse seines							52	118,100
Length, in yards							26,680	
Gill nets							151	5,390
Length, in yards							10,980	
Lampara nets							107	79,310
Paranzella nets							1	43
Lines								1,675
Trammel nets							82	3,060
Length, in yards							7,200	
Pots							200	500
Apparatus, shore fisheries:								
Gill nets					3	150	306	8,140
Length, in yards					100		15,850	
Lines				1,605				4,155
Lampara nets							158	66,900
Haul seines	10	800	3	600				
Length, in yards	2,190		760					
Trammel nets							369	11,200
Length, in yards							25,500	
Tongs, forks, rakes, and hoes			5	10			23	37
Dip nets			12	24				
Pots							760	2,270
Miscellaneous apparatus			222	444				
Shore and accessory property		12,300		193,547		100		4,072,967
Cash capital		1,000		42,000				371,914
Total		14,410		266,180		950		6,540,751

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Glenn		Humboldt		Imperial		Los Angeles	
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna							20, 359, 472	$1, 029, 573
Anchovies							364, 797	7, 295
Barracuda							4, 951, 931	345, 001
Bonito and skipjack							7, 203, 308	360, 022
Flounders			63, 652	$5, 075			1, 677, 898	233, 021
Flying fish							8, 495	174
Grayfish							4, 475	90
Halfmoon							27, 791	832
Herring			6, 222	124				
Kingfish							252, 659	5, 053
"Lingcod"			12, 060	603			172	8
Mackerel							1, 708, 881	51, 259
Mullet					106, 500	$11, 715	13, 328	1, 458
Perch			67, 077	2, 683			59, 962	3, 006
Pike, Sacramento	153	$8						
Pilchard, or sardines							44, 558, 068	456, 951
Pompano							14, 108	4, 315
Rock bass							146, 673	8, 758
Rockfishes			10, 010	500			1, 004, 589	60, 245
Salmon:								
Chinook	52, 129	8, 340	875, 246	70, 020				
Silver			36, 468	2, 917				
Sculpin							38, 156	766
Sea bass, black, or jewfish							73, 375	3, 948
Sea bass, white, or squeteague							2, 243, 287	133, 693
Sheepshead							1, 373	14
Skates							3, 938	79
Smelt			26, 510	1, 590			169, 121	11, 900
Sole			166	10			115, 884	5, 793
Striped bass	104	16						
Swordfish							22, 563	469
Tomcod							90	4
Whitebait			20, 874	1, 252				
Whitefish							28, 444	1, 421
Yellowtail							1, 521, 641	30, 420
Other fish			2, 768	138			37, 576	1, 132
Crabs			115, 236	5, 238				
Spiny lobster							158, 500	12, 874
Clams, hard			20, 242	1, 013			2, 290	160
Clams, soft			2, 516	125				
Cockles							162	16
Octopus							5, 981	235
Squid							22, 772	1, 136
Turtles							1, 377	56
Total	52, 386	8, 364	1, 259, 047	91, 288	106, 500	11, 715	86, 803, 137	2, 771, 177

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Marin		Mendocino		Monterey		Orange	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels, fishing					21			
In shore, fisheries	137		102		465		46	
Shoresmen	22		31		837		3	
Total	159		133		1,323		49	
INVESTMENT								
Vessels, fishing, gasoline					3	$26,080		
Tonnage					18			
Outfit						7,500		
Power boats	44	$41,425	85	$90,700	270	417,500	17	$17,325
Rowboats, scows, etc	8	865			2	75	10	400
Apparatus, vessel fisheries:								
Abalone outfit					3	2,800		
Apparatus, shore fisheries:								
Gill nets	33	2,005	3	1,500	11	650	58	3,825
Length, in yards	3,730		2,000		1,360		7,650	
Lines		855		3,910		9,180		665
Lampara nets					32	37,500	1	450
Haul seines	4	400			2	350	3	700
Length, in yards	880				390		300	
Trammel nets					4	176	119	3,570
Length, in yards					320		6,000	
Tongs, forks, rakes, and hoes	98	165						
Bag nets	14	700						
Pots							165	445
Abalone outfit					1	800		
Miscellaneous apparatus	262	375			37	50		
Shore and accessory property		8,900		67,650		1,086,902		1,100
Cash capital		7,900		6,000		183,500		
Total		63,590		169,760		1,773,063		28,480
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna					236	$11	18,082	$1,085
Anchovies					136,433	2,728		
Barracuda					13,031	912	9,433	659
Bonito and skipjack					2,106	105	60	4
Flounders	1,927	$248	37,148	$3,714	26,550	1,894	88,331	12,335
Herring	12,650	253						
Kingfish					228,019	4,560	106	2
"Lingcod"	86	5	6,873	344	85,526	5,132		
Mackerel					537,137	16,115	31,633	948
Perch	30,623	919			20,741	622	1,158	58
Pilchards or sardines	125	3			44,676,589	893,531	1,360	14
Pompano					448	134		
Rock bass							6,486	392
Rockfishes	183	14	1,485	74	1,261,424	47,143	15,990	960
Sablefish					3,879	116		
Salmon:								
Chinook	230,108	23,010	1,456,090	101,926	463,461	37,077		
Silver			60,670	4,247	19,310	1,544		
Sculpin							20	1
Sea bass, black, or jewfish							287	18
Sea bass, white, or squeteague	19,191	1,337			45,732	1,846	29,875	1,809
Skates					908	18	719	15
Smelt	19,916	1,183			63,329	5,066	134,942	9,445
Sole					62,745	1,882	3,170	160
Striped bass	3,417	512						
Whitebait	132	16						
Yellowtail							1,261	25
Other fish					8,475	254	1,756	81
Crabs	27,500	3,750			44	3		
Spiny lobsters							17,504	2,107
Shrimp	126,950	12,695						
Abalone					1,504,943	60,197		
Clams, hard	10,200	1,020						
Clams, soft	80,890	8,956						
Mussels							897	89
Oysters, eastern, market	94,598	101,351						
Octopus	50	2			66,802	2,004		
Squid					124,103	4,964		
Total	658,546	155,274	1,562,266	110,305	49,351,971	1,087,858	363,070	30,207

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Sacramento		San Diego		San Francisco		San Joaquin	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing			249		192			
On vessels transporting			12		57			
In shore fisheries	100		377		417		14	
Shoresmen	11		811		209		7	
Total	111		1,449		875		21	
INVESTMENT								
Vessels, fishing, steam					7	$238,800		
Tonnage					319			
Outfit						38,130		
Vessels, fishing, gasoline			54	$231,965	7	95,500		
Tonnage			513		84			
Outfit				68,100		21,350		
Vessels, fishing, sail					3	59,250		
Tonnage					1,043			
Outfit						16,000		
Vessels transporting			3	39,120	12	235,000		
Tonnage			138		1,385			
Outfit				6,000		25,963		
Power boats	47	$16,900	118	208,450	229	182,250	7	$2,735
Rowboats, scows, etc	20	4,640	13	630			21	4,025
Apparatus, vessel fisheries:								
Purse seines			2	1,900				
Length, in yards			1,000					
Gill nets			232	6,450				
Length, in yards			13,026					
Lampara nets			51	17,225				
Paranzella nets					28	7,250		
Lines				1,437		187		
Trammel nets			411	14,500				
Length in yards			33,288					
Shrimp nets					30	700		
Pots			530	1,400				
Harpoons					4	26,800		
Apparatus, shore fisheries:								
Gill nets	81	19,450	810	19,375	372	10,000	14	2,700
Length, in yards	24,150		37,950		20,790		4,880	
Lines				5,070		7,590		
Lampara nets			52	15,900	4	2,000		
Haul seines	1	250	2	500				
Length, in yards	300		500					
Trammel nets			882	27,030				
Length, in yards			57,170					
Tongs, forks, rakes, and hoes					30	75		
Fyke nets	30	180					50	300
Bag nets					60	1,500		
Pots			1,824	4,600				
Miscellaneous apparatus					2,509	5,046		
Shore and accessory property		21,500		1,074,094		347,050		30,500
Cash capital		7,500		104,110		113,000		3,500
Total		70,420		1,847,856		1,433,421		43,760
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna			4,872,537	$238,598				
Anchovies			500	10	150,786	$3,016		
Barracuda			1,204,980	83,833	81	8		
Bonito and skipjack			4,406,500	216,079				
Carp, German	11,158	$334					3,102	$93
Catfish	7,118	996						
Cod, salted					1,680,000	84,000		
Flounders			730,100	102,717	1,633,512	52,718		
Grayfish			214,900	4,723	93,641	1,873		
Hake					68,213	1,365		
Hardhead	18,206	1,183						
Herring					250,887	5,018		
Kingfish			13,735	275	3,434	69		
"Lingcod"			1,130	50	420,358	25,220		
Mackerel			183,040	5,506				
Mullet			28,800	3,168				
Perch			2,200	111	46,244	1,387		
Pike, Sacramento	1,466	50			487	15	1,015	30
Pilchard or sardines			2,705,800	27,058	170,420	3,409		
Pompano			220	88	1,685	502		
Rock bass			131,150	7,229				

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Sacramento		San Diego		San Francisco		San Joaquin	
PRODUCTS—Continued	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Rockfishes			555, 832	$33, 348	747, 137	$35, 700		
Sablefish					212, 008	6, 361		
Salmon: Chinook	157, 921	$18, 950			722, 890	65, 060	238, 637	$21, 477
Sculpin			6, 000	122				
Sea bass, black, or jewfish			13, 545	481				
Sea bass, white, or squeteague			439, 640	27, 130	31, 350	2, 820		
Shad	47, 438	1, 664			31, 633	950	84, 667	3, 269
Sheepshead			16, 520	169				
Skates					110, 588	2, 213		
Smelt			27, 230	1, 574	85, 408	6, 832		
Sole			8, 810	436	6, 509, 970	195, 298		
Split-tail	7, 587	227					1, 607	48
Striped bass	8, 317	1, 247			166, 761	25, 014	83, 895	12, 584
Suckers	1, 348	27						
Swordfish			1, 800	37				
Tomcod					30, 989	1, 240		
Whitebait					63, 001	7, 560		
Whitefish			3, 350	168				
Yellowtail			1, 873, 300	37, 818				
Other fish			11, 020	331	98, 092	3, 923		
Crabs					669, 000	55, 749		
Spiny lobster			726, 278	58, 451				
Shrimp					819, 275	77, 427		
Abalone			200	10				
Clams, hard					22	1		
Clams, soft					54, 834	2, 742		
Mussels					9, 256	370		
Octopus					11, 562	573		
Squid			62, 000	3, 100				
Sperm oil					37, 875	2, 525		
Whale oil					6, 862, 500	366, 000		
Other whale products					3, 136, 000	64, 330		
Total	260, 559	24, 678	18, 241, 117	852, 620	24, 929, 899	1, 101, 288	412, 923	37, 501

Items	San Luis Obispo		Santa Barbara		Santa Cruz		Solano	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels transporting							3	
In shore fisheries	32		43		17		128	
Shoresmen	32		14		11		4	
Total	64		57		28		135	
INVESTMENT								
Vessels transporting							2	$2, 000
Tonnage							10	
Outfit								1, 250
Power boats	8	$9, 875	10	$22, 800	8	$3, 760	82	51, 830
Rowboats, scows, etc	4	100	6	120			56	12, 300
Apparatus, shore fisheries:								
Gill nets	30	1, 100	321	5, 000	3	240	94	26, 685
Length, in yards	2, 100		9, 530		480		44, 150	
Lines		600		300		175		60
Lampara nets	2	400			8	3, 400		
Haul seines			2	500	2	250	1	300
Length, in yards			250		200		500	
Trammel nets	4	150	27	1, 080				
Length, in yards	160		1, 080					
Tongs, forks, rakes, and hoes	50	75			10	20		
Pots			1, 000	3, 000				
Abalone outfit	1	1, 000						
Miscellaneous apparatus					4	10		
Shore and accessory property		15, 500		19, 500		9, 000		
Cash capital		6, 000		3, 500		2, 500		
Total		34, 800		55, 800		19, 355		94, 425

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	San Luis Obispo		Santa Barbara		Santa Cruz		Solano	
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna			2,065	$150				
Barracuda	4,200	$378	95,192	8,567	517	$36		
Bonito and skipjack			11,200	673	24,649	1,232		
Carp, German							4,207	$125
Flounders	38,320	5,364	360,895	50,506	73,191	2,338	805	44
Hake					10,550	211		
Herring	510	10			1,000	20		
Kingfish			290	6	81,486	1,629		
"Lingeod"	15	1			39,360	2,361		
Mackerel	180	9	24,450	1,222	12,346	370		
Perch	270	10	125	5	6,498	195		
Pilchard or sardines			190	2	1,990	40		
Pompano					33	10		
Rock bass			1,185	70				
Rockfishes	72,750	4,366	23,520	1,410	512,823	20,758		
Sablefish					53,018	1,590		
Salmon:								
Chinook	30	5			381,464	29,748	488,639	43,975
Silver					15,894	1,240		
Sea bass, black, or jewfish			352	55				
Sea bass, white, or squeteague	1,840	180	42,089	4,208	48,217	3,689		
Shad							137,969	7,278
Sheepshead			327	10				
Skates			2,500	50	3,100	62		
Smelts	62,700	3,762	21,600	1,296	95,263	7,621		
Sole	10,600	530	26,700	1,335	211,382	6,341		
Striped bass							67,468	9,444
Tomcod					265	7		
Whitefish			390	20				
Yellowtail			20,100	402				
Other fish	800	32	5,100	200	19,734	592	373	11
Crabs					2,222	250		
Spiny lobster			58,000	11,600				
Abalone	18,400	736						
Clams, hard					1,385	83		
Clams, Pismo	191,880	9,594	100	5				
Mussels	150	5			185	7		
Octopus					14,796	591		
Total	402,645	24,982	696,370	81,792	1,611,368	81,021	699,461	60,877

Items	Sonoma		Ventura		Yolo		Total	
PERSONS ENGAGED	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
On vessels fishing							1,331	
On vessels transporting							189	
In shore fisheries	11		7		32		3,136	
Shoresmen							4,517	
Total	11		7		32		9,173	
INVESTMENT								
Vessels fishing, steam							7	$238,800
Tonnage							319	
Outfit								38,130
Vessels fishing, gasoline							199	1,142,890
Tonnage							2,525	
Outfit								293,200
Vessels fishing, sail							3	59,250
Tonnage							1,043	
Outfit								16,000
Vessels transporting							53	614,670
Tonnage							2,906	
Outfit								45,263
Power boats	10	$11,350	1	$1,500	14	$4,010	1,297	1,660,560
Rowboats, scows, etc			2	100	8	850	292	29,671
Apparatus, vessel fisheries:								
Purse seines							54	120,000
Length, in yards							27,680	
Gill nets							383	11,840
Length, in yards							24,006	
Lampara nets							158	96,535
Paranzella nets							29	7,293

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Sonoma		Ventura		Yolo		Total	
INVESTMENT—continued								
Apparatus, vessel fisheries—Con.	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Lines								$3,299
Trammel nets							493	17,560
Length, in yards							40,488	
Shrimp nets							30	700
Pots							730	1,900
Abalone outfit							3	2,800
Harpoons							4	26,800
Apparatus, shore fisheries:								
Gill nets					20	$2,000	2,437	159,965
Length, in yards					3,552		282,022	
Lines		$320		$30		2		35,102
Lampara nets							257	126,550
Haul seines	1	120	1	150	2	350	45	6,650
Length, in yards	93		100		430		8,528	
Trammel nets			8	320			1,413	43,526
Length, in yards			640				90,870	
Tongs, forks, rakes, and hoes	9	14					271	486
Fyke nets					127	762	222	1,332
Bag nets							74	2,200
Dip nets							12	24
Pots			70	200			3,819	10,515
Abalone outfit							2	1,800
Miscellaneous apparatus	145	355					3,222	6,710
Shore and accessory property		1,000				200		7,290,269
Cash capital								935,124
Total		13,159		2,300		8,174		13,047,414
PRODUCTS	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Volue*	*Pounds*	*Value*
Albacore and tuna							25,252,392	$1,269,417
Anchovies							652,516	13,049
Barracuda			4,700	$423			6,284,065	439,817
Bonito and skipjack			590	35			11,648,413	578,150
Carp, German					1,131	$34	55,054	1,649
Catfish							7,361	1,005
Cod, salted							1,680,000	84,000
Flounders			4,360	612	1,514	46	4,742,819	470,813
Flyingfish							8,495	174
Grayfish							314,176	6,709
Hake							78,763	1,576
Halfmoon							27,791	832
Hardhead							18,206	1,183
Herring							341,614	6,832
Kingfish							579,754	11,595
"Lingcod"	596	$30					569,821	33,936
Mackerel			530	26			2,498,197	75,455
Mullet							148,628	16,341
Perch	70	2					236,431	9,056
Pike, Sacramento							7,370	230
Pilchard, or sardines							92,114,542	1,381,008
Pompano							16,494	5,049
Rock bass							285,494	16,449
Rockfishes	2,245	112	2,530	152			4,219,650	205,239
Sablefish							268,905	8,067
Salmon:								
Chinook	105,000	7,350			15,056	2,258	7,084,950	579,211
Silver							151,630	11,298
Sculpin							44,176	889
Sea bass, black, or jewfish							87,559	4,502
Sea bass, white, or squeteague			2,700	270			2,904,054	176,993
Shad					31,528	1,605	1,133,270	55,513
Sheepshead			25	1			18,245	194
Skates							121,753	2,437
Smelt	157	10	5,000	300			728,406	51,908
Sole			130	15			6,949,557	211,800
Splittail							10,408	310
Steelhead trout							2,490	174
Striped bass					3,446	517	678,820	62,747
Suckers							1,348	27
Swordfish							24,363	506
Tomcod							31,344	1,251
Whitebait							84,007	8,828
Whitefish							32,184	1,609
Yellowtail			270	6			3,416,572	68,671
Other fish			31,000	930			217,781	7,657
Crabs	12,804	582					844,472	66,543
Spiny lobster			6,350	1,270			966,632	86,302

Persons engaged, investment, and products of the fisheries of California in 1922, by counties—Continued

Items	Sonoma		Ventura		Yolo		Total	
PRODUCTS—continued	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Shrimp							990,349	$94,534
Abalone							1,523,543	60,943
Clams, hard	50	$3					34,189	2,280
Clams, Pismo							191,980	9,599
Clams, soft	3,621	181					341,173	22,114
Cockles	698	35					860	51
Mussels							13,212	580
Oysters, eastern, market							94,598	101,351
Octopus							99,274	3,409
Squid							208,875	9,200
Turtles							1,452	64
Sperm oil							37,875	2,525
Whale oil							6,862,500	366.000
Other whale products							3,136,000	64,330
Total	125,241	8,305	58,185	$4,040	52,675	$4,460	191,126,852	6,773,981

VESSEL FISHERIES

The fisheries of California in 1922 employed in actual fishing 7 steam, 199 gasoline, and 3 sailing vessels of 5 tons net burden and over, as measured by the Customs Service, not including 53 vessels engaged in transporting fish. The yield of the fishing vessels amounted to 77,556,811 pounds, valued at $2,523,979.

Judging from the value of the catch, lines were the most important gear employed in the vessel fisheries, producing 15,409,209 pounds, valued at $772,126. Albacore and tuna were most important in this catch, contributing over half the yield; bonito and skipjack followed, with about one-third of the catch; the cod caught in Alaskan waters and the rockfishes caught principally off Los Angeles and San Diego were next in order, while some 20 species of fish caught in smaller quantities made up the remainder of the catch by this type of gear.

Purse seines, operated principally from the port of Los Angeles, were next in importance, with a total catch of 8,500,584 pounds, valued at $420,373. Their most important catches were barracuda, 2,395,635 pounds, valued at $166,086; tuna, 3,891,781 pounds, valued at $142,084; bonito and skipjack, 736,331 pounds, valued at $36,710; and white sea bass, 616,114 pounds, valued at $36,056. A number of other fishes caught incidentally in fishing for these principal species made up the remainder of the catch by purse seines.

Lampara nets produced an amount of fish much in excess of that produced by purse seines and nearly equaling the purse-seine catch in value, altogether amounting to 31,692,669 pounds, valued at $412,662. Three-quarters of the catch by this gear consisted of sardines, while smaller amounts of bonito, barracuda, yellowtail, mackerel, white sea bass, and other fishes made up the remainder. Lampara nets were also important in providing bait for the line fishery, although the amount of bait caught does not enter these statistics.

Paranzella nets, operated exclusively from the port of San Francisco, produced 9,047,496 pounds, valued at $287,086. Soles, flounders, and other bottom fish made up the catch of this gear.

Gill nets, fished principally for barracuda and white sea bass, caught 566,727 pounds, valued at $32,228; trammel nets, catching almost exclusively flounders, made a total catch of 526,533 pounds, valued at $72,168; abalone outfits, operated exclusively from Monterey County, produced 1,124,965 pounds, valued at $44,998; lobster pots in San Diego and Los Angeles Counties caught 562,253 pounds of spiny lobsters, valued at $44,983; and shrimp nets in San Francisco County yielded 90,000 pounds, valued at $4,500.

Whaling apparatus employed on vessels sailing from San Francisco and landing their whales at a shore station located at Moss Landing, furnished the raw material from which products valued at $432,855 were made.

The following table gives the statistics of the vessel fishery of California in 1922, by species, counties, and apparatus:

Yield of the vessel fisheries of California in 1922, by counties, apparatus, and species

Species	Los Angeles		San Diego		San Francisco		Total [1]	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Albacore and tuna	3,595,889	$131,785	295,892	$10,299			3,891,781	$142,084
Barracuda	2,343,435	162,429	52,200	3,657			2,395,635	166,086
Bonito and skipjack	675,231	33,655	61,100	3,055			736,331	36,710
Flounders	129,594	18,006	3,100	434			132,694	18,440
Flying fish	380	9					380	9
Kingfish	515	10					515	10
Mackerel	100,542	3,012	1,000	30			101,542	3,042
Mullet	13,328	1,458					13,328	1,458
Perch	16,445	830					16,445	830
Pilchard or sardines	20,830	208					20,830	208
Pompano	769	257					769	257
Rock bass	23,176	1,389					23,176	1,389
Rockfishes	3,984	238	30	2			4,014	240
Sculpin	720	17					720	17
Sea bass, black, or jewfish	31,164	1,693	100	4			31,264	1,697
Sea bass, white, or squeteague	604,774	35,376	11,340	680			616,114	36,056
Sheepshead	150	1					150	1
Skates	35	1					35	1
Smelt	9,159	640					9,159	640
Sole	15,855	792	1,400	70			17,255	862
Swordfish	750	23					750	23
Tomcod	90	4					90	4
Whitefish	3,500	175					3,500	175
Yellowtail	409,679	8,182	69,000	1,720			478,679	9,902
Other fish	1,397	43					1,397	43
Spiny lobster	27	2					27	2
Squid	2,627	131					2,627	131
Turtles	1,377	56					1,377	56
Total	8,005,422	400,422	495,162	19,951			8,500,584	420,373
Gill nets:								
Barracuda	106,876	7,478	92,800	6,404			199,676	13,882
Bonito	14,650	733	144,900	5,545			159,550	6,278
Flounders			14,500	2,530			14,500	2,530
Flying fish	200	5					200	5
Grayfish	4,450	89	11,200	344			15,650	433
Mackerel	27,118	813	3,400	102			30,518	915
Perch	311	16	300	15			611	31
Rock bass			400	24			400	24
Rockfishes	27	2					27	2
Sea bass, black, or jewfish	1,340	56	2,720	95			4,060	151
Sea bass, white, or squeteague	65,265	3,923	60,500	3,630			125,765	7,553
Smelt	1,197	83	600	42			1,797	125
Sole			150	8			150	8
Yellowtail	1,600	32	10,800	216			12,400	248
Other fish	1,423	43					1,423	43
Total	224,457	13,273	342,270	18,955			566,727	32,228

[1] Includes 1,124,965 pounds of abalone, caught in Monterey County, and valued at $44,998.

Yield of the vessel fisheries of California in 1922, by counties, apparatus, and species—Continued

Species	Los Angeles		San Diego		San Francisco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Lampara nets:								
Barracuda	240,015	$16,800	39,680	$2,760			279,695	$19,560
Bonito	1,104,908	55,212	88,400	4,420			1,193,308	59,632
Flounders	6,330	886					6,330	886
Grayfish	25	1	300	12			325	13
Kingfish	25,301	506	3,235	71			28,536	577
"Lingcod"	172	8					172	8
Mackerel	246,374	7,391	62,450	1,874			308,824	9,265
Perch	400	20					400	20
Pilchard or sardines	27,085,392	282,222	2,247,800	22,478			29,333,192	304,700
Pompano	579	231					579	231
Rock bass	5,820	349	200	12			6,020	361
Rockfishes	2,040	122					2,040	122
Sea bass, black, or jewfish	1,505	60	200	8			1,705	68
Sea bass, white, or squeteague	98,365	5,903	17,900	1,086			116,265	6,989
Skates	185	4					185	4
Smelt	9,177	642	5,780	403			14,957	1,045
Sole	6,362	318	1,100	55			7,462	373
Swordfish	300	6	100	3			400	9
Whitefish			40	2			40	2
Yellowtail	200,284	4,004	159,700	3,194			359,984	7,198
Other fish	655	19					655	19
Squid	95	5	31,500	1,575			31,595	1,580
Total	29,034,284	374,709	2,658,385	37,953			31,692,669	412,662
Paranzella nets:								
Flounders					1,600,941	$51,207	1,600,941	51,207
Grayfish					58,631	1,173	58,631	1,173
Hake					68,213	1,365	68,213	1,365
Kingfish					1,825	37	1,825	37
"Lingcod"					249,361	14,960	249,361	14,960
Perch					300	9	300	9
Pompano					1,376	412	1,376	412
Rockfishes					289,498	14,050	289,498	14,050
Sablefish					75,753	2,273	75,753	2,273
Pilchard or sardines					2,245	45	2,245	45
Sea bass, white, or squeteague					3,423	308	3,423	308
Skates					110,538	2,212	110,538	2,212
Smelt					4,037	322	4,037	322
Sole					6,474,454	194,233	6,474,454	194,233
Tomcod					5,445	218	5,445	218
Other fish					93,860	3,754	93,860	3,754
Crabs					4,008	333	4,008	333
Clams, hard					22	1	22	1
Clams, soft					26	2	26	2
Octopus					3,540	172	3,540	172
Total					9,047,496	287,086	9,047,496	287,086
Lines:								
Albacore and tuna	3,979,546	213,529	4,130,505	202,757			8,110,051	416,286
Barracuda	12,930	905	54,600	3,918			67,530	4,823
Bonito	2,438,605	121,927	2,240,800	109,494			4,679,405	231,421
Cod, salted					1,680,000	84,000	1,680,000	84,000
Founders			8,860	1,207			8,860	1,207
Grayfish			14,500	539			14,500	539
Kingfish			1,000	20			1,000	20
Mackerel	600	18	5,490	164			6,090	182
Mullet			6,800	748			6,800	748
Perch			200	11			200	11
Pompano			220	88			220	88
Rock bass			13,350	801			13,350	801
Rockfishes	22,112	1,327	318,180	19,089			340,292	20,416
Sculpin			200	4			200	4
Sea bass, black, or jewfish	920	37	8,425	294			9,345	331
Sea bass, white, or squeteague			25,300	2,278			25,300	2,278
Sheepshead	40	1	520	9			560	10
Skates	760	15					760	15
Smelt			50	3			50	3
Sole			50	2			50	2
Swordfish	780	25					780	25
Whitefish			870	44			870	44
Yellowtail	39,896	798	403,100	8,074			442,996	8,872
Total	6,496,189	338,582	7,233,020	349,544	1,680,000	84,000	15,409,209	772,126

Yield of the vessel fisheries of California in 1922, by counties, apparatus, and species—Continued

Species	Los Angeles		San Diego		San Francisco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Trammel nets:								
Barracuda			14,300	$801			14,300	$801
Founders	118,872	$16,641	389,100	54,510			507,972	71,151
Kingfish			100	2			100	2
Perch	477	24					477	24
Rockfishes			410	24			410	24
Sea bass, black, or jewfish	455	18					455	18
Sea bass, white, or squeteague			400	24			400	24
Smelt			300	21			300	21
Sole	2,009	100	10	1			2,019	101
Yellowtail			100	2			100	2
Total	121,813	16,783	404,720	55,385			526,533	72,168
Shrimp nets: Shrimp					90,000	$4,500	90,000	4,500
Pots: Spiny lobsters	23,858	1,908	538,395	43,075			562,253	44,983
Harpoons:								
Sperm oil					37,875	2,525	37,875	2,525
Whale oil					6,862,500	366,000	6,862,500	366,000
Other whale products					3,136,000	64,330	3,136,000	64,330
Total					10,036,375	432,855	10,036,375	432,855
Grand total	43,906,023	1,145,677	11,671,952	524,863	20,853,871	808,441	77,556,811	2,523,979

SHORE AND BOAT FISHERIES

The shore and boat fisheries of California in 1922 employed 3,133 fishermen on 1,207 power boats and 292 rowboats, scows, and similar inshore fishing craft. The total yield was 113,570,041 pounds, valued at $4,250,002.

As in the vessel fisheries, the greatest production was by lines, which contributed 28,067,355 pounds, valued at $1,529,745. Albacore and tuna yielded 13,250,560 pounds, valued at $711,047; salmon 4,270,980 pounds, valued at $337,689; rockfishes, 3,582,283 pounds, valued at $170,320; bonito and skipjack, 2,844,417 pounds, valued at $142,277; barracuda, mackerel, and yellowtail in considerable amounts, and other fishes in lesser amounts.

Lampara nets followed lines in importance. Their total yield was 69,763,499 pounds, valued at $1,353,915, made up largely of sardines, bonito and skipjack, barracuda, mackerel, white sea bass, and yellowtail.

Gill nets yielded 9,072,270 pounds, valued at $628,285. About one-third of this was salmon; one-fifth, barracuda; one-sixth, white sea bass; one-tenth, striped bass; and one-tenth, shad. Other fishes were caught in smaller amounts.

Trammel nets yielded 2,460,900 pounds, valued at $319,756, consisting almost entirely of flounders. Haul seines yielded a total catch of 795,421 pounds, valued at $61,815, consisting principally of chinook salmon and smelts.

Bag nets catching herring and shrimp; fyke nets catching carp, catfish, hardhead, Sacramento pike, and splittail; dip nets catching perch; lobster pots catching spiny lobsters; abalone outfits yielding abalone; tongs, forks, rakes, hoes, and miscellaneous apparatus employed in fishing for shellfish, produced the remainder of the catch of the shore fisheries.

The following tables give the yield of the shore fisheries of California in 1922 by species, apparatus, and counties:

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus

BY HAUL SEINES

Species	Coluso		Del Norte		Glenn		Humboldt		Marin	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders							16,343	$817	25	$1
Herring							6,222	124	12,650	253
"Lingcod"									86	5
Perch			1,402	$56			43,077	1,723	25,500	765
Pike, Sacramento					153	$8				
Pilchard or sardines									125	3
Salmon, chinook	11,164	$1,786	50,000	3,500	52,129	8,340				
Smelt			2,447	147			26,510	1,590		
Striped bass	166	26			104	16				
Turbot									784	157
White bait							20,874	1,252	132	16
Octopus									50	2
Turtles	75	8								
Total	11,405	1,820	53,849	3,703	52,386	8,364	113,026	5,506	39,352	1,202

Species	Monterey		Orange		Sacramento		Santa Barbara		Santa Cruz	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp, German					4,158	$124				
Flounders			265	$10						
Hardhead					3,206	208				
Kingfish			106	2						
Mackerel							14,450	$722		
Perch							125	5		
Pilchard or sardines			1,360	14			190	2		
Salmon, chinook					7,921	950				
Sheepshead							327	10		
Smelt	33,329	$2,666	134,942	9,445			21,600	1,296	60,000	$4,800
Suckers					1,348	27				
Mussels									185	7
Total	33,329	2,666	136,673	9,471	16,633	1,309	36,692	2,035	60,185	4,807

Species	Solano		Sonoma		Ventura		Yolo		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp, German									4,158	$124
Flounders									16,633	828
Hardhead									3,206	208
Herring									18,872	377
Kingfish									106	2
"Lingcod"									86	5
Mackerel					530	$26			14,980	748
Perch			70	$2					70,174	2,551
Pike, Sacramento									153	8
Pilchard or sardines									1,675	19
Salmon, chinook	196,377	$17,673	5,000	350			10,000	$1,500	332,591	34,099
Seabass, white, or squeteague					2,700	270			2,700	270
Shad							6,057	321	6,057	321
Sheepshead									327	10
Smelt			157	10	5,000	300			283,985	20,254
Striped bass									270	42
Suckers									1,348	27
Turbot									784	157
Whitebait									21,006	1,268
Other fish					16,000	480			16,000	480
Mussels									185	7
Octopus									50	2
Turtles									75	8
Total	196,377	17,673	5,227	362	24,230	1,076	16,057	1,821	795,421	61,815

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY GILL NETS

Species	Alameda		Colusa		Contra Costa		Del Norte	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp, German					35,456	$1,063		
Catfish					243	9		
Flounders					2,409	72		
Grayfish	560	$11						
Herring	30,000	600						
Perch	31	1			30	1		
Pike, Sacramento					4,249	127		
Salmon:								
Chinook			1,500	$240	767,795	69,101	1,033,342	$72,334
Silver							19,288	1,350
Shad	50	3			799,985	40,744		
Smelt	10,783	862						
Splittail	196	5			1,018	30		
Steelhead trout							2,490	174
Striped bass	10,000	1,400			331,792	11,504		
Other fish	109	3			978	30		
Total	51,729	2,885	1,500	240	1,943,955	122,681	1,055,120	73,858

Species	Imperial		Los Angeles		Marion		Monterey	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda			1,821,409	$127,492				
Bonito and skipjack			85,288	4,264				
Flying fish			7,915	160				
Halfmoon			8,000	240				
Kingfish			26,303	526				
Mackerel			150,233	4,507				
Mullet	106,500	$11,715						
Perch			36,000	1,800	5,123	$154	15,741	$472
Pompano			8,800	2,640				
Rock bass			1,547	93				
Rockfishes			546	32				
Salmon:								
Chinook							79,461	6,357
Silver							3,310	264
Sculpin			15	1				
Sea bass, white, or squeteague			1,010,622	60,637	12,191	917	597	41
Smelt					19,916	1,183	30,000	2,400
Swordfish			590	12				
Yellowtail			70	2				
Other fish			11,639	352				
Total	106,500	11,715	3,168,977	202,764	37,230	2,254	129,109	9,534

Species	Orange		Sacramento		San Diego		San Francisco	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda	8,831	$619			58,600	$3,797		
Bonito and skipjack					266,000	13,300		
Carp, German			3,000	$90				
Flounders							20,182	$605
Grayfish					52,500	1,100	5,010	100
Hardhead			5,000	325				
Mackerel	30,383	912			2,000	60		
Perch	912	46					45,944	1,378
Pike, Sacramento							487	15
Pilchard or sardines					6,000	60		
Rock bass	325	20			2,100	126		
Rockfishes					200	12		
Salmon: Chinook			150,000	18,000				
Sculpin					100	3		
Sea bass, white, or squeteague	26,054	1,568			321,200	19,252	27,927	2,512
Shad			47,438	1,664			31,633	950
Smelt					300	21		
Striped bass			8,317	1,247			166,761	25,014
Whitefish					40	2		
Total	66,505	3,165	213,755	21,326	709,040	37,733	297,944	30,574

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY GILL NETS—Continued

Species	San Joaquin		San Luis Obispo		Santa Barbara		Santa Cruz	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda					95,192	$8,567		
Bonito and skipjack					6,200	373		
Herring			510	$10			1,000	$20
Perch			270	10			3,498	105
Salmon:								
Chinook	238,637	$21,477					45,464	2,868
Silver							1,894	120
Sea bass, white, or squeteague			1,840	180	42,089	4,208	44,016	3,521
Shad	84,667	3,269						
Smelt			62,700	3,762			35,263	2,821
Striped bass	83,895	12,584						
Yellowtail					5,100	102		
Other fish					5,100	200		
Total	407,199	37,330	65,320	3,962	153,681	13,450	131,135	9,455

Species	Solano		Yolo		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Barracuda					1,984,032	$140,481
Bonito and skipjack					357,488	17,937
Carp, German	4,207	$125			42,663	1,278
Catfish					243	9
Flounders	805	44	1,514	$46	24,910	767
Flying fish					7,915	160
Grayfish					58,070	1,211
Halfmoon					8,000	240
Hardhead					5,000	325
Herring					31,510	630
Kingfish					26,303	526
Mackerel					182,616	5,479
Mullet					106,500	11,715
Perch					107,549	3,967
Pike, Sacramento					4,736	142
Pilchard or sardines					6,000	60
Pompano					8,800	2,640
Rock bass					3,972	239
Rockfishes					746	44
Salmon:						
Chinook	287,262	25,852	5,056	758	2,608,517	216,987
Silver					24,492	1,734
Sculpin					115	4
Sea bass, white, or squeteague					1,486,536	92,836
Shad	137,969	7,278	25,471	1,284	1,127,213	55,192
Smelt					158,962	11,049
Splittail					1,214	35
Steelhead trout					2,490	174
Striped bass	67,468	9,444	3,446	517	671,679	61,710
Swordfish					590	12
Whitefish					40	2
Yellowtail					5,170	104
Other fish	373	11			18,199	596
Total	498,084	42,754	35,487	2,605	9,072,270	628,285

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY LAMPARA NETS

Species	Los Angeles		Monterey		Orange		San Diego	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies	364,797	$7,295	136,433	$2,728			500	$10
Barracuda	215,890	15,095	13,031	912			264,800	18,536
Bonito and skipjack	1,177,914	58,895					500,000	25,000
Flounders	8,267	826					20	3
Halfmoon	42	2						
Kingfish	185,540	3,711	153,019	3,060			5,400	102
"Lingcod"			50,000	3,000				
Mackerel	523,467	15,702	337,137	10,115	578	$16	58,000	1,740
Perch	1,527	76						
Pilchard or sardines	17,451,846	174,521	44,676,589	893,531			452,000	4,520
Pompano	3,224	967	448	134				
Rock bass	39,512	2,330			633	37		
Sablefish			3,879	116				
Sea bass, black, or jewfish	4,409	265						
Sea bass, white, or squeteague	400,215	24,013	15,135	605	1,646	100		
Smelt	149,588	10,535					20,200	1,084
Sole	75,629	3,781	62,745	1,882			1,000	50
Whitefish	19,919	995						
Yellowtail	369,069	7,381			244	5	729,600	14,592
Other fish	10,462	315	8,475	254				
Squid	20,050	1,000	124,103	4,964			30,500	1,525
Total	21,021,367	327,705	45,580,994	921,301	3,101	158	2,062,020	67,162

Species	San Francisco		Santa Cruz		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies	150,786	$3,016			652,516	$13,049
Barracuda			517	$36	494,238	34,579
Bonito and skipjack					1,677,914	83,895
Flounders					8,287	829
Hake			10,550	211	10,550	211
Halfmoon					42	2
Herring	250,887	5,018			250,887	5,018
Kingfish	1,609	32	31,486	629	377,054	7,534
"Lingcod"			25,360	1,521	75,360	4,521
Mackerel					919,182	27,573
Perch					1,527	76
Pilchard or sardines	168,175	3,364	1,990	40	62,750,600	1,075,976
Pompano	309	90	33	10	4,014	1,201
Rock bass					40,145	2,367
Sablefish			53,018	1,590	56,897	1,706
Sea bass, black, or jewfish					4,409	265
Sea bass, white, or squeteague					416,996	24,718
Smelt	81,371	6,510			251,159	18,129
Sole			211,382	6,341	350,756	12,054
Tomcod	25,544	1,022	265	7	25,809	1,029
Whitebait	63,001	7,560			63,001	7,560
Whitefish					19,919	995
Yellowtail					1,098,913	21,978
Other fish			19,734	592	38,671	1,161
Squid					174,653	7,489
Total	741,682	26,612	354,335	10,977	69,763,499	1,353,915

BY TRAMMEL NETS

Species	Los Angeles		Monterey		Orange		San Diego	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders	1,403,358	$196,316	26,550	$1,894	87,741	$12,280	314,520	$44,033
Grayfish							35,000	700
Halfmoon	7,353	220						
Perch	4,802	240					1,600	80
Rock bass							64,000	3,200
Rockfishes							340	21
Sole	140	7						
Whitefish							1,300	65
Total	1,415,653	196,783	26,550	1,894	87,741	12,280	416,760	48,099

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY TRAMMEL NETS—Continued

Species	Santa Barbara		Santa Cruz		San Luis Obispo		Ventura		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders	360,895	$50,506	73,191	$2,338	38,320	$5,364	4,360	$612	2,308,935	$313,343
Grayfish									35,000	700
Halfmoon									7,353	220
Perch									6,402	320
Rock bass									64,000	3,200
Rockfishes									340	21
Sole	26,700	1,335			10,600	530	130	15	37,430	1,880
Whitefish									1,300	65
Total	387,595	51,841	73,191	2,338	48,920	5,894	4,490	627	2,460,900	319,756

BY FYKE NETS

Species	Sacramento		San Joaquin		Yolo		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp, German	4,000	$120	3,102	$93	1,131	$34	8,233	$247
Catfish	7,118	996					7,118	996
Hardhead	10,000	650					10,000	650
Pike, Sacramento	1,466	50	1,015	30			2,481	80
Splittail	7,587	227	1,607	48			9,194	275
Total	30,171	2,043	5,724	171	1,131	34	37,026	2,248

BY BAG NETS

Species	Alameda		Marin		San Francisco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Herring	40,345	$807					40,345	$807
Shrimp	44,124	4,412	126,950	$12,695	729,275	$72,927	900,349	90,034
Total	84,469	5,219	126,950	12,695	729,275	72,927	940,694	90,841

BY DIP NETS

Species	Humboldt	
	Pounds	*Value*
Perch	24,000	$960

BY LINES

Species	Alameda		Contra Costa		Del Norte		Humboldt	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders	1,500	$45			707	$64	47,309	$4,258
Grayfish	600	12						
Kingfish	25	1						
"Lingcod"					3,645	182	12,060	603
Rockfishes					9,132	457	10,010	500
Salmon:								
Chinook	7,000	630	25,000	$2,250	2,478	174	875,246	70,020
Silver							36,468	2,917
Sea bass, white, or squeteague					133	11		
Smelt	4,000	320						
Sole							166	10
Striped bass	3,454	483						
Other fish							2,768	138
Total	16,579	1,491	25,000	2,250	16,095	888	984,027	78,446

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY LINES—Continued

Species	Los Angeles		Marin		Mendocino		Monterey	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna	12,784,037	$684,259					236	$11
Barracuda	211,376	14,796						
Bonito and skipjack	1,706,712	85,336					2,106	105
Flounders	11,477	346	1,118	$90	37,148	$3,714		
Halfmoon	12,396	370						
Kingfish	15,000	300					75,000	1,500
"Lingcod"					6,873	344	35,526	2,132
Mackerel	660,547	19,816					200,000	6,000
Perch							5,000	150
Pompano	736	220						
Rock bass	76,618	4,597						
Rockfishes	975,880	58,524	183	14	1,485	74	1,261,424	47,143
Salmon:								
Chinook			230,108	23,010	1,456,090	101,926	384,000	30,720
Silver					60,670	4,247	16,000	1,280
Sculpin	37,421	748						
Sea bass, black, or jewfish	33,582	1,819						
Sea bass, white, or squeteague	64,046	3,841	7,000	420			30,000	1,200
Sheepshead	1,183	12						
Skates	2,958	59					908	18
Sole	15,889	795						
Striped bass			3,417	512				
Swordfish	20,143	403						
Whitefish	5,025	251						
Yellowtail	501,043	10,021						
Other fish	12,000	360						
Octopus	5,981	235						
Total	17,154,050	887,108	241,826	24,046	1,562,266	110,305	2,010,200	90,259

Species	Orange		San Diego		San Francisco		Santa Barbara		Santa Cruz	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna	18,082	$1,085	446,140	$25,542			2,065	$150		
Barracuda	602	40	628,000	43,960	81	$8				
Bonito and skipjack	60	4	1,105,300	55,265			5,000	300	24,649	$1,232
Flounders	325	45			12,389	906				
Grayfish			101,400	2,028	30,000	600				
Kingfish			4,000	80			290	6	50,000	1,000
"Lingcod"			1,130	50	170,997	10,260			14,000	840
Mackerel	672	20	50,700	1,536			10,000	500	12,346	370
Mullet			22,000	2,420						
Perch	246	12	100	5					3,000	90
Rock bass	5,528	335	51,100	3,066			1,185	70		
Rockfishes	15,990	960	236,672	14,200	457,639	21,650	23,520	1,410	512,823	20,758
Sablefish					136,255	4,088				
Salmon:										
Chinook					722,890	65,060			336,000	26,880
Silver									14,000	1,120
Sculpin	20	1	5,700	115						
Sea bass, black, or jewfish	287	18	2,100	80			352	55		
Sea bass, white, or squeteague	2,175	141	3,000	180					4,201	168
Sheepshead			16,000	160						
Skates	719	15			50	1	2,500	50	3,100	62
Sole	3,170	160	5,100	250	35,516	1,065				
Swordfish			1,700	34						
Whitefish			1,100	55			390	20		
Yellowtail	1,017	20	501,000	10,020			15,000	300		
Other fish	1,756	81	11,020	331	4,232	169				
Total	50,649	2,937	3,193,262	159,377	1,570,049	103,807	60.302	2,861	974,119	52,520

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY LINES—Continued

Species	San Luis Obispo		Solano		Sonoma		Ventura		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore and tuna									13, 250, 560	$711, 047
Barracuda	4, 200	$378					4, 700	$423	848, 959	59, 605
Bonito and skipjack							590	35	2, 844, 417	142, 277
Flounders									111, 973	9, 468
Grayfish									132, 000	2, 640
Halfmoon									12, 396	370
Kingfish									144, 315	2, 887
"Lingcod"	15	1			596	$30			244, 842	14, 442
Mackerel	180	9							934, 445	28, 251
Mullet									22, 000	2, 420
Perch									8, 346	257
Pompano									736	220
Rock bass									134, 431	8, 068
Rockfishes	72, 750	4, 366			2, 245	112	2, 530	152	3, 582, 283	170, 320
Sablefish									136, 255	4, 088
Salmon:										
Chinook	30	5	5, 000	$450	100, 000	7, 000			4, 143, 842	328, 125
Silver									127, 138	9, 564
Sculpin									43, 141	864
Sea bass, black, or jewfish									36, 321	1, 972
Sea bass, white, or squeteague									110, 555	5, 961
Sheepshead							25	1	17, 208	173
Skates									10, 235	205
Smelt									4, 000	320
Sole									59, 841	2, 280
Striped bass									6, 871	995
Swordfish									21, 843	437
Whitefish									6, 515	326
Yellowtail							270	6	1, 018, 330	20, 367
Other fish	800	32					15, 000	450	47, 576	1, 561
Octopus									5, 981	235
Total	77, 975	4, 791	5, 000	450	102, 841	7, 142	23, 115	1, 067	28, 067, 355	1, 529, 745

BY LOBSTER POTS AND ABALONE OUTFITS

Species	Los Angeles		Monterey		Orange		San Diego	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Spiny lobsters	134, 615	$10, 964			17, 504	$2, 107	187, 883	$15, 376
Abalone			379, 978	$15, 199				

Species	San Luis Obispo		Santa Barbara		Ventura		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Spiny lobsters			58, 000	$11, 600	6, 350	$1, 270	404, 352	$41, 317
Abalone	18, 400	$736					398, 378	15, 935

BY TONGS, FORKS, RAKES, HOES, AND BY HAND

Species	Alameda		Contra Costa		Humboldt		Los Angeles	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Clams, hard					20, 242	$1, 013	2, 290	$160
Clams, soft	14, 575	$874	184, 737	$9, 236	2, 516	125		
Cockles							162	16
Mussels	2, 724	109						
Total	17, 299	983	184, 737	9, 236	22, 758	1, 138	2, 452	176

Yield of the shore fisheries of California in 1922, by counties, species, and apparatus—Continued

BY TONGS, FORKS, RAKES, HOES, AND BY HAND—Continued

Species	Marin		Orange		San Diego		San Francisco		Santa Cruz	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Abalone					200	$10				
Clams, hard	10,200	$1,020							1,385	$83
Clams, soft	80,890	8,956					54,808	$2,740		
Mussels			897	$89			9,256	370		
Oysters, eastern, market	94,598	101,351								
Total	185,688	111,327	897	89	200	10	64,064	3,110	1,385	83

Species	San Luis Obispo		Santa Barbara		Sonoma		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Abalone							200	$10
Clams, hard					50	$3	34,167	2,279
Clams, Pismo	191,880	$9,594	100	$5			191,980	9,599
Clams, soft					3,621	181	341,147	22,112
Cockles					698	35	860	51
Mussels	150	5					13,027	573
Oysters, eastern, market							94,598	101,351
Total	192,030	9,599	100	5	4,369	219	675,979	135,975

BY MISCELLANEOUS APPARATUS

Species	Alameda		Del Norte		Humboldt		Marin		Monterey	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	1,804	$250	15,862	$721	115,236	$5,238	27,500	$3,750	44	$3
Octopus			83	4					66,802	2,004
Total	1,804	250	15,945	725	115,236	5,238	27,500	3,750	66,846	2,007

Species	San Francisco		Santa Cruz		Sonoma		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs	664,992	$55,416	2,222	$250	12,804	$582	840,464	$66,210
Octopus	8,022	401	14,796	591			89,703	3,000
Total	673,014	55,817	17,018	841	12,804	582	930,167	69,210

CANNING INDUSTRY

In 1922 there were 36 canning establishments in California. These employed 3,370 persons, paid wages amounting to $1,562,469, had an investment of $5,562,594, and produced a quantity of canned fishery products equal to 1,068,727 cases of forty-eight 1-pound cans each, valued at $8,119,109. The sardine was the most important species canned, having a production in this year equal to 715,359 cases, each containing forty-eight 1-pound cans, and valued at $3,361,480. The group of tuna and tunalike fishes, consisting of albacore, yellowfin tuna, bluefin tuna, striped tuna or skipjack, bonito, and yellowtail, produced a total pack exceeding that of sardines in value though not in quantity. It amounted to a quantity equal to 336,141 cases of forty-eight 1-pound cans each, valued at $4,511,873. The pack of canned salmon amounted to 11,831 cases of forty-eight 1-pound cans, valued at $196,310, and the pack of miscellaneous fishery products amounted to 5,396 cases of forty-eight 1-pound cans, valued at $49,446.

The following table gives the statistics of the canning industry of California in 1922:

Canning industry of California in 1922

Items	Number	Number	Value
Establishments	36		$5,071,744
Cash capital			490,850
Persons engaged	3,370		
Wages paid			1,562,469
PRODUCTS			
	Cases as packed	*Standard cases* [1]	*Value*
Salmon, chinook:			
½-lb. flat (48 to case)	15,338	7,669	138,042
1-lb. flat (48 to case)	4,162	4,162	58,268
Total		11,831	196,310
Sardines:			
In oil—			
¼-lb. square (100 to case)	21,086	10,982	217,763
½-lb. square (100 to case)	2,413	2,514	28,952
½-lb. oval (48 to case)	376	188	4,512
1-lb. oval (48 to case)	650	650	2,600
In mustard—			
1-lb. oval (48 to case)	53,993	53,993	295,111
In tomato sauce—			
¼-lb. square (100 to case)	38	20	190
½-lb. square (100 to case)	482	502	3,401
½-lb. oval (48 to case)	4,296	2,148	14,835
1-lb. oval (48 to case)	601,111	601,111	2,518,843
1-lb. tall (48 to case)	78	78	232
All others—			
½-lb. oval (48 to case)	2,567	1,284	12,835
1-lb. oval (48 to case)	41,889	41,889	262,206
Total		715,359	3,361,480
Albacore:			
¼-lb. round (48 to case)	24,962	6,240	126,139
¼-lb. round (100 to case)	14,820	7,719	222,300
½-lb. round (48 to case)	188,235	94,118	1,368,883
½-lb. round (50 to case)	9,436	4,914	108,514
1-lb. round (48 to case)	34,475	34,475	466,399
4-lb. tall (12 to case)	635	635	12,700
Total		148,101	2,304,935
Tuna, bluefin and yellowfin:			
¼-lb. round (48 to case)	37,537	9,384	154,757
¼-lb. round (100 to case)	2,390	1,245	24,083
Tuna, bluefin and yellowfin—Con.			
½-lb. round (48 to case)	101,737	50,868	$613,344
1-lb. round (48 to case)	22,926	22,926	255,437
Total		84,423	1,047,621
Tuna, striped:			
¼-lb. round (48 to case)	34,772	8,693	126,678
¼-lb. round (100 to case)	3,162	1,647	33,690
½-lb. round (48 to case)	122,310	61,155	622,565
1-lb. round (48 to case)	17,502	17,502	159,423
Total		88,997	942,356
"Tonno:"			
¼-b. round (48 to case)	21,221	5,305	110,919
¼-lb. round (100 to case)	1,467	764	14,670
½-lb. round (48 to case)	1,575	788	13,478
Total		6,857	139,067
Bonito:			
¼-lb. round (100 to case)	5,223	2,720	34,879
½-lb. round (48 to case)	5,368	2,684	24,021
Total		5,404	58,900
Yellowtail:			
½-lb. round (48 to case)	4,088	2,044	17,104
1-lb. tall (48 to case)	315	315	1,890
Total		2,359	18,994
Miscellaneous: [2]			
¼-lb. round (48 to case)	1,336	334	4,866
½-lb. round (48 to case)	2,474	1,237	11,716
½-lb. flat (48 to case)	220	110	5,280
1-lb. round (48 to case)	219	219	1,861
1-lb. oval (48 to case)	205	205	1,640
1-lb. tall (48 to case)	3,291	3,291	24,085
Total		5,396	49,446
Grand total		1,068,727	8,119,109

[1] Cases shown in this column have been reduced to the standard basis of forty-eight 1-pound cans.
[2] Includes fish flakes, abalone, mackerel, squid, shad, and shad roe.

WHOLESALE FISH TRADE

The wholesale fish trade of California in 1922 was conducted in 60 establishments valued at $1,023,904 and employing $195,074 cash capital and 456 persons, who received wages totaling $487,115.

The following table gives the detailed statistics of the wholesale fish trade of California in 1922:

Investment, persons engaged, and wages paid in the wholesale fish trade of California in 1922

Localities	Establishments		Cash capital	Persons engaged	Wages paid
	Number	*Value*			
San Francisco	11	$47,730	$30,000	64	$64,417
Oakland	4	69,950	30,700	31	54,550
San Pedro	11	501,209	28,014	68	80,208
San Diego	8	121,293	29,860	118	99,023
Los Angeles	8	136,682	38,000	88	127,265
Monterey	3	22,740	3,000	12	6,240
Sacramento and Pittsburg	3	46,500	8,500	19	8,860
Miscellaneous localities	12	77,800	27,000	56	46,552
Total	60	1,023,904	195,074	456	487,115

FISHERIES OF THE PACIFIC COAST STATES, 1923

Realizing the value, both to the conservationist and to the fish trade, of annual statistics on our fisheries, the general canvass of the Pacific Coast States for 1922 was followed by a similar though less detailed canvass for 1923. This was done in part to determine the feasibility of taking annual statistics with the limited personnel and funds available for this purpose. The Pacific Coast States were particularly favorable for such a trial, for a certain amount of statistics on the fisheries are collected annually by the State organizations responsible for the administration of the fisheries of those States. In California statistics were available on the number and type of fishing boats and vessels, number of fishermen, and the catch of each species by counties or by groups of counties. In Washington and Oregon statistics were available on the number of fishermen and the catch of certain fishes in Territorial waters. The statistics given herein are the available State statistics, supplemented and made uniform in character and scope by canvassing the industry for the necessary additional information.

In 1922 the total number of fishermen in the Pacific Coast States was 14,223, the number of fishing vessels 555, the number of boats 5,741, and the total catch 409,885,597 pounds, valued at $18,914,976. The following table gives the detailed statistics, by States, of the Pacific Coast States in 1923:

Fisheries of the Pacific Coast States, 1923

Items	Washington		Oregon		California		Total	
Vessel fishery:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Fishermen	1,945		15		1,972		3,932	
Vessels	267		3		285		555	
Tonnage	6,980		44		4,071		11,095	
Shore fishery:								
Fishermen	3,454		4,230		2,625		10,309	
Power boats	1,751		2,042		1,307		5,100	
Sail and row boats	289		233		135		657	
FISH	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore					12,514,833	$1,627,193	12,514,833	$1,627,193
Anchovies					307,074	19,292	307,074	19,292
Barracuda					7,200,575	575,285	7,200,575	575,285
Bonito					1,115,247	47,310	1,115,247	47,310
Carp	383,705	$11,511			148,607	2,972	532,312	14,483

Fisheries of the Pacific Coast States, 1923—Continued

Items	Washington		Oregon		California		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
FISH—continued								
Catfish	1,230	$62			129,286	$23,271	130,516	$23,333
Cod, fresh	162,642	7,167					162,642	7,167
Cod, salted	3,680,711	184,036			1,398,000	69,900	5,078,711	253,936
Eels					18,249	548	18,249	548
Dolly Varden trout	69	3					69	3
Flounders	195,600	4,092	5,000	$150	4,282,659	459,840	4,483,259	464,082
Grayfish	59,400	85			360,363	1,802	419,763	1,887
Hake					78,969	789	78,969	789
Halibut	24,151,374	3,183,820	864,166	136,056			25,015,540	3,319,876
Hardhead					9,563	96	9,563	96
Herring	425,389	4,254	93,750	1,876	383,950	3,994	903,089	10,124
Kingfish					411,564	10,301	411,564	10,301
"Lingcod"	223,088	5,292	77,500	2,325	467,357	23,369	767,945	30,986
Mackerel	20	1			3,592,446	144,082	3,592,466	144,083
Mullet					74,225	8,065	74,225	8,065
Perch	53,743	2,224	15,000	750	359,682	19,682	428,425	22,656
Pike, Sacramento					4,624	92	4,624	92
Pilchard or sardine					159,197,006	704,280	159,197,006	704,280
Pompano					32,918	13,298	32,918	13,298
Rock bass					357,269	30,301	357,269	30,301
Rockfishes	192,997	4,625	62,510	1,875	4,950,244	250,314	5,205,751	256,814
Sablefish	2,226,480	112,074	250,000	12,500	538,292	32,297	3,014,772	156,871
Salmon	71,720,053	3,512,467	27,278,859	3,057,937	7,090,260	638,122	106,089,172	7,208,526
Sculpin					60,466	6,046	60,466	6,046
Sea bass, black					226,995	22,168	226,995	22,168
Sea bass, white, or squeteague	532	13			2,520,263	224,869	2,520,795	224,882
Shad	88,767	2,710	403,859	6,072	1,285,383	58,088	1,778,009	66,870
Sheepshead					31,628	639	31,628	639
Skates	7,210	74			133,988	717	141,198	791
Skipjack or striped tuna					11,462,522	298,085	11,462,522	298,085
Smelt	1,178,551	28,623	277,195	2,771	806,380	24,149	2,262,126	55,543
Sole	119,904	3,637			7,086,035	286,631	7,205,939	290,268
Splittail					13,956	140	13,956	140
Steelhead trout	1,400,973	100,902	2,855,543	200,181	3,011	422	4,259,527	301,505
Striped bass					909,573	90,957	909,573	90,957
Sturgeon	84,057	6,798	124,121	9,928			208,178	16,726
Suckers					342	3	342	3
Swordfish					11,691	1,468	11,691	1,468
Tomcod	784	13	5,000	400	41,767	3,341	47,551	3,754
Tuna, bluefin					3,301,087	165,885	3,301,087	165,885
Tuna, yellowfin					10,836,925	600,412	10,836,925	600,412
Tuna, mixed					662,370	35,471	662,370	35,471
Whitefish					39,908	2,089	39,908	2,089
Yellowtail					3,979,611	217,050	3,979,611	217,050
Other fish					252,012	21,055	252,012	21,055
Total	106,357,279	7,174,483	32,312,503	3,432,821	248,689,175	6,766,180	387,358,957	17,373,484
SHELLFISH								
Crabs	1,145,540	54,384	359,283	47,737	1,075,800	148,459	2,580,623	250,580
Crawfish			141,800	12,000			141,800	12,000
Spiny lobster					1,092,858	225,656	1,092,858	225,656
Shrimp	34,657	4,504			1,113,358	66,801	1,148,015	71,305
Clams:								
Cockle					36,117	3,973	36,117	3,973
Hard	598,685	17,276					598,685	17,276
Mixed					25,845	2,076	25,845	2,076
Pismo					237,948	16,656	237,948	16,656
Razor	983,900	44,275	137,305	6,180			1,121,205	50,455
Soft			31,716	1,429	283,095	11,323	314,811	12,752
Mussels					60,026	3,002	60,026	3,002
Oysters, eastern, market					9,600	3,360	9,600	3,360
Oysters, native, market	2,739,960	267,000	19,200	16,800			2,759,160	283,800
Abalone					1,587,733	60,367	1,587,733	60,367
Octopus	52,377	1,573	71	4	110,222	11,022	162,670	12,599
Squid					1,180,446	7,680	1,180,446	7,680
Terrapin					1,270	77	1,270	77
Total	5,555,119	389,012	689,375	84,150	6,814,318	560,452	13,058,812	1,033,614
WHALE PRODUCTS								
Sperm oil	347,250	18,500			15,585	1,282	362,835	19,782
Whale oil	1,375,500	91,500			4,644,293	316,450	6,019,793	407,950
Other products	744,000	18,510			2,370,000	81,796	3,114,000	100,306
Total	2,466,750	128,510			7,029,878	399,528	9,496,628	528,038
Grand total	114,379,148	7,692,005	33,001,878	3,516,971	262,533,371	7,726,160	409,914,397	18,935,136

WASHINGTON

In 1923 the fisheries of Washington employed 5,399 fishermen, 267 fishing vessels, 1,751 power boats, 289 rowboats, sink floats, and scows, and yielded 114,379,148 pounds of fishery products, valued at $7,692,005.

The vessel fishery was carried on largely with gas vessels, all of the 267 mentioned above being of this type with the exception of 3 steamers at Grays Harbor engaged in whaling, 1 steamer and 2 schooners in King County in the line fishery, and 3 schooners in Skagit County also engaged in the line fishery. The total number of fishermen on vessels was 1,945, and the yield of vessels amounted to 56,323,616 pounds, valued at $4,358,928. The shore and boat fisheries employed 3,454 fishermen and yielded 58,055,532 pounds, valued at $3,333,077.

The following tables give the number, crew, and tonnage of fishing vessels, by apparatus employed and counties; the number of power and other boats employed in the shore or boat fisheries, by fishing apparatus and counties; the number of fishermen in the shore and boat fisheries, by counties; the yield of the vessel fisheries, by counties; the yield of the shore or boat fisheries, by counties; and the total yield of the fisheries of Washington, by counties.

Vessels engaged in the fisheries of Washington in 1923, by apparatus and persons

Fishery	Grays Harbor County			Island County			Jefferson County			King County		
	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage
	Number	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*
Lines							2	6	13	134	924	3,335
Purse seines	2	14	48	1	7	10	1	8	16	29	197	577
Haul seines				1	7	10				2	13	34
Beam trawls										1	7	20
Drag bag nets										3	18	45
Whaling apparatus	3	30	195									
Total [1]	5	44	243	1	7	10	3	14	29	158	1,095	3,842

Fishery	Kitsap County			Pierce County			San Juan County			Skagit County		
	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage
	Number	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*
Lines	9	53	111	6	29	81				4	109	921
Purse seines	20	128	300	30	227	681	1	5	10	7	57	170
Haul seines	5	33	77									
Beam trawls	2	12	34									
Drag bag nets	1	7	17									
Crab traps										1	8	25
Total [1]	22	138	317	36	256	762	1	5	10	11	166	1,091

[1] Exclusive of duplication.

Vessels engaged in the fisheries of Washington in 1923, by apparatus and persons—Continued

Fishery	Snohomish County			Whatcom County			Total		
	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage
	Number	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*
Lines							155	1,121	4,461
Purse seines	12	89	256	18	131	420	121	863	2,488
Haul seines				3	21	69	11	74	190
Beam trawls							3	19	54
Drag bag nets							4	25	62
Whaling apparatus							3	30	195
Crab traps	2	14	25	1	8	18	4	30	68
Total [1]	12	89	256	18	131	420	267	1,945	6,980

Boats (by apparatus) and persons engaged in the shore fisheries of Washington in 1923, by counties

Boats, by apparatus	Asotin	Benton	Clallam	Clarke	Cowlitz	Garfield	Grant	Grays Harbor	Island
Gill nets, drift: Gas			1	43	53			62	
Gill nets, set:									
Gas			3	7	21			57	
Row								57	
Haul seines: Gas	3		1	3		1	1		10
Pound nets: Gas					11			17	1
Lines: Gas		1	139	3	1			28	74
Drag bag nets: Gas			1	1	4				5
Dip bag nets: Gas				2	45				
Beam trawl: Gas									1
Ring nets: Gas								8	
Crab traps: Gas			4						3
Total: [1]									
Gas	3	1	147	57	134	1	1	169	88
Row, sink floats, and scows								57	
Persons engaged	8	1	243	85	140	2	4	684	148

Boats, by apparatus	Jefferson	Kitsap	King	Klickitat	Mason	Okanogan	Pacific	Pierce	San Juan
Gill nets, drift: Gas		2	15	2			83	5	1
Gill nets, set:									
Gas		1	2	4			17		
Row							6		
Haul seines:									
Gas	2	20	7		6		5	4	
Row							4		
Pound nets: Gas	1		8	5			59		3
Lines: Gas	27	48	102	5	1	1	64	35	36
Drag bag nets: Gas		1			1		1		
Dip bag nets: Gas		7			3				1
Reef nets: Gas									5
Beam trawl: Gas		4	7		1			2	
Fish wheels: Gas				2			1		
Brush wier: Gas			1						
Ring nets: Gas		1	8				19		
Crab traps: Gas	1						13	1	
Clam hoes, shovels, and forks: Gas		6	1					2	
Oyster forks, rakes, and baskets:									
Gas					3				
Row, sink floats, and scows					42				
Total: [1]									
Gas	31	86	129	15	15	1	246	48	45
Row, sink floats, and scows					42		10		
Persons engaged	81	179	222	21	42	1	534	79	69

[1] Exclusive of duplication.

Boats (by apparatus) and persons engaged in the shore fisheries of Washington in 1923, by counties—Continued

Boats, by apparatus	Skagit	Skamania	Snohomish	Thurston	Wahkiakum	Walla Walla	Whatcom	Whitman	Total
Gill nets, drift: Gas	85	1	12		162				527
Gill nets, set:									
Gas	1	6			7		1		127
Row		2							65
Haul seines:									
Gas	6	1	8	7	4		2	3	94
Row					2				6
Pound nets: Gas	13	2			21		35		176
Lines: Gas	45	2	45	6	2	3	30		698
Drag bag nets: Gas	3		1						18
Dip bag nets: Gas	1		2	5			1		67
Reef nets: Gas									5
Beam trawl: Gas	1		1	1					18
Fish wheels: Gas									3
Brush wier: Gas							1		2
Ring nets: Gas									36
Crab traps: Gas	25		10				8		65
Clam hoes, shovels, and forks: Gas									9
Oyster forks, rakes, and baskets:									
Gas	2			14					19
Row, sink floats, and scows	8			168					218
Total:[1]									
Gas	146	12	75	31	184	3	80	3	1,751
Row, sink floats, and scows	8	2		168	2				289
Persons engaged	217	17	90	113	293	3	172	6	3,454

[1] Exclusive of duplication.

Yield of the fisheries of Washington in 1923, by counties and species

Species	Asotin		Benton		Clallam		Clarke	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp							190,080	$5,702
Cod, fresh					463	$14		
Dolly Varden trout					38	1		
Halibut					500,220	62,535		
"Lingcod"					62	1		
Salmon:								
Blueback or sockeye	4,000	$540					84,324	11,385
Chinook	8,609	1,205			651,498	66,638	307,636	43,198
Chum					4,602	116	13,841	139
Silver					765,901	34,225	61,436	3,073
Shad							31,414	471
Smelt					6,802	544	9,700	97
Steelhead trout	19,592	1,371			2,080	187	58,484	4,095
Sturgeon	218	17	330	$26			8,682	694
Crabs					57,134	2,857		
Octopus					42,064	1,262		
Total	32,419	3,133	330	26	2,030,864	168,380	765,597	68,854

Species	Cowlitz		Garfield		Grant		Grays Harbor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					193,625	$5,809		
Salmon:								
Blueback or sockeye	225,009	$30,376	1,596	$215			15,249	$2,110
Chinook	435,622	60,847	360	32			1,148,761	58,632
Chum	148,823	1,489					1,527,843	23,852
Humpback							1,138,693	79,188
Silver	172,910	8,648	2,880	144			1,237,488	37,399
Shad	5,385	81					189	3
Smelt	901,495	9,014						
Steelhead trout	144,345	10,105					6,499	608
Sturgeon	7,206	574					7,727	605
Crabs							64,724	3,136
Clams, razor							639,138	28,762
Sperm oil							347,250	18,500
Whale oil							1,375,500	91,500
Other whale products							744,000	18,510
Total	2,040,795	121,134	4,836	391	193,625	5,809	8,253,061	362,805

Yield of the fisheries of Washington in 1923, by counties and species—Continued

Species	Island		Jefferson		King		Kitsap	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish					1,230	$62		
Cod, fresh	918	$27			156,434	6,993	2,747	$71
Cod, salted					1,356,711	67,836		
Dolly Varden trout	16	1					15	1
Flounders	6,097	124			48,595	976	18,174	537
Grayfish	53,400	70			6,000	15		
Halibut	48	7	1,000	$123	22,311,314	2,942,670	210,139	31,062
Herring	4,961	50			176,668	1,767	108,930	1,089
"Lingcod"	430	9			212,166	5,072	1,795	36
Mackerel	20	1						
Perch	6,360	254			9,406	419	14,704	621
Rockfish	7,584	153			166,682	4,094	6,721	135
Sablefish					2,174,980	109,364	4,500	360
Salmon:								
Blueback or sockeye	822	116	19,348	2,755	232,755	32,686	112,760	15,811
Chinook	328,286	33,590	188,374	19,363	1,771,774	167,290	371,054	37,292
Chum	18,344	440	23,762	573	2,052,148	47,097	700,160	17,199
Humpback	85,590	2,682	251,720	8,390	9,805,955	155,872	1,997,868	63,344
Silver	279,804	12,725	207,133	9,770	2,654,261	89,955	731,014	26,867
Sea bass, white, or squeteague	161	4			6	1		
Shad					69	3		
Skates	295	3			5,240	52	145	3
Smelt	55,933	2,722	3,565	285	1,495	120	49,156	3,858
Sole	4,524	136			44,583	1,377	49,563	1,487
Steelhead trout			48	4	28,328	2,547	64	6
Sturgeon					1,920	185	1,165	105
Tomcod							510	10
Crabs	35,420	1,769	1,386	69	62,942	3,147	9,658	483
Shrimp							13,142	1,708
Clams, hard	18,860	407	65,935	1,318	30,230	1,209	404,100	11,221
Clams, razor			54,425	2,449				
Octopus	189	6	3,890	117	1,781	53	1,589	48
Total	908,062	55,296	820,636	45,216	43,313,673	3,640,862	4,809,673	213,354

Species	Klickitat		Mason		Okanogan		Pacific	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh			46	$1				
Flounders			115	2				
"Lingcod"			16	1				
Perch			16,810	672			550	$22
Rockfish			941	19				
Salmon:								
Blueback or sockeye	2,937	$406					231,572	31,262
Chinook	27,250	3,097	4,167	427			2,001,173	267,419
Chum	12,919	130					259,099	4,674
Silver	203,328	8,000	4,166	198			1,107,557	52,749
Shad							43,238	1,977
Smelt			25,420	2,017				
Sole			1,240	37				
Steelhead trout	161,005	12,508					454,424	31,815
Sturgeon	7,102	572			720	$58	22,019	1,762
Crabs							213,158	10,648
Shrimp			2,880	374				
Clams, hard			11,569	463				
Clams, razor							287,686	12,945
Oysters			300,000	28,000				
Total	414,541	24,713	367,370	32,211	720	58	4,620,476	415,273

Species	Pierce		San Juan		Skagit		Skamania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh	630	$19	44	$1	1,360	$41		
Cod, salted					2,324,000	116,200		
Flounders	748	15			437	9		
Halibut	1,118,210	145,767	1,200	190	8,492	1,347		
Herring					6,030	60		
"Lingcod"	1,296	26	3,913	78	2,571	51		
Perch	4,091	163						
Rockfish	295	6	9,137	183	1,159	24		
Sablefish	47,000	2,350						
Salmon:								
Blueback or sockeye	310,704	43,438	59,976	8,516	412,350	59,036	9,362	$1.263
Chinook	221,256	22,379	217,226	21,518	1,612,271	146,869	29,723	4,161
Chum	1,336,679	32,203	54,517	1,348	587,690	14,522	12,072	121
Humpback	4,766,248	150,183	258,505	8,616	3,358,766	117,851		
Silver	1,043,282	33,445	312,641	12,148	1,258,753	40,336	14,393	719
Sea bass, white, or squeteague	88	2			277	6		
Shad					220	11	233	3
Skates	500	5			30	1		

Yield of the fisheries of Washington in 1923, by counties and species—Continued

Species	Pierce		San Juan		Skagit		Skamania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Smelt	13,857	$1,075	579	$46	8,717	$698		
Sole	18,300	549			1,650	50		
Steelhead trout	181	14	16	1	22,184	1,995	32,192	$2,253
Sturgeon					4,145	373	4,813	386
Tomcod	274	3						
Crabs	594	30			366,630	18,332		
Shrimp	2,457	319			13,054	1,697		
Clams, hard	57,240	2,290			7,251	290		
Oysters					99,960	5,000		
Octopus	1,250	38	200	6	1,206	37		
Total	8,945,180	434,319	917,954	52,651	10,099,203	524,836	102,788	8,906

Species	Snohomish		Thurston		Wahkiakum		Walla Walla	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders	121,314	$2,427	120	$2				
Herring	200	2						
"Lingcod"	594	13						
Perch	1,822	73						
Rockfish	401	9						
Salmon:								
Blueback or sockeye	95,532	14,245			127,652	$17,324		
Chinook	260,863	25,858	37,503	3,843	1,281,404	179,407		
Chum	612,164	15,322			257,681	2,576		
Humpback	1,694,175	53,508						
Silver	598,088	21,079	37,494	1,781	434,509	21,724	198	$10
Shad					8,019	161		
Skates	1,000	10						
Smelt	4,302	344	87,394	6,992				
Sole	44	1						
Steelhead trout	54	5			451,633	31,612		
Sturgeon					17,380	1,391	475	38
Crabs	77,616	3,881						
Shrimp			3,124	406				
Clams, hard	400	16						
Clams, razor					2,651	119		
Oysters			2,340,000	234,000				
Octopus	208	6						
Total	3,468,777	136,799	2,505,635	247,024	2,580,929	254,314	673	48

Species	Whatcom		Whitman		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					383,705	$11,511
Catfish					1,230	62
Cod, fresh					162,642	7,167
Cod, salted					3,680,711	184,036
Dolly Varden trout					69	3
Flounders					195,600	4,092
Grayfish					59,400	85
Halibut	751	$119			24,151,374	3,183,820
Herring	128,600	1,286			425,389	4,254
"Lingcod"	245	5			223,088	5,292
Mackerel					20	1
Perch					53,743	2,224
Rockfish	77	2			192,997	4,625
Sablefish					2,226,480	112,074
Salmon:						
Blueback or sockeye	1,717,497	242,708	750	$65	3,664,245	514,257
Chinook	2,307,450	210,416	5,164	723	13,217,424	1,374,204
Chum	1,168,741	28,357			8,791,085	190,158
Humpback	9,739,420	320,956			33,096,940	960,590
Silver	1,821,023	58,158	2,100	105	12,950,359	473,258
Sea bass, white, or squeteague					532	13
Shad					88,767	2,710
Skates					7,210	74
Smelt	10,136	811			1,178,551	28,623
Sole					119,904	3,637
Steelhead trout	19,344	1,741	500	35	1,400,973	100,902
Sturgeon			155	12	84,057	6,798
Tomcod					784	13
Crabs	256,278	10,032			1,145,540	54,384
Shrimp					34,657	4,504
Clams, hard	3,100	62			598,685	17,276
Clams, razor					983,900	44,275
Oysters					2,739,960	267,000
Sperm oil					347,250	18,500
Whale oil					1,375,500	91,500
Other whale products					744,000	18,510
Octopus					52,377	1,573
Total	17,172,662	874,653	8,669	940	114,379,148	7,692,005

Yield of the vessel fisheries of Washington in 1923, by counties and species

Species	Grays Harbor		Island		Jefferson		King	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh							149,284	$6,778
Cod, salted							1,356,711	67,836
Flounders							357	11
Halibut					1,000	$123	22,311,314	2,942,670
Herring			4,200	$42			74,820	749
"Lingcod"							207,524	4,979
Perch							6,247	293
Rockfish							164,662	4,054
Sablefish							2,174,980	109,364
Salmon:								
Blueback or sockeye	8,904	$1,253	822	116			195,000	27,325
Chinook	2,360	212	1,980	177	11,400	1,227	20,470	1,864
Chum	97,468	2,069	18,170	436	22,934	552	1,539,695	34,286
Humpback	309,660	10,109	85,510	2,679			3,100,805	99,039
Silver	49,960	1,266	21,856	629	4,200	126	843,849	24,560
Skate							105	1
Smelt							1,495	120
Sole							4,145	164
Steelhead trout							256	21
Sturgeon							380	46
Sperm oil	347,250	18,500						
Whale oil	1,375,500	91,500						
Other whale products	744,000	18,510						
Total	2,935,102	143,419	132,538	4,079	39,534	2,028	32,152,099	3,324,160

Species	Kitsap		Pierce		San Juan		Skagit	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh	1,200	$24						
Cod, salted							2,324,000	$116,200
Flounders	96	2						
Halibut	210,139	31,062	1,118,210	$145,767				
Herring	44,200	442						
"Lingcod"	1,675	34	1,000	20				
Perch	1,420	57						
Rockfish	949	19						
Sablefish	4,500	360	47,000	2,350				
Salmon:								
Blueback or sockeye	110,006	15,420	310,152	43,360			19,950	2,795
Chinook	56,868	5,118	20,860	1,849			1,989	177
Chum	700,160	17,199	1,336,374	32,195	31,414	$770	320,285	7,784
Humpback	1,992,623	63,169	4,764,068	150,110			430,291	13,896
Silver	396,780	11,417	838,616	23,805	2,400	69	126,960	3,689
Smelt	2,644	212						
Sole	34,327	1,030					190	6
Steelhead trout	64	6	181	14			96	7
Crabs							12,760	638
Shrimp	7,063	918						
Total	3,564,714	146,489	8,436,461	399,470	33,814	839	3,236,521	145,192

Species	Snohomish		Whatcom		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod, fresh					150,484	$6,802
Cod, salted					3,680,711	184,036
Flounders					453	13
Halibut					23,640,663	3,119,622
Herring			49,600	$496	172,820	1,729
"Lingcod"					210,199	5,033
Perch					7,667	350
Rockfish					165,611	4,073
Sablefish					2,226,480	112,074
Salmon:						
Blueback or sockeye	87,852	$13,354	100,978	13,162	833,664	116,785
Chinook	25,360	2,270	12,961	1,148	154,248	14,042
Chum	589,193	14,748	844,608	20,254	5,500,301	130,293
Humpback	1,690,430	53,383	1,831,745	57,367	14,205,132	449,752
Silver	326,616	9,434	201,593	5,819	2,812,830	80,814
Skate	1,000	10			1,105	11
Smelt			8,541	683	12,680	1,015
Sole					38,662	1,200
Steelhead trout	54	5	104	9	755	62
Sturgeon					380	46
Crabs	17,578	879	4,620	231	34,958	1,748
Shrimp					7,063	918
Sperm oil					347,250	18,500
Whale oil					1,375,500	91,500
Other whale products					744,000	18,510
Total	2,738,083	94,083	3,054,750	99,169	56,323,616	4,358,928

Yield of the shore fisheries of Washington in 1923, by counties and species

Species	Asotin		Benton		Clallam		Clarke	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp							190,080	$5,702
Cod					463	$14		
Dolly Varden trout					38	1		
Halibut					500,220	62,535		
"Lingcod"					62	1		
Salmon:								
Blueback or sockeye	4,000	$540					84,324	11,385
Chinook	8,609	1,205			651,498	66,638	307,636	43,198
Chum					4,602	116	13,841	139
Silver					765,901	34,225	61,436	3,073
Shad							31,414	471
Smelt					6,802	544	9,700	97
Steelhead trout	19,592	1,371			2,080	187	58,484	4,095
Sturgeon	218	17	330	$26			8,682	694
Crabs					57,134	2,857		
Octopus					42,064	1,262		
Total	32,419	3,133	330	26	2,030,864	168,380	765,597	68,854

Species	Cowlitz		Garfield		Grant		Grays Harbor	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					193,625	$5,809		
Salmon:								
Blueback or sockeye	225,009	$30,376	1,596	$215			6,345	$857
Chinook	435,622	60,847	360	32			1,146,401	58,420
Chum	148,823	1,489					1,430,375	21,783
Humpback							829,033	69,079
Silver	172,910	8,648	2,880	144			1,187,528	36,133
Shad	5,385	81					189	3
Smelt	901,495	9,014						
Steelhead trout	144,345	10,105					6,499	608
Sturgeon	7,206	574					7,727	605
Crabs							64,724	3,136
Clams, razor							639,138	28,762
Total	2,040,795	121,134	4,836	391	193,625	5,809	5,317,959	219,386

Species	Island		Jefferson		King		Kitsap	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish					1,230	$62		
Cod	918	$27			7,150	215	1,547	$47
Dolly Varden trout	16	1					15	1
Flounders	6,097	124			48,238	965	18,078	535
Grayfish	53,400	70			6,000	15		
Halibut	48	7						
Herring	761	8			101,848	1,018	64,730	647
"Lingcod"	430	9			4,642	93	120	2
Mackerel	20	1						
Perch	6,360	254			3,159	126	13,284	564
Rockfish	7,584	153			2,020	40	5,772	116
Salmon:								
Blueback or sockeye			19,398	$2,755	37,755	5,361	2,754	391
Chinook	326,306	33,413	176,974	18,136	1,751,304	165,426	314,186	32,174
Chum	174	4	828	21	512,453	12,811		
Humpback	80	3	251,720	8,390	6,705,150	56,833	5,245	175
Silver	257.948	12,096	202,933	9,644	1,810,412	65,395	334,234	15,450
Sea bass, white or squeteague	161	4			6	1		
Shad					69	3		
Skate	295	3			5,135	51	145	3
Smelt	55,933	2,722	3,565	285			46,512	3,646
Sole	4,524	136			40,438	1,213	15,236	457
Steelhead trout			48	4	28,072	2,526		
Sturgeon					1,540	139	1,165	105
Tomcod							510	10
Crabs	35,420	1,769	1,386	69	62,942	3,147	9,658	483
Shrimp							6,079	790
Clams, hard	18,860	407	65,935	1,318	30,230	1,209	404,100	11,221
Clams, razor			54,425	2,449				
Octopus	189	6	3,890	117	1,781	53	1,589	48
Total	775,524	51,217	781,102	43,188	11,161,574	316,702	1,244,959	66,865

Yield of the shore fisheries of Washington in 1923, by counties and species—Contd.

Species	Klickitat		Mason		Okanogan		Pacific	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod			46	$1				
Flounders			115	2				
"Lingcod"			16	1				
Perch			16,810	672			550	$22
Rockfish			941	19				
Salmon:								
Blueback or sockeye	2,937	$406					231,572	31,262
Chinook	27,250	3,097	4,167	427			2,001,173	267,419
Chum	12,919	130					259,099	4,674
Silver	203,328	8,000	4,166	198			1,107,557	52,749
Shad							43,238	1,977
Smelt			25,420	2,017				
Sole			1,240	37				
Steelhead trout	161,005	12,508					454,424	31,815
Sturgeon	7,102	572			720	$58	22,019	1,762
Crabs							213,158	10,648
Shrimp			2,880	374				
Clams, hard			11,569	463				
Clams, razor							287,686	12,945
Oysters			300,000	28,000				
Total	414,541	24,713	367,370	32,211	720	58	4,620,476	415,273

Species	Pierce		San Juan		Skagit		Skamania	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cod	630	$19	44	$1	1,360	$41		
Flounders	748	15			437	9		
Halibut			1,200	190	8,492	1,347		
Herring					6,030	60		
"Lingcod"	295	6	3,913	78	2,571	51		
Perch	4,091	163						
Rockfish	295	6	9,137	183	1,159	24		
Salmon:								
Blueback or sockeye	552	78	59,976	8,516	392,400	56,241	9,362	$1,263
Chinook	200,396	20,530	217,226	21,518	1,610,282	146,692	29,723	4,161
Chum	305	8	23,103	578	267,405	6,738	12,072	121
Humpback	2,180	73	258,505	8,616	2,928,475	103,955		
Silver	204,666	9,640	310,241	12,079	1,131,793	36,647	14,393	719
Sea bass, white, or squeteague	88	2			277	6		
Shad					220	11	233	3
Skate	500	5			30	1		
Smelt	13,857	1,075	579	46	8,717	698		
Sole	18,300	549			1,460	44		
Steelhead trout			16	1	22,088	1,988	32,192	2,253
Sturgeon					4,145	373	4,813	386
Tomcod	274	3						
Crabs	594	30			353,870	17,694		
Shrimp	2,457	319			13,054	1,697		
Clams, hard	57,240	2,290			7,251	290		
Oysters					99,960	5,000		
Octopus	1,250	38	200	6	1,206	37		
Total	508,719	34,849	884,140	51,812	6,862,682	379,644	102,788	8,906

Species	Snohomish		Thurston		Wahkiakum		Walla Walla	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders	121,314	$2,427	120	$2				
Herring	200	2						
"Lingcod"	594	13						
Perch	1,822	73						
Rockfish	401	9						
Salmon:								
Blueback or sockeye	7,680	891			127,652	$17,324		
Chinook	235,503	23,588	37,503	3,843	1,281,404	179,407		
Chum	22,971	574			257,681	2,576		
Humpback	3,745	125						
Silver	271,472	11,645	37,494	1,781	434,509	21,724	198	$10
Shad					8,019	161		
Smelt	4,302	344	87,394	6,992				
Sole	44	1						
Steelhead trout					451,633	31,612		
Sturgeon					17,380	1,391	475	38
Crabs	60,038	3,002						
Shrimp			3,124	406				
Clams, hard	400	16						
Clams, razor					2,651	119		
Oysters			2,340,000	234,000				
Octopus	208	6						
Total	730,694	42,716	2,505,635	247,024	2,580,929	254,314	673	48

Yield of the shore fisheries of Washington in 1923, by counties and species—Contd.

Species	Whatcom		Whitman		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp					383,705	$11,511
Catfish					1,230	62
Cod					12,158	365
Dolly Varden trout					69	3
Flounders					195,147	4,079
Grayfish					59,400	85
Halibut	751	$119			510,711	64,198
Herring	79,000	790			252,569	2,525
"Lingcod"	245	5			12,889	259
Mackerel					20	1
Perch					46,076	1,874
Rockfish	77	2			27,386	552
Salmon:						
Blueback or sockeye	1,616,519	229,546	750	$65	2,830,581	397,472
Chinook	2,294,489	209,268	5,164	723	13,063,176	1,360,162
Chum	324,133	8,103			3,290,784	59,865
Humpback	7,907,675	263,589			18,891,808	510,838
Silver	1,619,430	52,339	2,100	105	10,137,529	392,444
Sea bass, white, or squeteague					532	13
Shad					88,767	2,710
Skate					6,105	63
Smelt	1,595	128			1,165,871	27,608
Sole					81,242	2,437
Steelhead trout	19,240	1,732	500	35	1,400,218	100,840
Sturgeon			155	12	83,677	6,752
Tomcod					784	13
Crabs	251,658	9,801			1,110,582	52,636
Shrimp					27,594	3,586
Clams, hard	3,100	62			598,685	17,276
Clams, razor					983,900	44,275
Oysters					2,739,960	267,000
Octopus					52,377	1,573
Total	14,117,912	775,484	8,669	940	58,055,532	3,333,077

OREGON

The fisheries of Oregon in 1923 employed 4,230 fishermen, 3 vessels, 2,042 power boats, 218 rowboats, and yielded 32,982,678 pounds of fish valued at $3,500,171, of which 161,659 pounds, valued at $9,293, consisting of halibut and salmon, were caught by 3 vessels sailing from Clatsop County. These vessels had a total net tonnage of 44 and carried a total of 15 fishermen. Two of them operated lines and one was a purse seiner.

The following tables give the number of boats using each kind of fishing apparatus, by counties, the number of fishermen by counties, and the total catch of the fisheries of Oregon by species and counties:

Boats (by apparatus) and persons engaged in the shore fisheries of Oregon in 1923, by counties

Boats, by apparatus	Clackmas	Clatsop	Columbia	Coos	Curry	Douglas	Hood River
Gill nets, drift, gas	32	694	258	48	64	106	5
Gill nets, set:							
Gas	9	19	5	29	4	39	3
Row	10	16	12	23	2	62	4
Haul seines:							
Gas		11	4	3	2		
Row		7	2	3	2		
Pound nets, gas		15					1
Lines, gas		50	5	2		5	
Drag bag nets, gas			5				
Ring nets, gas		22		14		33	
Total:[1]							
Gas	33	790	265	83	69	151	8
Row	10	23	14	24	3	62	4
Persons engaged	75	1,653	529	166	140	345	19

[1] Exclusive of duplication.

Boats (by apparatus) and persons engaged in the shore fisheries of Oregon in 1923, by counties—Continued

Boats, by apparatus	Jackson	Josephine	Lane	Lincoln	Multnomah	Tillamook	Wasco	Total
Gill nets, drift, gas	2	16	22	67	143	140	11	1,608
Gill nets, set:								
Gas			27	81	18	129	1	364
Row			15	12	14	31		201
Haul seines:								
Gas					3		1	24
Row					3		1	18
Pound nets, gas					3			19
Lines, gas			2	2	6			72
Drag bag nets, gas								5
Fish wheels, gas					1			1
Ring nets, gas			4	71		32		176
Tongs and dredges, scows [1]				15				15
Total: [2]								
Gas	2	16	42	175	166	230	12	2,042
Row			15	27	19	31	1	233
Persons engaged	4	32	90	301	373	473	30	4,230

[1] Exclusive of duplication.
[2] In addition to the above there were 30 men and 30 gas boats fishing crab traps on the Molalla, Columbia, Willamette, and Yamhill Rivers, which could not be divided by counties.

Yield of the fisheries of Oregon in 1923 by counties and species

Species	Clackamas		Clatsop		Columbia		Coos	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Halibut			369,600	$56,926			70,653	$11,304
Herring			15,625	313				
"Lingcod"			66,428	1,993				
Rockfishes			26,046	781			31,256	938
Salmon:								
Chinook	627,948	$87,913	8,160,331	1,142,445	2,421,169	$338,972	444,008	62,162
Chum			281,342	3,381	127,983	1,279	15,704	157
Humpback			50,105	1,570				
Silver	48,068	2,403	1,083,832	53,787	71,484	3,574	422,464	21,123
Sockeye	352	48	514,862	69,512	629,350	84,962		
Shad	168	3	45,097	679	171,285	2,570	3,114	46
Smelt					27,195	271		
Steelhead trout	13,451	942	825,561	57,926	308,959	21,626	166,642	11,664
Sturgeon	324	25	60,709	4,856	18,966	1,517	918	73
Tomcod			5,000	400				
Crabs			5,368	698			20,592	2,677
Clams, razor			137,305	6,180				
Clams, soft							7,249	327
Octopus					71	4		
Total	690,311	91,334	11,647,211	1,401,447	3,776,462	454,775	1,182,600	110,471

Species	Curry		Douglas		Hood River		Josephine	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Salmon:								
Chinook	1,120,753	$156,905	427,899	$59,907	26,216	$3,670	100,146	$14,020
Chum			40,476	405	9,525	95		
Silver	14,100	705	1,318,540	65,927	6,394	320		
Sockeye					5,274	712		
Shad			148,038	2,221	376	6		
Steelhead trout	42,452	2,971	202,949	14,206	16,476	1,153		
Sturgeon			8,164	653	628	50		
Crabs			98,396	12,791				
Clams, soft			300	14				
Total	1,177,305	160,581	2,244,762	156,124	64,889	6,006	100,146	14,020

Yield of the fisheries of Oregon in 1923 by counties and species—Continued

Species	Jackson		Lane		Lincoln		Multnomah	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders					5,000	$150		
Halibut					176,630	28,261	247,283	$39,565
Herring					78,125	1,563		
"Lingcod"					11,072	332		
Perch					15,000	750		
Rockfishes							5,208	156
Sabelfish							250,000	12,500
Salmon:								
Chinook	23,594	$3,303	105,820	$14,824	646,982	90,578	1,950,744	273,103
Chum			7,884	79	98,392	985	16,849	169
Silver			357,670	17,884	1,133,418	56,671	359,876	17,993
Sockeye							844,436	114,051
Shad	82	1	5,354	81	430	6	29,253	439
Shad roe							662	20
Smelt							250,000	2,500
Steelhead trout	4,492	314	35,864	2,510	204,560	14,479	618,594	43,302
Sturgeon	994	80			134	11	29,763	2,381
Crabs			7,992	1,039	168,354	21,886		
Clams, soft							3,967	179
Oysters, native, private					19,200	16,800		
Total	29,162	3,698	520,584	36,417	2,557,297	232,472	4,606,635	506,358

Species	Tillamook		Wasco		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Flounders					5,000	$150
Halibut					864,166	136,056
Herring					93,750	1,876
"Lingcod"					77,500	2,325
Perch					15,000	750
Rockfishes					62,510	1,875
Sablefish					250,000	12,500
Salmon:						
Chinook	957,132	$134,000	348,156	$48,742	17,360,898	2,430,544
Chum	488,008	5,006			1,086,163	11,556
Humpback					50,105	1,570
Silver	1,793,284	89,666	107,532	5,377	6,716,662	335,430
Sockeye	9,188	1,240	61,569	8,312	2,065,031	278,837
Shad					403,197	6,052
Shad roe					662	20
Smelt					277,195	2,771
Steelhead trout	258,846	18,119	156,697	10,969	2,855,543	200,181
Sturgeon			3,521	282	124,121	9,928
Tomcod					5,000	400
Crabs	58,581	8,646			359,283	47,737
Clams, razor					137,305	6,180
Clams, soft	20,200	909			31,716	1,429
Oysters, native, private					19,200	16,800
Octopus					11	4
Total	3,585,239	257,586	677,475	73,682	[1] 32,860,078	[1] 3,504,971

[1] In addition to the above there were caught in the Molalla, Willamette, Columbia, and Yamhill Rivers 141,800 pounds of crawfish, valued at $12,000, bringing the grand total to 33,001,878 pounds, valued at $3,516,971.

CALIFORNIA

The fisheries of California in 1923 employed 4,594 fishermen, 285 vessels, 1,306 power boats, and 135 sail and row boats, and yielded 262,523,771 pounds of fishery products, valued at $7,722,800. This includes the fisheries prosecuted by California fishermen in waters off the coast of Mexico, the total yield of which amounted to 23,954,007 pounds, valued at $1,479,447, in 1923.

The vessel fishery of California employed 1,972 fishermen, sailing on 285 vessels, all of which were gas vessels excepting 11 sailing from San Francisco. Of these 5 were steamers in the paranzella fishery, 2 were schooners in the hand-line fishery, and 4 were steamers engaged in whaling.

The following tables give the number, crew, and tonnage of vessels using each kind of fishing apparatus, by counties; the number of boats using each kind of fishing apparatus, by counties; the number of persons in the shore or boat fisheries, by counties; the total yield of the fisheries of California, by species and counties; and the yield of the fisheries prosecuted by California fishermen in waters off the coast of Mexico, by species and landing ports.

Vessels engaged in the fisheries of California in 1923

Fishery	Los Angeles County			San Diego County			San Francisco County			Total		
	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage	Vessels	Crew	Tonnage
	Number	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*	*Number*	*Number*	*Net tons*
Lines	89	844	691	67	288	527	3	61	737	159	1,193	1,955
Lampara nets	125	1,078	1,012	6	28	42	------	------	------	131	1,106	1,054
Purse seines	43	351	1,039	3	18	54	------	------	------	46	369	1,093
Trammel nets	13	53	94	10	38	74	------	------	------	23	91	168
Paranzella nets	1	8	24	------	------	------	11	44	254	12	52	278
Gill nets	4	17	25	10	38	74	------	------	------	14	55	99
Lobster traps	------	------	------	2	10	24	------	------	------	2	10	24
Abalone outfit	------	------	------	------	------	------	1	5	8	1	5	8
Whaling apparatus	------	------	------	------	------	------	4	44	235	4	44	235
Total [1]	191	1,490	2,213	75	328	624	19	154	1,234	285	1,972	4,071

Exclusive of duplication.

Boats (by apparatus) and persons engaged in the shore fisheries of California in 1923, by counties

Boats, by apparatus	Del Norte and Humboldt	Mendocino, Sonoma, and Lake	Marin	Solano and Yolo	Coluso, Glenn, and Sutter	Sacramento and San Joaquin	Alameda and Contra Costa	San Francisco and San Mateo
Lines:								
Gas	41	75	29	--------	--------	3	3	178
Sail and row	2	1	--------	--------	1	1	2	--------
Gill nets:								
Gas	4	4	6	71	2	41	78	47
Sail and row	88	--------	3	1	4	3	7	--------
Lampara nets: Gas	--------	--------	--------	--------	--------	--------	--------	1
Trammel nets: Gas	--------	--------	1	--------	--------	--------	--------	--------
Bag nets: Gas	--------	--------	--------	--------	--------	--------	--------	10
Paranzella nets: Gas	--------	--------	--------	--------	--------	--------	--------	1
Fyke nets:								
Gas	--------	--------	--------	1	--------	2	--------	1
Row	--------	--------	--------	1	2	2	--------	--------
Haul seines:								
Gas	2	1	--------	--------	--------	--------	1	1
Row	--------	--------	1	--------	3	--------	--------	--------
Lobster traps: Gas	--------	--------	--------	--------	--------	--------	--------	1
Crab nets:								
Gas	11	6	22	--------	--------	3	1	105
Row	1	--------	--------	--------	--------	--------	--------	--------
Abalone outfit: Gas	--------	--------	--------	--------	--------	1	--------	--------
Other gear: Gas	--------	--------	2	--------	--------	--------	--------	2
Total: [1]								
Gas	45	80	37	71	2	43	84	207
Sail and row	91	1	4	2	9	8	8	--------
Persons engaged	253	90	50	134	16	81	171	326

[1] Exclusive of duplication.

Boats (by apparatus) and persons engaged in the shore fisheries of California in 1923, by counties—Continued

Boats, by apparatus	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, and Ventura	Los Angeles	Orange	San Diego	Total
Lines:							
Gas	27	182	18	376	29	104	1,065
Sail and row				8	1		16
Gill nets:							
Gas	10	5	5	26	2	27	328
Sail and row			3	1			110
Lampara nets: Gas		28	1	64	1	5	100
Trammel nets:							
Gas			2	21	3	13	40
Row			1				1
Bag nets: Gas							10
Paranzella nets: Gas		1	6	1			9
Fyke nets:							
Gas							4
Row							5
Haul seines:							
Gas			1	1			7
Row							4
Lobster traps: Gas		1	1	5	4	5	17
Crab nets:							
Gas	2	1					151
Row							1
Abalone outfit: Gas		6					7
Other gear: Gas				1			5
Total:[1]							
Gas	18	192	27	363	32	106	1,307
Sail and row			2	9	1		135
Persons engaged	30	416	63	724	47	224	2,625

[1] Exclusive of duplication.

Yield of the fisheries of California in 1923, by counties

Species	Del Norte and Humboldt		Mendocino, Sonoma, and Lake		Marin		Solano and Yolo	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Carp			12,185	$244			3,257	$65
Catfish			50,884	9,159			823	148
Flounder	186,144	$26,124	8,351	1,253	1,649	$164	3,210	96
Herring	3,341	25			28,035	210		
"Lingcod"	13,122	656	6,562	328	332	17		
Perch	43,317	2,166			23,148	1,157	108	5
Pike, Sacramento							111	2
Rockfishes	5,864	293	1,609	80	3,037	152		
Salmon	1,990,235	179,121	812,867	73,158	31,129	2,802	475,812	42,823
Sea bass, white, or squeteague					6,020	548		
Shad							1,565	31
Shad, buck							47,266	945
Shad, roe							110,248	6,615
Smelt	32,166	322	2,765	28	42,104	421		
Sole	10,153	406			182	7		
Steelhead trout	3,011	422						
Striped bass					2,593	259	78,030	7,803
Tomcod					424	34		
Other fish	26,759	5,117	4,700	188	1,051	210	1,482	59
Crabs	254,640	35,140	6,480	894	16,776	2,315		
Shrimp					418,773	25,126		
Clams, cockle	5,538	609	20	2	23,145	2,546		
Clams, mixed	14,551	1,164			10,497	840		
Clams, soft			530	21	78,560	3,142		
Mussels					230	12		
Oysters, eastern, market					9,600	3,360		
Abalone					40	2		
Octopus					219	22		
Total	2,588,841	251,565	906,953	85,355	697,544	43,346	721,912	58,592

Yield of fisheries of California in 1923, by counties—Continued

Species	Tehama, Colusa, Glenn, Sutter, and Butte		Sacramento and San Joaquin		Alameda and Contra Costa		San Francisco and San Mateo	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Anchovies							184, 085	$15, 806
Barracuda							56	4
Bonito							574	25
Carp			65, 341	$1, 307	58, 163	$1, 163	9, 661	193
Catfish			51, 330	9, 239	26, 249	4, 725		
Cod, salted							1, 398, 000	69, 900
Flounder					12, 117	364	1, 658, 823	64, 269
Grayfish							152, 208	761
Hake							70, 232	702
Hardhead			9, 563	96				
Herring					66, 087	496	269, 785	2, 023
Kingfish							735	29
"Lingcod"							321, 542	16, 077
Mackerel							74	3
Perch					97	5	63, 287	3, 164
Pike, Sacramento			647	13	3, 772	75	94	2
Pilchard or sardines							339, 804	1, 359
Pompano							618	247
Rockfishes							566, 319	28, 225
Sablefish							198, 590	11, 915
Salmon	68, 964	$6, 207	477, 526	42, 977	1, 221, 643	109, 947	1, 283, 748	115, 537
Sea bass, white, or squeteague							16, 555	1, 507
Shad			4, 912	98	37, 099	742	28, 470	569
Shad, buck			23, 163	463	333, 331	6, 667	27	1
Shad, roe			38, 148	2, 289	661, 100	39, 666	5	1
Skates							127, 224	636
Smelt					82	1	109, 934	1, 099
Sole					270	11	6, 174, 114	246, 964
Splittail			13, 156	132	800	8		
Striped bass	119	12	141, 342	14, 134	581, 870	58, 187	105, 508	10, 551
Suckers			342	3				
Tomcod							37, 868	3, 029
Other fish			204	8	1, 332	53	83, 911	9, 854
Crabs					3, 552	490	786, 936	108, 597
Shrimp							694, 585	41, 675
Clams, soft					145, 231	5, 809	58, 774	2, 351
Mussels					477	24	9, 409	470
Octopus							9, 877	988
Terrapin			1, 128	68				
Sperm oil							15, 585	1, 282
Whale oil							4, 644, 293	316, 450
Other whale products							2, 370, 000	81, 796
Total	69, 083	6, 219	826, 802	70, 827	3, 153, 272	228, 433	21, 791, 310	1, 158, 061

Species	Santa Cruz		Monterey		San Luis Obispo, Santa Barbara, and Ventura		Los Angeles	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore			149	$18			8, 514, 349	$1, 106, 865
Anchovies			85, 016	638			37, 973	2, 848
Barracuda			6, 982	510	21, 693	$1, 584	5, 925, 768	507, 658
Bonito			3, 325	143	2, 288	98	1, 006, 531	43, 281
Flounder	185, 024	$7, 264	12, 720	922	333, 398	49, 995	877, 628	140, 673
Grayfish	1, 345	7					5, 645	28
Hake	8, 737	87						
Herring	188	1						
Kingfish	50, 848	2, 034	110, 207	4, 408	26	1	238, 722	3, 660
"Lingcod"	28, 693	1, 435	93, 677	4, 684				
Mackerel	944	38	570, 371	22, 815	13, 012	520	2, 688, 143	107, 864
Mullet							10, 805	1, 184
Perch	1, 884	94	22, 502	1, 125	980	49	164, 110	9, 846
Pilchard or sardines	275	1	86, 060, 322	344, 241	1, 060	4	67, 493, 419	337, 467
Pompano	187	75	106	42			20, 997	8, 453
Rock bass					2, 041	171	220, 395	18, 685
Rockfishes	559, 561	26, 217	1, 468, 475	66, 844	68, 408	3, 312	1, 343, 236	77, 910
Sablefish	329, 238	19, 754	10, 464	628				
Salmon	306, 336	27, 570	422, 000	37, 980				
Sculpin							44, 623	4, 462
Sea bass, black					2, 703	246	47, 398	4, 433
Sea bass, white, or squeteague	119, 368	2, 561	30, 187	655	149, 870	13, 638	1, 583, 470	146, 230

Yield of fisheries of California in 1923, by counties—Continued

Species	Santa Cruz		Monterey		San Luis Obispo, Santa Barbara, and Ventura		Los Angeles	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Shad	49	$1						
Sheepshead					289	$6	5,979	$120
Skates	2,507	13	990	$5			3,019	60
Skipjack or striped tuna							7,707,653	199,472
Smelt	62,210	622	7,140	71	69,200	692	339,261	14,735
Sole	642,785	25,711	54,275	2,171	73,842	3,692	114,077	6,845
Striped bass			111	11				
Swordfish							6,277	785
Tomcod	3,475	278						
Tuna, bluefin							1,901,334	95,897
Tuna, yellowfin							6,838,741	378,372
Tuna, mixed							662,355	35,470
Whitefish							27,066	1,390
Yellowtail					3,001	156	1,600,166	85,643
Other fish	14,019	561	6,332	392	13,470	539	85,099	3,440
Crabs	4,848	669	2,568	354				
Sea crawfish or spiny lobster					75,583	15,116	169,468	34,007
Clams, cockle							7,414	816
Clams, mixed							397	36
Clams, Pismo	720	50			237,228	16,606		
Mussels	50	3	4,665	233	95	5		
Abalone	15	1	1,532,757	58,245	22,322	848	32,599	1,271
Octopus	42,134	4,213	57,823	5,782			169	17
Squid			1,098,510	7,140			81,011	534
Terrapin							142	9
Total	2,365,440	119,260	91,661,674	560,057	1,090,509	107,278	109,805,439	3,380,466

Species	Orange		San Diego and Imperial		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore	754	$98	3,999,581	$520,212	12,514,833	$1,627,193
Anchovies					307,074	19,292
Barracuda	28,738	2,385	1,217,338	63,144	7,200,575	575,285
Bonito	28	1	102,501	3,762	1,115,247	47,310
Carp					148,607	2,972
Catfish					129,286	23,271
Cod, salted					1,398,000	69,900
Eels	18,061	542	188	6	18,249	548
Flounder	34,903	5,616	968,692	163,100	4,282,659	459,840
Grayfish			201,165	1,006	360,363	1,802
Hake					78,969	789
Hardhead					9,563	96
Herring			16,514	1,239	383,950	3,994
Kingfish			11,026	169	411,564	10,301
"Lingcod"			3,429	172	467,357	23,369
Mackerel	96,408	3,856	223,494	8,986	3,592,446	144,082
Mullet			63,420	6,881	74,225	8,065
Perch	959	58	39,290	2,013	359,682	19,682
Pike, Sacramento					4,624	92
Pilchard or sardines	775	3	5,301,351	21,205	159,197,006	704,280
Pompano	10	4	11,000	4,477	32,918	13,298
Rock bass	6,921	581	127,912	10,864	357,269	30,301
Rockfishes	52,824	3,063	880,911	44,218	4,950,244	250,314
Sablefish					538,292	32,297
Salmon					7,090,260	638,122
Sculpin	59	6	15,784	1,578	60,466	6,046
Sea bass, black	839	76	176,055	17,413	226,995	22,168
Sea bass, white, or squeteague	14,428	1,312	600,365	58,418	2,520,263	224,869
Shad					72,095	1,441
Shad, buck					403,787	8,076
Shad, roe					809,501	48,571
Sheepshead	76	2	25,284	511	31,628	639
Skates	188	2	60	1	133,988	717
Skipjack or striped tuna			3,754,869	98,613	11,462,522	298,085
Smelt	120,795	5,230	20,723	928	806,380	24,149
Sole	3,388	169	12,949	655	7,086,035	286,631
Splittail					13,956	140
Steelhead trout					3,011	422
Striped bass					909,573	90,957

Yield of fisheries of California in 1923, by counties—Continued

Species	Orange		San Diego and Imperial		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Suckers					342	$3
Swordfish			5,414	$683	11,691	1,468
Tomcod					41,767	3,341
Tuna, bluefin			1,399,753	69,988	3,301,087	165,885
Tuna, yellowfin			3,998,184	222,040	10,836,925	600,412
Tuna, mixed	15	$1			662,370	35,471
Whitefish	595	30	12,247	669	39,908	2,089
Yellowtail	2,748	143	2,373,696	131,108	3,979,611	217,050
Other fish	440	18	13,213	616	252,012	21,055
Crabs					1,075,800	148,459
Sea crawfish or spiny lobsters	25,206	5,041	822,601	171,492	1,092,858	225,656
Shrimp					1,113,358	66,801
Clams, cockle					36,117	3,973
Clams, mixed			400	36	25,845	2,076
Clams, Pismo					237,948	16,656
Clams, soft					283,095	11,323
Mussels	45,100	2,255			60,026	3,002
Oysters, eastern, market					9,600	3,360
Abalone					1,587,733	60,367
Octopus					110,222	11,022
Squid			925	6	1,180,446	7,680
Terrapin					1,270	77
Sperm oil					15,585	1,282
Whale oil					4,644,293	316,450
Other whale products					2,370,000	81,796
Total	454,258	30,492	26,400,334	1,626,209	262,533,371	7,726,160

Yield of the fisheries prosecuted by California fisherman in waters off the coast of Mexico

Species	Landed at San Pedro		Landed at San Diego		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Albacore			26,634	$3,729	26,634	$3,729
Barracuda	1,561,909	$145,458	502,842	36,708	2,064,751	182,166
Bonito	564,818	24,287	71,658	2,436	636,476	26,723
Flounders	70,924	11,348	811,389	139,536	882,313	150,884
Kingfish	7,822	196	307	8	8,129	204
"Lingcod"			47	3	47	3
Mackerel	33,826	1,691	4,669	233	38,495	1,924
Mullet	10,302	1,133	53,916	5,931	64,218	7,064
Perch	28,840	1,730	4,793	288	33,633	2,018
Pompano	5,456	2,237	7,682	3,150	13,138	5,387
Rock bass	17,238	1,620	11,992	1,127	29,230	2,747
Rockfishes	675	41	17,219	1,033	17,894	1,074
Sea bass, black	11,993	1,211	139,262	14,065	151,255	15,276
Sea bass, white, or squeteague	213,374	21,551	378,503	38,228	591,877	59,779
Sheepshead			517	16	517	16
Skipjack or striped tuna	4,531,884	135,957	2,351,561	70,547	6,883,445	206,504
Smelt	4,465	238	3,075	164	7,540	402
Sole	146	9	804	48	950	57
Swordfish			635	86	635	86
Tuna, bluefin	82,997	4,980			82,997	4,980
Tuna, yellowfin	6,515,754	363,579	3,892,275	217,189	10,408,029	580,768
Tuna, mixed	235,204	14,112			235,204	14,112
Whitefish	967	59	4,438	271	5,405	330
Yellowtail	243,523	15,098	767,492	47,585	1,011,015	62,683
Other fish	5,027	251	8,757	438	13,784	689
Spiny lobster	11,300	2,373	697,177	146,407	708,477	148,780
Clams, mixed	397	36	400	36	797	72
Abalone	32,599	945			32,599	945
Squid	4,381	36			4,381	36
Terrapin	142	9			142	9
Total	14,195,963	750,185	9,758,044	729,262	23,954,007	1,479,447

FISHERIES OF THE SOUTH ATLANTIC STATES IN 1923

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 1923. They are the result of a canvass made by the bureau's agents[3] during 1924, and in so far as possible the methods used were similar to those employed in the corresponding canvass of this section for 1918 in order that the statistics obtained might be strictly comparable. The results of the canvass have already been published in condensed form in Statistical Bulletin No. 652 and distributed to the trade. The detailed statistics are published herewith for the first time.

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. 1 (xi+808 pp.), Vol. II (xx+881 pp.), 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), pp. 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), pp. 269–356, Pls. XLIII–LXXIV.

1897. Report on the Fisheries of Indian River, Fla. By John J. Brice et al. Report, U. S. Commission of Fish and Fisheries, 1896 (1898), pp. 223–262, pls. 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), pp. 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), pp. 31–43.

The Shad Fisheries of the Atlantic Coast of the United States. By Charles H. Stevenson. Ibid., pp. 101–176.

1900. Statistics of the Fisheries of the South Atlantic States [1897]. Report, U. S. Commission of Fish and Fisheries, 1899 (1900), pp. 171–227.

1905. Statistics of the South Atlantic States, 1902. Report, U. S. Commission of Fish and Fisheries, 1903 (1905), pp. 343–410.

1911. Fisheries of the United States, 1908. Special Reports, Bureau of the Census, 1911.

1921. Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1920. By Lewis Radcliffe. Appendix V to the Report of the U. S. Commissioner of Fisheries for 1921, pp. 59–120.

COMMON AND SCIENTIFIC NAMES OF FISHES

Trade usage in the nomenclature of fishes is often confused and sometimes renders it impossible to properly separate and distinguish species occurring in the statistical reports. In the following statistics

[3] The data were collected by Winthrop A. Roberts and Rob Leon Greer, assisted by Carl B. Tendick, James Buckley, and Frank E. Kingsbury.

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of the South Atlantic States it was found impossible to separate the crappie from the other sunfishes except in the State of Florida. Harvest fish (*Peprilus alepidotus*), caught together with butterfish (*Poronotus triancanthus*), and selling at the same price, were often included with the latter, but separation of the statistics has been made in so far as possible. The pigfish (*Orthopristis chrysopterus*) is sometimes known as hogfish in North Carolina, and it is possible that some of the hogfish reported in North Carolina may be this species rather than the hogfish (*Lachnolaimus maximus*) more commonly found in the Florida waters. Both the fresh-water catfish (Ameiurus species and Ictalurus species) and the salt-water catfish (Felichthys species and Galeichthys species) were included together. In North Carolina it was possible to report the gray trout (*Cynoscion regalis*) and the speckled trout (*Cynoscion nebulosus*) separately; elsewhere they have been included together under the name squeteague or "sea trout."

The following list gives the scientific names of the fishes corresponding to the common names as listed in the statistics in so far as it has been possible to determine them:

Alewives	*Pomolobus æstivalis.* *Pomolobus pseudoharengus.*
Amber fish	Seriola (species).
Angel fish	*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, German	*Cyprinus carpio.*
Catfish	Siluridæ (species).
Cero and kingfish	*Scomberomorus regalis.* *Scomberomorus cavalla.*
Crappie	*Pomoxis sparoides.* *Pomoxis annularis.*
Crevalle	Caranx (species).
Croaker	*Micropogon undulatus.*
Drum, black	*Pogonias cromis.*
Drum, red	*Sciænops ocellatus.*
Eels	*Anguilla rostrata.* Other Apodes.
Flounders	Pleuronectidæ (species).
Garfish	*Lepisosteus osseus.*
Gizzard shad	*Dorosoma cepedianum.*
Groupers	Epinephelus (species). Mycteroperca (species). *Garrupa nigrita.*
Grunts	Hæmulonidæ (species).
Harvest fish	*Peprilus alepidotus.*
Hickory shad	*Pomolobus mediocris.*
Hogfish	*Lachnolaimus maximus.*
Jewfish	*Promicrops itaiara.*
King whiting	Menticirrhus (species).
Leather jacket or "turbot"	*Balistes carolinensis.*
Menhaden	*Brevoortia tyrannus.*
Moonfish	*Vomer setipinnis.*
Mullet	*Mugil cephalus.* *Mugil curema.*
Permit	*Trachinotus goodei.*

Pigfish	*Orthopristis chrysopterus.*
Pike or pickerel	Esox (species).
Pinfish or sailor's choice	Lagodon (species). Other species.
Pompano	*Trachinotus carolinus.* Trachinotus (other species).
Porkfish	*Anisotremus virginicus.*
Scup	Stenotomus (species).
Sea bass	*Centopristes striatus.*
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 blackfordii.*
Snook or sergeant fish	*Centropomus unodecimalis.*
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	Catostomidæ (species).
Sunfish	Centrarchidæ (species).
Tautog	*Tautoga onitis.*
Tripletail	*Lobotes surinamensis.*
White perch	*Morone americana.*
Yellow perch	*Perca flavescens.*
Yellowtail or "silver perch"	*Bairdiella chrysura.*

GENERAL STATISTICS

The number of persons engaged in the fisheries of the South Atlantic States in 1923 was 16,298, of whom 1,480 were on vessels fishing, 180 on vessels transporting fishery products, 8,614 in shore fisheries and 6,024 shoresmen in the wholesale fishery trade, fish canneries, and similar industries connected with the fisheries. Of the total 9,308 of the persons were in North Carolina, 2,164 in South Carolina, 2,019 in Georgia, and 2,807 on the east coast of Florida.

The capital invested in the fisheries of this region amounted to $8,505,259, distributed as follows: North Carolina, $4,198,894; South Carolina, $606,781; Georgia, $1,378,704; and the east coast of Florida, $2,320,880. The investment included vessels and boats valued at $2,545,644; fishing apparatus used by vessels and boats, $699,604; shore and accessory property to the value of $4,530,711; and cash capital to the amount of $729,300.

The products of the fisheries of this region amounted to 228,747,930 pounds, valued at $5,087,340. Of this total North Carolina produced 95,192,343 pounds, valued at $2,414,499; South Carolina, 6,763,279 pounds, valued at $284,791; Georgia, 39,896,386 pounds, valued at $668,129; and the east coast of Florida 86,895,922 pounds, valued at $1,719,921.

Arranged in order of value, some of the more important fishery products are as follows: Shrimp 23,705,901 pounds, valued at $821,861; menhaden, 148,180,970 pounds, valued at $752,026; shad, 3,190,666 pounds, valued at $716,649; oysters, from both public and private beds, 11,172,336 pounds, valued at $448,137; squeteagues or "sea trout," 5,258,047 pounds, valued at $381,155; mullet, 7,734,412 pounds fresh and 622,000 pounds salted, valued altogether at $378,301; bluefish, 2,004,244 pounds, valued at $214,826; Spanish mackerel, 2,652,341 pounds, valued at $205, 987; cero and kingfish, 1,966,596 pounds, valued at $161,201; and alewives or river herring, 2,609,347 pounds fresh and 4,961,050 pounds salted, valued altogether at $146,104.

Compared with the statistics for 1918 there was an increase of 8.3 per cent in the persons engaged, an increase of 14.6 per cent in the investment, and a decrease of 31.2 per cent in the quantity and 4.9 per cent in the value of the products of the fisheries. In North Carolina there was an increase of 15.8 per cent in persons engaged, a decrease of 0.6 per cent in the investment, and a decrease of 54.8 per cent in the quantity and 18.9 per cent in the value of products of the fisheries. In South Carolina there was an increase of 8.2 per cent in persons engaged, 174.2 per cent in investment, and 80.5 per cent in the quantity and 37.1 per cent in the value of products of the fisheries. The fisheries of Georgia also showed increases in all phases of the industry; there was an increase of 20.2 per cent in persons engaged, 79 per cent in the investment, 7.4 per cent in the quantity, and 60.6 per cent in the value of the production. On the east coast of Florida there was a decrease of 15.7 per cent of persons engaged, an increase of 5 per cent in the investment, an increase of 7 per cent in quantity of fishery products, and a decrease of 1.5 per cent in the value of the products.

Practically all of the decrease in production may be attributed to a failure in the menhaden fishery, which in 1923 produced only 148,180,970 pounds, as compared with 257,757,799 pounds in 1918. Other fishes showing a severe decrease since 1918 are alewives, cero and kingfish, red and black drum, mullet, and Spanish mackerel. The yield of shad and squeteague or "sea trout" increased somewhat, and the production of shrimp and oysters was greatly increased over that of 1918.

Persons engaged in the fisheries of the South Atlantic States in 1923

States	On vessels fishing	On vessels transporting	In shore fisheries	Shoresmen	Total
North Carolina	1,055	51	5,140	3,062	9,308
South Carolina	8	94	1,044	1,018	2,164
Georgia	186	29	620	1,184	2,019
Florida (east coast)	231	6	1,810	760	2,807
Total	1,480	180	8,614	6,024	16,298

Investment in the fisheries of the South Atlantic States in 1923

Items	North Carolina		South Carolina		Georgia		Florida (east coast)		Total	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels fishing:										
Steam	3	$92,500					4	$155,300	7	$247,800
Tonnage	179						353		532	
Outfit		10,400						26,683		37,083
Gasoline	64	471,980	1	$3,500	24	$182,075	7	67,000	96	724,555
Tonnage	1,506		11		469		208		2,194	
Outfit		91,830		2,000		34,763		18,800		147,393
Sail	74	66,230							74	66,230
Tonnage	667								667	
Outfit		11,753								11,753
Accessory gasoline boats	82	25,950							82	25,950
Vessels transporting:										
Gasoline	30	58,000	15	47,700	10	11,700	3	4,100	58	121,500
Tonnage	273		224		99		33		629	
Outfit		22,535		3,250		1,225		550		27,560
Sail	3	4,900	34	22,100	8	8,500			45	35,500
Tonnage	29		362		111				502	
Outfit		650		2,950		455				4,055
Power boats	1,384	330,930	58	22,325	145	130,300	792	517,650	2,379	1,001,205
Sailboats	110	14,780	18	1,800					128	16,580
Rowboats, etc	1,892	42,215	674	13,900	347	7,465	514	14,900	3,427	78,480
Apparatus, vessel fisheries:										
Purse seines	35	53,200			4	7,200	8	10,300	47	70,700
Haul seines	34	21,200							34	21,200
Lines		130		100		300				530
Otter trawls	2	110			16	780	3	150	21	1,040
Dredges	156	4,070			2	100			158	4,170
Tongs	40	226							40	226
Apparatus, shore fisheries:										
Purse seines	9	5,200					5	7,500	14	12,700
Haul seines	529	74,834	16	1,695			85	16,160	630	92,689
Gill nets	12,518	82,923	281	21,460	146	4,560	568	80,475	13,513	189,418
Pound nets	2,873	259,382							2,873	259,382
Fyke nets	548	5,095							548	5,095
Stop nets			7	210					7	210
Cast nets							6	30	6	30
Dip nets	323	157					31	62	354	219
Lines		577		150		40		4,595		5,362
Eel pots	4,129	5,070							4,129	5,070
Spears	152	155	55	47			3	3	210	205
Revolving traps	6	246							6	246
Weirs	5	100							5	100
Otter trawls	48	2,418	8	350	118	5,900	226	12,000	400	20,668
Dredges	729	4,680							729	4,680
Tongs	418	2,618	46	250	134	706	35	251	633	3,825
Rakes	553	540	84	70			12	9	649	619
Grabs			425	540	183	246	4	4	612	790
Crab traps							30	75	30	75
Drag nets	69	255							69	255
Turtle traps	100	100							100	100
Shore and accessory property		2,197,855		366,884		859,889		1,106,083		4,530,711
Cash capital		233,100		95,500		122,500		278,200		729,300
Total		4,198,894		606,781		1,378,704		2,320,880		8,505,259

NOTE.—In this report all craft of 5 net tons and upward are classed as vessels and all under 5 net tons are classed as boats.

Yield of the fisheries of the South Atlantic States, 1923

Species	North Carolina		South Carolina		Georgia	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	1,589,347	$33,366				
Alewives, salted	4,933,050	86,038				
Angel fish	7,305	418				
Black bass	331,161	47,227				
Bluefish	896,694	66,805	7,000	$700		
Bonito	43,070	2,688				
Bowfin	21,009	390				
Butterfish	298,990	14,625				
Carp, German	209,147	10,438				
Catfish	255,318	6,877	2,500	79		
Cero and kingfish	1,139	124				
Cod	340	10				
Crevalle	325	16	7,000	350		
Croaker	2,262,308	53,993	26,000	1,274		
Drum, black	1,794	194	13,050	392		
Drum, red, or redfish	245,443	10,763	31,000	1,730	600	$36
Eels	179,526	17,036				
Flounders	332,773	22,039	27,650	2,164	200	12
Garfish	2,150	20				
Gizzard shad	8,905	177				
Groupers			8,000	480	11,413	571
Grunts	1,100	33			123	10
Harvestfish or "starfish"	520,816	22,217				
Hickory shad	381,521	29,598	7,500	750	10,510	1,066
Jewfish					2,767	111
King whiting	560,159	21,326	83,400	7,823	1,000	100
Menhaden	63,289,940	325,967			26,973,000	149,850
Mullet, fresh	1,379,712	109,464	152,500	11,600	4,000	240
Mullet, salted	369,000	39,305	253,000	23,600		
Pigfish	385,270	8,823				
Pike	13,910	1,413				
Pinfish or sailor's choice	13,860	425			400	24
Pompano	49,547	3,681				
Scup or porgy			8,500	605	1,601	182
Sea bass	102,265	8,217	218,000	20,300	104,090	8,327
Shad	2,370,134	582,591	183,916	43,721	133,750	27,890
Sharks			18,000	360		
Sheepshead	51,685	3,421	1,000	80		
Skate			3,000	60		
Snapper, red	1,200	84	2,000	200	104,970	7,347
Spanish mackerel	182,941	18,740				
Spot, fresh	1,672,223	54,647	56,500	3,880	600	36
Spot, salted	78,500	5,750	50,000	4,600		
Squeteague or "sea trout"	3,984,347	250,847	70,300	6,954	5,000	500
Striped bass	477,001	75,953			360	29
Sturgeon	18,854	3,129	49,406	14,983	32,000	3,600
Sturgeon caviar	305	593	575	1,725	38	114
Suckers	1,394	17				
Sunfish	42,383	815	1,500	120		
Tautog	75	5				
Tripletail	181	9				
White perch	438,542	33,749				
Yellow perch	268,397	16,007				
Other fish	213	13				
Crabs, hard	331,350	5,395	9,000	270	120,000	7,000
Crabs, soft	182,296	27,692				
Shrimp	1,658,476	50,772	355,000	12,425	10,668,380	373,303
Clams, hard	263,536	64,064	85,640	9,611		
Oysters, market, public	3,904,446	228,351	4,587,226	99,534	948,787	57,380
Oysters, market, private	12,950	1,225	445,116	14,421	771,547	29,391
Scallops	554,574	46,214				
Octopus					50	10
Terrapin	360	120			1,200	1,000
Turtles	9,086	583				
Total	95,192,343	2,414,499	6,763,279	284,791	39,896,386	668,129

Yield of the fisheries of the South Atlantic States, 1923—Continued

Species	Florida (east coast)		Total	
	Pounds	*Value*	*Pounds*	*Value*
Alewives, fresh	1,020,000	$25,500	2,609,347	$58,866
Alewives, salted	28,000	1,200	4,961,050	87,238
Amber fish	4,100	128	4,100	128
Angel fish	3,200	118	10,505	536
Barracuda	2,700	86	2,700	86
Black bass	82,293	8,379	413,454	55,606
Bluefish	1,100,550	147,321	2,004,244	214,826
Blue runner or hardtail	179,400	4,244	179,400	4,244
Bonito	350	12	43,420	2,700
Bowfin			21,009	390
Butterfish			298,990	14,625
Carp, German			209,147	10,438
Catfish	783,440	38,372	1,041,258	45,328
Cero and kingfish	1,965,457	161,077	1,966,596	161,201
Cod			340	10
Crappie	65,403	3,532	65,403	3,532
Crevalle	164,600	5,049	171,925	5,415
Croaker	21,500	674	2,309,858	55,941
Drum, black	46,700	1,519	61,541	2,105
Drum, red, or redfish	121,850	4,434	398,893	16,963
Eels			179,526	17,036
Flounders	5,850	489	366,473	24,704
Garfish			2,150	20
Gizzard shad			8,905	177
Groupers	17,200	900	36,613	1,951
Grunts	7,650	307	8,873	350
Harvestfish or "starfish"			520,816	22,217
Hickory shad			399,531	31,414
Hogfish	1,550	64	1,550	64
Jewfish	250	7	3,017	118
King whiting	175,300	6,812	819,859	36,061
Leatherjacket or "turbot"	400	16	400	16
Menhaden	57,918,030	276,209	148,180,970	752,026
Moonfish	2,200	69	2,200	69
Mullet, fresh	6,198,200	194,092	7,734,412	315,396
Mullet, salted			622,000	62,905
Permit	5,700	179	5,700	179
Pigfish	14,150	435	399,420	9,258
Pike			13,910	1,413
Pinfish or sailor's choice	51,130	1,561	65,390	2,010
Pompano	60,650	8,926	110,197	12,607
Porkfish	2,000	60	2,000	60
Scup or porgy	2,000	110	12,101	897
Sea bass	4,175	264	428,530	37,108
Sergeant fish or snook	139,700	4,273	139,700	4,273
Shad	502,866	62,447	3,190,666	716,649
Sharks			18,000	360
Sheepshead	32,100	1,329	84,785	4,830
Skate			3,000	60
Snapper, mangrove	26,500	1,004	26,500	1,004
Snapper, mutton	123,100	4,305	123,100	4,305
Snapper, red	11,600	776	119,770	8,407
Spanish mackerel	2,469,400	187,247	2,652,341	205,987
Spot, fresh	71,700	2,877	1,801,023	61,440
Spot, salted			128,500	10,350
Squeteague or "sea trout"	1,198,400	122,854	5,258,047	381,155
Striped bass			477,361	75,982
Sturgeon			100,260	21,712
Sturgeon caviar			918	2,432
Suckers			1,394	17
Sunfish	476,809	19,672	520,692	20,607
Tautog			75	5
Tripletail			181	9
White perch			438,542	33,749
Yellow perch			268,397	16,007
Yellowtail or "silver perch"	28,650	897	28,650	897
Other fish			213	13
Crabs, hard	72,000	3,600	[1] 532,350	16,265
Crabs, soft			[2] 182,296	27,692
Sea crawfish or spiny lobsters	156,200	11,634	156,200	11,634
Shrimp	11,024,045	385,361	23,705,901	821,861
Clams, hard	4,560	1,665	[3] 353,736	75,340
Oysters, market, public	464,214	14,475	[4] 9,906,673	399,740
Oysters, market, private	36,050	3,360	[5] 1,265,663	48,397
Scallops			[6] 554,574	46,214
Octupus			50	10
Terrapin			1,560	1,120
Turtles			9,086	583
Total	86,895,922	1,719,921	228,747,930	5,087,340

[1] 1,597,050 in number.
[2] 546,888 in number.
[3] 44,217 bushels.
[4] 1,415,239 bushels.
[5] 180,809 bushels.
[6] 92,429 bushels.

Extent of the fisheries of the South Atlantic States, various years, 1880 to 1923[1]

	North Carolina	South Carolina	Georgia	Florida (east coast)	Total
PERSONS ENGAGED	*Number*	*Number*	*Number*	*Number*	*Number*
1880	5,274	1,005	899	368	7,546
1887	7,352	1,280	627	(2)	(2)
1888	7,704	1,346	638	851	10,539
1889	8,655	2,642	1,497	1,244	14,038
1890	10,274	2,701	1,622	1,404	16,001
1897	12,045	2,139	1,869	1,132	17,185
1902	14,755	3,713	2,286	2,698	23,452
1908	9,681	2,559	2,525	3,196	17,961
1918	8,036	2,000	1,680	3,330	15,046
1923	9,308	2,164	2,019	2,807	16,298
INVESTMENT	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1880	506,561	66,275	78,770	43,554	695,160
1887	766,881	92,930	61,806	(2)	(2)
1888	801,474	97,189	65,556	109,670	1,073,889
1889	968,600	107,205	120,975	128,434	1,325,214
1890	1,243,988	127,762	174,431	142,105	1,688,286
1897	1,218,459	174,354	284,864	151,155	1,828,832
1902	1,973,441	320,723	342,150	354,835	2,991,149
1908	1,270,000	114,000	409,000	531,000	2,324,000
1918	4,222,043	221,251	769,998	2,210,679	7,423,971
1923	4,198,894	606,781	1,378,704	2,320,880	8,505,259
PRODUCTS					
Quantity:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1880	32,249,488	6,143,250	2,272,500	2,286,750	42,951,988
1887	45,124,956	4,075,537	1,882,790	(2)	(2)
1888	43,022,855	4,180,847	1,957,749	(2)	(2)
1889	45,545,643	4,879,125	2,643,533	5,982,375	59,050,676
1890	51,799,142	4,944,840	2,994,117	7,463,531	67,201,630
1897	64,234,257	5,280,446	4,993,100	5,882,662	80,390,465
1902	67,584,734	8,174,463	11,102,610	19,584,265	106,446,072
1908	101,422,000	14,104,000	14,828,000	36,521,000	166,875,000
1918	210,501,750	3,746,932	37,153,953	81,211,488	332,614,123
1923	95,192,343	6,763,279	39,896,386	86,895,922	228,747,930
Value:	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1880	845,695	212,482	119,993	78,408	1,256,578
1887	772,957	157,688	80,745	(2)	(2)
1888	776,439	163,657	82,910	173,886	1,196,892
1889	950,427	200,381	105,727	199,043	1,455,578
1890	1,027,669	202,602	123,563	219,870	1,573,704
1897	1,316,017	210,456	170,605	136,077	1,833,155
1902	1,739,661	263,023	359,081	477,868	2,839,633
1908	1,776,000	288,000	701,000	1,269,000	4,034,000
1918	2,978,708	207,690	416,043	1,746,175	5,348,616
1923	2,414,499	284,791	668,129	1,719,921	5,087,340

[1] Statistics for 1908 are from data published by the Bureau of the Census.
[2] Statistics not available.

COMPARISON OF YIELD OF CERTAIN SPECIES IN VARIOUS YEARS

In the foregoing statistics of the products of the fisheries a number of species have been shown fresh and salted as marketed by the fishermen, the quantity salted varying more or less in different years. In order to afford a comparison of the total catch of the more important species on a uniform basis, the quantities salted by the fishermen have been converted to the equivalent of weights of fresh fish, and the total catch of each species is shown as in the fresh condition in the tables below. Varying practices in salting fish make it difficult to determine the actual shrinkage that may have occurred when the fresh fish were salted, but the losses in salting of various species are thought to be approximately as follows: Alewives, croaker, mullet, shad, and spot, 33⅓ per cent; bluefish, sheepshead, Spanish mackerel, squeteague, and striped bass, 50 per cent; red and black drum, 65 per cent. These figures were used as a basis for converting the salt fish to a fresh-fish basis throughout the comparisons. The statistics on oysters, clams, and scallops are given in pounds and represent the meat or edible portion only.

Certain species of importance occurring in all of the South Atlantic States have been assembled in the first of the following tables. It is interesting to note that of the seven fishery products listed, only shrimp have shown a continuously increased production during years for which statistics are available. This product has increased from comparative insignificance in 1897 to a commodity of first importance in 1923, its production in the latter year exceeding 23,000,000 pounds, as compared with about 600,000 pounds in 1897. The production of oysters reached its peak in 1908, when nearly 30,000,000 pounds were reported; in 1918 the production had dropped below 6,000,000 pounds, and in 1923 it increased again to over 11,000,000 pounds, which is approximately one-third of the maximum production recorded. Of the fishes, shad is probably of most interest. In 1897 this species showed the greatest yield—over 11,000,000 pounds. Since then the decline was continuous until 1918 and 1923, when about 3,000,000 pounds were reported. The production of alewives, amounting to 22,000,000 pounds in 1890, dropped to less than 14,000,000 pounds in 1908, increased again to 18,000,000 pounds in 1918, and then decreased to 10,000,000 pounds in 1923. This is the lowest production on record and is less than one-half of the peak production. Mullet, one of the staple food fishes of the South, reached its maximum production of 16,000,000 pounds in 1902, and the catch has since declined continuously, until in 1923 its production totaled less than 9,000,000 pounds. Squeteagues and drum attained their maximum production in 1908 and have since shown a distinct reduction in yield. It is apparent that the most important food fishes of the South Atlantic States are being caught in alarmingly smaller quantities in the recent years than in the earlier years of the fishery. Reference to tables showing the yield of certain species in each of the States also reveals a strikingly lower production of many of the more important fishes in recent years as compared with the previous years.

The following tables give comparative statistics of the yield of certain fishery products in the South Atlantic States in various years, 1889 to 1923.

Comparative statistics of the yield of certain fishery products of the South Atlantic States in various years, 1889 to 1923

Year	Alewives	Drum, red and black	Mullet	Shad	Squeteague or "sea trout"	Shrimp	Oysters
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1889	19,389,254	1,038,197	5,990,867	8,387,428	2,460,950	743,640	8,895,572
1890	22,174,325	745,605	7,065,944	9,432,029	2,613,584	744,025	8,344,805
1897	20,906,968	846,683	7,281,722	11,268,343	3,824,770	627,221	11,285,268
1902	15,601,672	583,394	16,034,101	9,849,338	5,050,419	3,810,641	22,719,074
1908	13,782,000	1,421,000	15,489,200	8,572,000	8,628,000	5,697,000	29,973,000
1918	18,057,523	1,007,311	11,986,343	2,888,644	5,105,329	15,656,903	5,871,376
1923	10,050,922	460,437	8,667,412	3,190,666	5,258,047	23,705,901	11,172,336

Compararative statistics of the yield of certain fishery products of North Carolina in various years, 1889 to 1923

Species	1889	1890	1897	1902	1908	1918	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Alewives	19,316,094	22,111,605	20,838,555	15,173,475	12,530,000	17,355,758	8,988,922
Bluefish	1,077,611	1,539,008	1,909,975	1,049,342	1,257,800	322,744	896,694
Butterfish	----------	----------	94,750	83,218	1,302,000	731,257	819,806
Croaker	327,868	353,525	[1]	1,938,635	1,177,000	386,807	2,262,308
Drum, red and black	515,290	219,417	230,801	211,309	343,000	99,546	247,237
Eels	55,250	160,615	96,700	507,111	258,000	174,541	179,526
Flounders	48,200	48,630	173,975	261,762	403,000	91,121	332,773
Menhaden	8,753,250	12,410,400	11,310,000	18,862,000	57,412,000	179,910,599	63,289,940
Mullet	4,252,726	4,891,564	4,715,665	8,428,785	6,013,700	1,285,704	1,933,212
Pompano	8,200	9,750	53,175	19,590	11,000	8,685	49,547
Sea bass	228,900	33,075	189,225	57,250	72,000	111,650	102,265
Shad	5,402,586	5,815,088	8,963,488	6,566,724	3,942,000	1,657,036	2,370,134
Sheepshead	187,202	202,025	271,206	154,929	249,000	26,223	51,685
Spanish mackerel	82,445	100,050	330,840	354,084	457,000	149,440	182,941
Spot	440,565	498,810	[1]	977,095	852,000	1,257,508	1,789,973
Squeteagues	1,971,119	2,131,194	3,173,750	3,983,606	4,648,000	3,361,406	3,984,347
Striped bass	536,449	573,841	845,123	1,175,400	510,000	286,528	477,001
Sturgeon	227,797	175,210	404,125	144,705	62,000	7,587	19,159
Crabs	50,000	47,400	1,026,720	203,441	390,000	379,310	513,646
Shrimp	135,240	144,200	146,496	84,160	371,000	940,120	1,658,476
Clams, hard	----------	----------	937,808	1,175,176	726,000	197,576	263,536
Oysters, market	7,011,340	5,650,820	6,011,726	7,159,691	5,275,000	1,518,734	3,917,396
Scallops	15.750	18,000	118,323	13,020	[1]	422,832	554,574

[1] Statistics not available.

Comparative statistics of the yield of certain fishery products of South Carolina in various years, 1889 to 1923

Species	1889	1890	1897	1902	1908	1918	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Alewives	37,160	28,600	2,000	----------	----------	9,500	----------
Bluefish	110,060	100,480	40,000	1,000	7,400	3,000	7,000
Croaker	[1]	[1]	[1]	27,000	85,000	16,000	26,000
Drum, red and black	261,175	273,028	325,000	177,200	109,000	6,000	44,050
Flounders	----------	----------	----------	1,900	4,700	16,200	27,650
Mullet	464,400	552,813	61,000	138,600	708,500	272,100	532,000
Sea bass	886,274	826,164	632,400	709,545	491,000	132,000	218,000
Shad	577,457	563,259	506,125	434,133	464,000	167,462	183,916
Sheepshead	38,640	39,100	36,200	26,650	20,000	2,100	1,000
Spot	[1]	[1]	[1]	21,800	66,000	75,325	131,500
Squeteague	116,113	103,106	80,000	85,700	183,000	59,150	70,300
Striped bass	10,785	11,560	10,100	9,800	5,000	----------	----------
Sturgeon	284,730	216,099	480,905	94,150	[1]	117,890	49,981
Crabs, hard	86,230	93,260	110,000	96,200	33,000	18,000	9,000
Shrimp	380,400	371,840	374,500	369,500	452,000	55,400	355,000
Clams, hard	----------	----------	185,400	225,064	76,000	800	85,640
Oysters, market	305,340	442,050	1,504,300	4,827,900	10,941,000	2,783,830	5,032,342

[1] Statistics not available.

Comparative statistics of the yield of certain fishery products of Georgia in various years, 1889 to 1923

Species	1889	1890	1897	1902	1908	1918	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Alewives	36,000	24,000	25,000	22,500	32,000	----------	----------
Drum, red and black	48,675	53,870	38,100	60,000	151,000	1,674	600
Flounders	----------	----------	6,500	2,600	7,200	10,800	200
Groupers	----------	----------	----------	50,000	160,000	27,758	11,413
Menhaden	----------	----------	----------	----------	----------	29,484,600	26,973,000
Mullet	57,425	52,740	56,000	125,800	194,000	10,650	4,000
Sea bass	8,200	10,000	----------	76,500	235,000	292,615	104,090
Shad	356,352	399,660	787,550	1,029,050	1,333,000	100,540	133,750
Sheepshead	5,165	5,000	25,000	50,000	64,000	400	----------
Snapper, red	----------	----------	----------	125,000	880,000	112,349	104,970
Squeteague	130,337	144,000	54,650	82,550	140,000	39,550	5,000
Striped bass	13,260	9,000	9,000	2,500	8,900	125	360
Sturgeon	212,235	83,560	157,300	----------	100,000	39,150	32,038
Crabs, hard	43,267	47,866	74,660	80,000	196,000	8,455	120,000
Shrimp	150,000	162,160	67,600	344,127	528,000	5,793,465	10,668,380
Oysters, market	1,142,400	1,570,485	3,406,440	8,568,000	10,053,000	1,109,822	1,720,334

Comparative statistics of the yield of certain fishery products of the east coast of Florida in various years, 1889 to 1923

Species	1889	1890	1897	1902	1908	1918	1923
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Alewives		10, 120	41, 413	405, 697	1, 220, 000	692, 265	1, 062, 000
Bluefish	5, 240	7, 310	46, 421	79, 500	372, 000	561, 301	1, 100, 550
Bream and sunfish	497, 305	588, 190	248, 989	643, 514	1, 409, 000	(1)	476, 809
Croaker	(1)	(1)	(1)	6, 593	92, 000	124, 278	21, 550
Drum, red and black	213, 057	199, 290	252, 782	134, 885	818, 000	900, 091	168, 550
Flounders				49, 380	99, 000	13, 490	5, 850
Groupers				26, 910	45, 000	74, 783	17, 200
Menhaden	8, 000					48, 362, 600	57, 918, 030
Mullet	1, 216, 316	1, 568, 827	2, 449, 057	7, 340, 916	8, 573, 000	10, 417, 889	6, 198, 200
Pompano	12, 434	30, 135	196, 344	265, 231	276, 000	133, 419	60, 650
Sea bass	10, 800	10, 445	5, 570	29, 800	110, 000	41, 331	4, 175
Shad	2, 051, 033	2, 654, 022	1, 011, 180	1, 819, 431	2, 833, 000	963, 606	502, 866
Sheepshead	264, 491	274, 113	390, 164	404, 251	1, 098, 000	104, 303	32, 100
Snapper, red				20, 000	60, 000	20, 200	11, 600
Snapper, other				8, 043	110, 000	264, 264	149, 600
Spanish mackerel			3, 450	659, 088	1, 228, 000	3, 061, 965	2, 469, 400
Spot	(1)	(1)	(1)	32, 451	130, 000	393, 030	71, 700
Squeteague	243, 381	235, 284	516, 370	898, 563	3, 657, 000	1, 645, 223	1, 198, 400
Sturgeon	42, 620	29, 930			55, 000		
Crabs, hard	3, 000	4, 100	3, 700	6, 066	146, 000	52, 000	72, 000
Shrimp	78, 000	65, 825	38, 625	3, 012, 854	4, 346, 000	8, 867, 918	11, 024, 045
Oysters, market	436, 492	681, 450	362, 802	2, 163, 483	3, 704, 000	458, 990	502, 264

[1] Statistics not available.

MENHADEN INDUSTRY

The menhaden industry of the South Atlantic States in 1923 was prosecuted in North Carolina, Georgia, and on the east coast of Florida. There were 20 factories in operation, having a value of $1,835,751. The cash or working capital employed amounted to $212,000. There were 906 persons engaged in the factories, and the wages paid amounted to $175,215. The vessels and boats employed included 6 steam vessels, 39 gas vessels, 1 transporting vessel, and 3 motor boats, having a value of $965,029. The tonnage of the vessels was 2,138 net tons, and there were 997 fishermen. There were 49 purse seines used with vessels and boats, and the catch amounted to 148,180,970 pounds, or 246,968,283 in number, valued at $752,026. In addition to this there were 16,309,167 pounds or 27,181,945 menhaden, valued at $83,176, delivered to the menhaden firms by vessels other than those having their home ports in the South Atlantic States, making a total of 164,490,137 pounds, or 274,150,228 menhaden, valued at $835,202, utilized by these firms. Of the 20 menhaden factories 17 were located in North Carolina, but the greater part of the catch was taken in Georgia and on the east coast of Florida. The products, consisting of oil, fish scrap, and meal, in North Carolina were valued at $738,743, and in Georgia and the east coast of Florida at $593,008. The statistics are given in detail in the following table:

Menhaden industry of the South Atlantic States, 1923

Items	North Carolina		Georgia and Florida (east coast)		Total	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*
Firms	17	$1,508,899	3	$326,852	20	$1,835,751
Cash capital		87,000		125,000		212,000
Shoresmen	791		115		906	
Wages paid		119,543		55,672		175,215
Fishermen	660		337		997	
Vessels, steam	2	67,400	4	180,833	6	248,233
Net tonnage	160		353		513	
Vessels, gas	32	492,728	7	216,068	39	708,796
Net tonnage	1,240		369		1,609	
Power boats	3	1,500			3	1,500
Transporting vessels	1	6,500			1	6,500
Net tonnage	16				16	
Purse seines:						
On steam vessels	2	3,000	4	6,100	6	9,100
On gas vessels	33	50,200	7	10,400	40	60,600
On boats	3	4,000			3	4,000
Total	38	57,200	11	16,500	49	73,700
Catch:						
By steam vessels....pounds	2,292,400	22,930	33,172,260	161,472	35,464,660	184,402
By gas vessels....do	59,497,540	295,537	51,718,770	264,587	111,216,310	560,124
By boats....do	1,500,000	7,500			1,500,000	7,500
Total....do	63,289,940	325,967	84,891,030	426,059	[1] 148,180,970	752,026
Menhaden utilized [2]....do	79,599,107	409,143	84,891,030	426,059	[3] 164,490,137	835,202
Products:						
Oil....gallons	777,829	349,245	433,700	181,641	1,211,529	530,886
Dry scrap and meal....tons	4,596	210,712	5,744	277,327	10,340	488,039
Acidulated scrap....pounds	7,068	178,786	5,168	134,040	12,236	312,826
Total		738,743		593,008		1,331,751

[1] 246,968,283 in number.
[2] This item includes in addition to the catch 16,309,167 pounds, or 27,181,945 menhaden, valued at $83,176, delivered to North Carolina firms by vessels other than those having their home ports in the South Atlantic States.
[3] 274,150,228 in number.

FISHERIES OF NORTH CAROLINA

The fisheries of North Carolina in 1923 furnished employment for 9,308 persons, of whom 6,246 were directly employed in fishing operations and the transporting of fish to landing points, 669 in the wholesale fishery trade, and 2,393 in the canning, by-products, and other fishery industries.

The investment in the fishing equipment and fishery industries amounted to $4,198,894, of which $1,244,653 were invested in fishing and transporting vessels and boats, $523,286 in fishing gear, and $2,430,955 in investment and cash capital used in the fish trade and industries.

The production of fishery products by fishermen amounted to 95,192,343 pounds, valued at $2,414,499, of which 88,275,269 pounds, valued at $1,990,083, were fish, and 6,917,074 pounds, valued at $424,416, were shellfish. Some of the more important fishes, arranged in order of value, were the following: Shad, 2,370,134 pounds, valued at $582,591; menhaden, 63,289,940 pounds, valued at $325,967; squeteagues, 3,984,347 pounds, valued at $250,847, of which 3,070,437 pounds, valued at $134,531, were gray "trout" and 913,910 pounds, valued at $116,316, were speckled "trout"; mullet, 1,379,712 pounds fresh and 369,000 pounds salted, valued at $148,769; alewives, 1,589,347 pounds fresh and 4,933,050 pounds salted, valued at $119,404; striped bass, 477,001 pounds, valed at $75,953; bluefish, 896,694 pounds, valued at $66,805; spot, 1,672,223 pounds fresh and 78,500 pounds salted, valued at $60,397; and croakers, 2,262,308 pounds, valued at $53,993. Of the shellfish the following, arranged in order of value, were most important: Oysters, 3,904,446 pounds from public beds and 12,950 pounds from private beds, valued at $229,576; hard clams, 263,536 pounds, valued at $64,064; shrimp, 1,658,476 pounds, valued at $50,772; and scallops, 554,574 pounds, valued at $46,214.

Compared with 1918 there was an increase in the number of persons employed of 1,272, or 15.83 per cent, but a decrease in the investment of $23,149, or 0.55 per cent. There was also a decrease in the products of 115,309,407 pounds, or 54.78 per cent, in quantity and of $564,209, or 18.94 per cent, in value. The decrease in production was due to a falling off in the catch of menhaden.

The following tables give the number of persons employed, investment, and products of the fisheries of North Carolina, by counties, in 1923:

Persons engaged in the fisheries of North Carolina in 1923, by counties

Counties	On vessels fishing	On vessels transporting	In shore fisheries	Shoresmen	Total
Beaufort	51	9	155	150	365
Bertie			23	16	39
Bladen			25		25
Brunswick	189	8	583	301	1,081
Camden			6		6
Carteret	630	22	1,297	1,546	3,495
Chowan			193	108	301
Craven	3	1	51	10	65
Cumberland			50		50
Currituck			298		298
Dare	9	2	697	73	781
Duplin			75		75
Gates			38		38
Hertford			20	10	30
Hyde	21	2	230	4	257
Jones			2		2
Martin			67	34	101
New Hanover	60		504	547	1,111
Onslow			185	24	209
Pamlico	85	2	194	159	440
Pasquotank	7		36	10	53
Pender			157		157
Perquimans			58		58
Tyrrell			88	5	93
Washington		5	108	65	178
Total	1,055	51	5,140	3,062	9,308

Investment in the fisheries of North Carolina in 1923, by counties

Items	Beaufort		Bertie		Bladen		Brunswick	
	Number	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Vessels fishing:								
Gasoline	1	$700					12	$161,300
Tonnage	9						414	
Outfit		30						22,870
Sail	16	13,700						
Tonnage	125							
Outfit		1,720						
Accessory gasoline boats	9	1,150						
Vessels transporting:								
Gasoline	5	12,300					4	14,000
Tonnage	40						54	
Outfit		6,460						1,625
Sail							1	4,000
Tonnage							16	
Outfit								375
Power boats	49	9,000	5	$675			43	42,900
Sailboats	7	2,200						
Rowboats, etc	70	1,380	10	145	25	$150	219	3,185
Apparatus, vessel fisheries:								
Purse seines							10	17,500
Otter trawls							2	110
Dredges	34	908						

Investment in the fisheries of North Carolina in 1923, by counties—Continued

Items	Beaufort		Bertie		Bladen		Brunswick	
Apparatus, shore fisheries:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Haul seines	8	$3,400					21	$2,630
Gill nets	424	2,415			25	$350	59	1,360
Pound nets	123	12,110	56	$4,520				
Eel pots	130	300						
Otter trawls							34	1,955
Oyster dredges	14	350						
Tongs and rakes							216	567
Shore and accessory property		109,220		2,000		50		508,440
Cash capital		34,500						34,500
Total		211,843		7,340		550		817,317

Items	Camden		Carteret		Chowan		Craven	
Vessels fishing:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Steam			1	$35,500				
Tonnage			19					
Gasoline			48	304,180				
Tonnage			1,058					
Outfit				68,605				
Sail			22	17,605			1	$500
Tonnage			196				8	
Outfit				5,998				225
Accessory gasoline boats			44	21,150			1	150
Vessels transporting:								
Gasoline			16	21,200			1	1,500
Tonnage			141				12	
Outfit				10,000				2,500
Sail			1	300				
Tonnage			7					
Outfit				200				
Power boats	3	$475	563	141,875	52	$10,225	14	3,300
Sailboats			55	3,075				
Rowboats, etc	2	50	393	7,780	42	2,745	27	661
Apparatus, vessel fisheries:								
Purse seines			23	32,700				
Haul seines			34	21,200				
Lines				130				
Dredges			46	1,350			2	100
Tongs			38	211				
Apparatus, shore fisheries:								
Purse seines			3	4,000				
Haul seines			135	25,855			7	675
Gill nets	50	400	3,013	22,959	151	4,920	191	826
Pound nets			264	17,665	668	64,375		
Fyke nets	44	330						
Lines				50				
Eel pots	40	130	150	373				
Spears			22	45				
Otter trawls			14	463				
Scallop dredges			651	3,265				
Oyster dredges			2	50				
Tongs and rakes			430	1,111				
Other apparatus				412				
Shore and accessory property		50		631,187		18,150		8,225
Cash capital				92,100				6,500
Total		1,435		1,492,594		100,415		25,162

Items	Cumberland		Currituck		Dare		Duplin	
Vessels fishing:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Gasoline					1	$4,000		
Tonnage					9			
Outfit						75		
Sail					2	1,000		
Tonnage					14			
Outfit						135		
Vessels transporting:								
Gasoline					1	1,000		
Tonnage					8			
Outfit						300		
Power boats			162	$16,865	236	50,325		
Sailboats					4	400		
Rowboats, etc	25	$125	28	707	239	8,601	35	$215
Apparatus, vessel fisheries:								
Dredges					4	100		
Tongs					2	15		
Apparatus, shore fisheries:								
Purse seines					6	1,200		
Haul seines			143	10,635	100	12,479	10	400
Gill nets	25	260	200	1,025	4,318	10,235	90	450

Investment in the fisheries of North Carolina in 1923, by counties—Continued

Items	Cumberland		Currituck		Dare		Duplin	
Apparatus, shore fisheries—Contd.	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Pound nets			37	$2,175	1,187	119,117		
Fyke nets			395	3,585				
Lines						$225		
Eel pots			2,820	3,028	810	940		
Oyster dredges					2	35		
Tongs and rakes					19	89		
Other apparatus						100		
Shore and accessory property		$250		7,350		69,023		$25
Cash capital						2,500		
Total		635		45,370		281,894		1,090

Items	Gates		Hertford		Hyde		Jones	
Vessels fishing:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Sail					7	$3,850		
Tonnage					61			
Outfit						990		
Accessory gasoline boats					5	700		
Vessels transporting:								
Sail					1	600		
Tonnage					6			
Outfit						75		
Power boats	1	$100	2	$200	86	19,540		
Sailboats					27	4,905		
Rowboats, etc	32	350	8	140	31	885	2	$30
Apparatus, vessel fisheries:								
Dredges					14	285		
Apparatus, shore fisheries:								
Haul seines			3	400	7	950		
Gill nets	47	425	14	95	1,153	4,150	2	30
Pound nets	8	400	14	700	157	17,900		
Fyke nets	36	370						
Lines						2		
Eel pots					12	25		
Spears					5	10		
Oyster dredges					26	390		
Tongs and rakes					134	809		
Shore and accessory property		200		225		6,550		20
Cash capital						2,000		
Total		1,845		1,760		64,616		80

Items	Martin		New Hanover		Onslow		Pamlico	
Vessels fishing:	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*
Steam			2	$57,000				
Tonnage			160					
Outfit				10,400				
Sail							25	$28,375
Tonnage							257	
Outfit								2,635
Accessory gasoline boats							23	2,800
Vessels transporting:								
Gasoline							2	2,000
Tonnage							12	
Outfit								1,300
Power boats	3	$1,100	3	2,425	15	$2,465	56	13,625
Sailboats							17	4,200
Rowboats, etc	18	770	240	6,540	143	2,066	79	1,645
Apparatus, vessel fisheries:								
Purse seines			2	3,000				
Dredges							50	1,177
Apparatus, shore fisheries:								
Haul seines	4	2,600	37	3,000	8	560	31	2,150
Gill nets	3	75	243	6,250	157	2,818	703	2,150
Pound nets							147	8,125
Lines				300				
Eel pots							122	207
Spears			70	70				
Oyster dredges							34	590
Tongs and rakes			60	45	35	162	29	150
Other apparatus		346						
Shore and accessory property		5,090		715,450		4,120		47,245
Cash capital				31,000		3,500		16,500
Total		9,981		835,480		15,691		134,874

Investment in the fisheries of North Carolina in 1923, by counties—Continued

Items	Pasquotank		Pender		Perquimans	
	Number	Value	Number	Value	Number	Value
Vessels fishing:						
Gasoline	2	$1,800				
Tonnage	16					
Outfit		250				
Sail	1	1,200				
Tonnage	6					
Outfit		50				
Power boats	16	3,800	4	$800	18	$3,400
Rowboats, etc	15	455	132	1,060	22	515
Apparatus, vessel fisheries:						
Dredges	6	150				
Apparatus, shore fisheries:						
Haul seines			13	1,100		
Gill nets	361	5,315	53	960	421	6,690
Pound nets					34	1,700
Fyke nets	73	810				
Eel pots	45	67				
Spears			55	30		
Tongs and rakes			48	225		
Shore and accessory property		31,200		565		3.175
Cash capital		10,000				
Total		55,097		4,740		15,480

Items	Tyrrell		Washington		Total	
	Number	Value	Number	Value	Number	Value
Vessels fishing:						
Steam					3	$92,500
Tonnage					179	
Outfit						10,400
Gasoline					64	471,980
Tonnage					1,506	
Outfit						91,830
Sail					74	66,230
Tonnage					667	
Outfit						11,753
Accessory gasoline boats					82	25,950
Vessels transporting:						
Gasoline			1	$6,000	30	58,000
Tonnage			6		273	
Outfit				350		22,535
Sail					3	4,900
Tonnage					29	
Outfit						650
Power boats	34	$4,635	19	3,200	1,384	330,930
Sailboats					110	14,780
Rowboats, etc	28	850	27	1,165	1,892	42,215
Apparatus, vessel fisheries:						
Purse seines					35	53,200
Haul seines					34	21,200
Lines						130
Otter trawls					2	110
Dredges					156	4,070
Tongs					40	226
Apparatus, shore fisheries:						
Purse seines					9	5,200
Haul seines			2	8,000	529	74,834
Gill nets	655	6,370	160	2,395	12,518	82,923
Pound nets	80	4,995	98	5,600	2,873	259,382
Fyke nets					548	5,095
Lines						577
Eel pots					4,129	5,070
Spears					152	155
Otter trawls					48	2,418
Scallop dredges					651	3,265
Oyster dredges					78	1,415
Tongs and rakes					971	3,158
Other apparatus						858
Shore and accessory property		5,790		24,255		2,197,855
Cash capital						233,100
Total		22,640		50,965		4,198,894

Yield of the fisheries of North Carolina in 1923, by counties and species

Species	Beaufort		Bertie		Bladen		Brunswick	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	160,795	$1,850	22,832	$330				
Alewives, salted			111,550	2,123				
Angel fish	475	34						
Black bass	4,600	455	180	45				
Bluefish	1,215	85						
Butterfish	1,400	35						
Catfish	33,648	435	975	37			1,300	$130
Croaker	52,940	2,017					4,425	241
Drum, black							1,140	114
Drum, red, or redfish	7,200	250					13,825	1,323
Eels	21,475	2,940	50	6				
Flounders	3,973	296	50	3			20,000	1,025
Gizzard shad			200	2				
Hickory shad	71,854	4,524	1,200	98			110	22
King whiting							9,350	375
Menhaden							20,289,600	99,398
Mullet, fresh	13,000	1,200					32,500	2,840
Mullet, salted							340,050	34,515
Pigfish	79,015	1,621					70	7
Pike	1,750	140	100	20				
Pinfish, or sailor's choice	3,900	84					1,075	101
Shad	70,216	14,037	7,555	1,869	6,000	$1,600	1,750	385
Sheepshead	100	16					1,050	158
Spanish mackerel	720	89						
Spot, fresh	44,615	1,818					23,265	1,136
Spot, salted							78,500	5,750
Squeteague ("sea trout"), gray	199,714	6,290					10,600	1,657
Squeteague ("sea trout") speckled	30,906	4,829						
Striped bass	30,895	3,915	3,425	684			3,800	760
Sunfish	1,550	88						
White perch	7,515	439	1,095	110				
Yellow perch	40,280	2,027	100	8				
Shrimp							1,357,684	40,726
Clams, hard							104,000	26,000
Oysters, market, public	347,900	28,125					25,900	925
Oysters, market, private	4,200	600						
Total	1,235,851	78,239	149,312	5,335	6,000	1,600	22,319,994	217,588

Species	Camden		Carteret		Chowan		Craven	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	500	$10	24,850	$895	633,510	$9,992	36,000	$280
Alewives, salted					2,787,600	46,880		
Angel fish			5,000	252				
Black bass	250	40					100	2
Bluefish			511,190	45,199				
Bonito			37,870	2,557				
Bowfin	800	16						
Butterfish			177,426	9,350				
Carp, German	3,000	180			4,931	297	2,025	21
Catfish	500	20			15,715	629	21,400	428
Cero			1,139	124				
Croaker			1,734,495	34,700			73,500	2,940
Drum, red, or redfish			96,470	3,347				
Eels	1,000	100	15,535	2,325	6,585	721		
Flounders			70,762	3,419			7,150	654
Garfish							2,150	20
Grunts			1,100	33				
Harvest fish or "starfish"			219,070	7,892				
Hickory shad			66,850	3,399	62,307	6,035	100	6
King whiting			190,650	10,971				
Menhaden			40,707,940	203,639				
Mullet, fresh			495,404	34,365			41,800	4,180
Mullet, salted			6,800	760				
Pigfish			277,835	5,714				
Pinfish or sailor's choice			1,060	40				
Pompano			15,360	1,501				
Red snapper			1,200	84				
Sea bass			102,265	8,247				
Shad	9,500	2,400	103,319	26,044	201,496	46,303	205,637	54,510
Sheepshead			36,185	2,322				
Spanish mackerel			131,173	13,568				
Spot, fresh			766,248	17,919			36,500	1,460
Squeteague ("sea trout"), gray			815,290	39,073			33,900	2.712

Yield of the fisheries of North Carolina in 1923, by counties and species—Contd.

Species	Camden		Carteret		Chowan		Craven	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Squeteague ("sea trout"), speckled			418,900	$46,699			73,000	$10,950
Striped bass	500	$100	35,990	6,502	45,650	$7,242	19,425	3,622
Sunfish	1,000	20					2,500	150
Tautog			75	5				
White perch	734	57	300	54	29,660	2,972	23,200	2,320
Yellow perch	9,866	744			5,122	398	1,750	105
Crabs, soft			181,996	27,673				
Shrimp			252,792	8,606				
Clams, hard			115,192	26,292				
Oysters, market, public			1,591,156	89,477			28,000	1,800
Oysters, market, private			1,750	125				
Scallops			554,574	46,214				
Turtles			300	7				
Total	27,650	3,687	49,765,511	729,363	3,792,576	121,469	608,137	86,170

Species	Cumberland		Currituck		Dare		Duplin	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh			13,050	$562	276,228	$11,477	150	$6
Alewives, salted			15,000	300	20,400	254		
Angel fish					785	48		
Black bass			270,750	39,733	41,145	4,884		
Bluefish			2,200	176	326,881	16,555		
Bonito			800	19	4,400	112		
Bowfin			16,950	190	213	4		
Butterfish			500	10	53,264	3,359		
Carp, German			179,037	9,260	15,649	519		
Catfish			71,026	1,643	36,151	949		
Cod					340	10		
Croaker			10,200	204	180,078	6,883		
Drum, black					154	5		
Drum, red, or redfish			1,100	19	73,938	3,980		
Eels			95,192	7,980	23,089	994		
Flounders			7,900	289	162,991	9,577		
Gizzard shad					504	10		
Harvest fish or "starfish"			1,550	31	155,526	10,404		
Hickory shad			1,000	35	37,419	2,520	315	57
King whiting			38,000	760	230,474	4,925		
Mullet, fresh					50,867	4,032		
Pigfish					10,000	400		
Pike			3,550	320	1,300	142		
Pompano			3,500	166	22,212	1,348		
Shad	9,500	$2,200	11,825	4,005	1,164,106	299,972	3,970	1,095
Sheepshead			2,000	138	9,375	568		
Spanish mackerel			1,050	105	25,248	2,124		
Spot, fresh			44,000	880	486,345	15,220		
Squeteague ("sea trout"), gray			10,600	444	1,072,128	53,241		
Squeteague ("sea trout"), speckled			8,400	840	208,828	27,692		
Striped bass			31,490	5,534	96,054	13,062		
Sturgeon					13,964	2,306		
Sturgeon caviar					305	593		
Suckers			1,300	13				
Sunfish			35,965	412	285	15		
Tripletail					181	9		
White perch			203,400	13,943	31,233	1,591		
Yellow perch			151,912	9,492	10,250	400		
Other fish					163	5		
Crabs, hard					331,350	5,395		
Crabs, soft					300	19		
Clams, hard					344	97		
Oysters, market, public					57,288	4,485		
Terrapin					360	120		
Turtles					8,786	576		
Total	9,500	2,200	1,233,247	97,503	5,240,901	510,881	4,435	1,158

Yield of the fisheries of North Carolina in 1923, by counties and species—Contd.

Species	Gates		Hertford		Hyde		Jones	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	14,000	$174	28,600	$359	48,400	$1,079	2,000	$40
Alewives, salted	26,000	390	42,000	630				
Black bass	1,700	306	150	26				
Bluefish					28,995	1,512		
Bowfin	2,000	160						
Butterfish					43,240	1,150		
Catfish	12,850	414	1,450	69				
Croaker					39,460	659		
Drum, red, or redfish					20,900	413		
Eels	100	10	150	15	250	13		
Flounders					14,940	580		
Harvest fish or "starfish"					144,670	3,890		
Hickory shad					33,825	3,240		
King whiting					20,785	616		
Mullet, fresh					5,100	510		
Mullet, salted					22,150	4,030		
Pigfish					5,100	76		
Pike	25	5	75	15				
Pompano					7,350	535		
Shad	9,863	2,051	950	200	180,988	38,622		
Sheepshead					2,200	100		
Spanish mackerel					13,450	1,345		
Spot, fresh					26,085	417		
Squeteague ("sea trout"), gray					569,335	15,049		
Squeteague ("sea trout"), speckled					25,900	3,820		
Striped bass	100	15	300	45	21,250	3,628		
White perch	15,225	1,523	2,750	275	600	18		
Yellow perch	3,675	294	150	12	4,000	120		
Clams, hard					3,200	600		
Oysters, market, public					538,342	29,478		
Total	85,538	5,342	76,575	1,646	1,820,515	111,500	2,000	40

Species	Martin		New Hanover		Onslow		Pamlico	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	54,000	$648			130,522	$2,292	39,710	$1,914
Alewives, salted	340,000	5,950						
Angel fish			200	$10			445	54
Black bass							6,075	760
Bluefish			6,950	1,665	14,853	1,189	1,910	174
Butterfish							23,160	721
Carp, German	200	6						
Catfish	300	5					6,600	184
Crevalle			325	16				
Croaker			15,390	757	16,220	1,223	127,600	3,969
Drum, black			500	75				
Drum, red, or redfish			15,400	770			8,610	201
Eels							10,325	1,326
Flounders			25,400	3,580			4,100	328
Hickory shad	1,450	59	1,825	366			22,410	1,471
King whiting			6,700	350	61,200	3,209		
Menhaden			2,292,400	22,930				
Mullet, fresh			381,700	32,440	250,990	19,235	36,700	3,670
Pigfish			12,250	913			200	12
Pike							3,925	314
Pinfish or sailor's choice			250	13			7,575	187
Pompano			200	25			675	81
Shad	2,192	392	79,650	18,586			56,012	12,543
Sheepshead							275	44
Spanish mackerel			4,400	700			6,900	809
Spot, fresh			105,500	7,825	19,650	1,477	41,515	1,920
Squeteague ("sea trout"), gray			1,665	333	89,470	7,395	263,735	8,177
Squeteague ("sea trout"), speckled			6,300	1,260	45,376	6,729	87,300	12,222
Striped bass	5,300	795			6,145	1,044	17,860	3,315
Sturgeon			4,800	800				
White perch	13,200	864	500	25			1,625	163
Yellow perch							32,725	1,654
Shrimp			48,000	1,440				
Clams, hard			18,000	5,375	12,800	3,200		
Oysters, market, public			28,000	1,400	58,415	6,021	1,170,995	62,790
Oysters, market, private							7,000	500
Total	416,642	8,719	3,056,305	101,654	705,641	53,014	1,985,962	119,503

Yield of the fisheries of North Carolina in 1923, by counties and species—Contd.

Species	Pasquotank		Pender		Perquimans	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	10,200	$612	125	$3	83,975	$719
Alewives, salted	10,000	50			25,000	175
Angel fish			400	20		
Black bass	3,636	509			425	70
Bluefish			2,500	250		
Bowfin	976	19			70	1
Carp, German	1,554	70			451	18
Catfish	23,214	813			2,844	85
Croaker			8,000	400		
Drum, red, or redfish			8,000	460		
Eels	2,100	235			1,000	100
Flounders	630	43	14,500	2,220	377	25
Gizzard shad	4,536	92			3,665	73
Hickory shad	4,915	344	150	25	18,091	1,870
King whiting			3,000	120		
Mullet, fresh	601	48	71,000	6,940	50	4
Pigfish			800	80		
Pike	1,750	131			85	8
Pompano			250	25		
Shad	40,238	11,863	3,150	895	68,641	13,703
Sheepshead			500	75		
Spot, fresh			78,500	4,575		
Squeteague ("sea trout"), gray			4,000	160		
Squeteague ("sea trout"), speckled			9,000	1,275		
Striped bass	6,028	904	500	100	18,514	2,948
Stugeon					90	23
Suckers	69	3			25	1
Sunfish	1,008	121			75	9
White perch	9,106	820			2,479	226
Yellow perch	4,277	342			350	28
Other fish					50	8
Clams, hard			10,000	2,500		
Oysters, market, public	29,050	2,450	29,400	1,400		
Total	153,888	19,469	243,775	21,523	226,257	20,094

Species	Tyrrell		Washington		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	2,000	$25	7,900	$99	1,589,347	$33,366
Alewives, salted	251,500	3,771	1,304,000	25,515	4,933,050	86,038
Angel fish					7,305	418
Black bass	1,550	279	600	108	331,161	47,227
Bluefish					896,694	66,805
Bonito					43,070	2,688
Bowfin					21,009	390
Butterfish					298,990	14,625
Carp, German	1,425	42	875	25	209,147	10,438
Catfish	18,595	744	8,750	292	255,318	6,877
Cero					1,139	124
Cod					340	10
Crevalle					325	16
Croaker					2,262,308	53,993
Drum, black					1,794	194
Drum, red, or redfish					245,443	10,763
Eels	2,000	200	675	71	179,526	17,036
Flounders					332,773	22,039
Garfish					2,150	20
Gizzard shad					8,905	177
Grunts					1,100	33
Harvest fish or "starfish"					520,816	22,217
Hickory shad	40,800	4,070	16,900	1,457	381,521	29,598
King whiting					560,159	21,326
Menhaden					63,289,940	325,967
Mullet, fresh					1,379,712	109,464
Mullet, salted					369,000	39,305
Pigfish					385,270	8,823
Pike	1,000	230	350	88	13,910	1,413
Pinfish or sailor's choice					13,860	425
Pompano					49,547	3,681
Red snapper					1,200	84
Sea bass					102,265	8,217
Shad	59,850	13,444	73,726	15,872	2,370,134	582,591
Sheepshead					51,685	3,421
Spanish mackerel					182,941	18,740
Spot, fresh					1,672,223	54,647
Spot, salted					78,500	5,750

Yield of the fisheries of North Carolina in 1923, by counties and species—Contd.

Species	Tyrrell		Washington		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Squeteague ("sea trout"), gray					3,070,437	$134,531
Squeteague ("sea trout"), speckled					913,910	116,316
Striped bass	41,000	$7,380	92,775	$14,358	477,001	75,953
Sturgeon					18,854	3,129
Sturgeon caviar					305	593
Suckers					1,394	17
Sunfish					42,383	815
Tautog					75	5
Tripletail					181	9
White perch	30,170	3,620	65,750	4,729	438,542	33,749
Yellow perch	3,150	315	790	68	268,397	16,007
Other fish					213	13
Crabs, hard					[1] 331,350	5,395
Crabs, soft					[2] 182,296	27,692
Shrimp					1,658,476	50,772
Clams, hard					[3] 263,536	64,064
Oysters, market, public					[4] 3,904,446	228,351
Oysters, market, private					[5] 12,950	1,225
Scallops					[6] 554,574	46,214
Terrapin					360	120
Turtles					9,086	583
Total	453,040	34,120	1,573,091	62,682	95,192,343	2,414,499

[1] 994,050 in number.
[2] 546,888 in number.
[3] 32,942 bushels.
[4] 557,778 bushels.
[5] 1,850 bushels.
[6] 92,429 bushels.

FISHERIES BY APPARATUS

The vessel fisheries of North Carolina in 1923 employed 3 steamers, 64 motor vessels, 74 sailing vessels, and in addition 82 accessory gas boats, some of them employed as auxiliary power for sailing vessels and others in connection with the long-haul seine fishing. There were 35 purse seines, 34 haul seines, 2 otter trawls, 156 dredges, 40 tongs, and lines to the value of $130 used in the vessel fisheries The total yield by all forms of apparatus used on vessels was 66,355,182 pounds, valued at $543,167.

The catch by purse seines, consisting entirely of menhaden, and by far the most important apparatus in the vessel fishery, amounted to 61,789,940 pounds, valued at $318,467. The catch by dredges, which was next in importance, consisted of 2,048,508 pounds or 292,644 bushels of oysters, valued at $120,692, and 26,600 pounds of hard crabs, valued at $500. Haul seines were third in importance, with a catch of 2,128,505 pounds, valued at $71,439, most of which consisted of squeteagues, or "sea trout," and croaker. Next in order of value was the catch by lines, amounting to 132,220 pounds, valued at $19,054, consisting largely of sea bass and bluefish. The catch by tongs, consisting of oysters, and the catch by otter trawls, consisting of shrimp, made up the remainder of the yield of the vessel fishery.

In the shore or boat fisheries the total yield by all forms of apparatus was 28,837,161 pounds, valued at $1,871,332. The catch by pound nets, which were the most productive form of apparatus used in the shore fisheries, amounted to 9,279,555 pounds, valued at $532,667. Some of the more important species taken in pound nets were alewives, 1,233,805 pounds fresh and 3,326,550 pounds salted, valued together at $81,984; squeteagues, 1,781,808 pounds, valued at $72,117; and shad, 1,110,678 pounds, valued at $270,421.

A number of other species were taken in considerable quantities also. The catch with purse and haul seines in the shore fisheries amounted to 9,408,598 pounds, valued at $444,599. The catch with purse seines was 1,516,023 pounds, valued at $9,825, of which 1,500,000 pounds, valued at $7,500, was menhaden, while the remainder consisted of striped bass and squeteagues. The catch with haul seines was 7,892,575 pounds, valued at $434,774. Among the more important species taken in haul seines were alewives, 102,815 pounds fresh and 1,533,000 pounds salted, valued together at $31,012; spot, 1,040,316 pounds fresh and 66,000 pounds salted, valued together at $36,449; mullet, 582,474 pounds fresh and 271,000 pounds salted, valued together at $74,296; and squeteagues, 826,536 pounds, valued at $74,457. Various other species, as black bass, bluefish, German carp, catfish, croaker, red drum, king whiting, pigfish, striped bass, white perch, yellow perch, crabs, and shrimp, were also taken in large quantities. The yield by gill nets, which was much less in quantity but exceeded that of seines in value, amounted to 5,221,200 pounds, valued at $581,849. The principal species included in the catch, in the order of their value, were shad, 1,182,898 pounds, valued at $293,320; mullet, 796,060 pounds fresh and 98,000 pounds salted, valued together at $74,377; squeteagues 775,697 pounds fresh and 202,006 pounds salted, valued together at $73,968; bluefish 483,287 pounds, valued at $30,680; and striped bass, 158,124 pounds valued at $27,865. The catch taken with dredges, tongs, rakes, and hands totaled 2,506,697 pounds, valued at $207,633. The catch consisted principally of oysters, scallops, and hard clams. A small quantity of soft crabs was also taken with rakes. Various species were taken with fyke nets, amounting to 210,121 pounds, valued at $14,533, and with lines, 356,750 pounds, valued at $8,678.

The catch with otter trawls amounted to 1,470,174 pounds, valued at $44,250, of which 1,440,940 pounds, valued at $43,287, were shrimp and the remainder consisted of various species of fish. The catch with eelpots consisted of 160,402 pounds of eels, valued at $15,569 and with spears, 73,000 pounds of flounders, valued at $7,280. With other forms of apparatus, such as stop nets, cast nets, dip nets, revolving traps, crab traps, drag nets, and turtle traps, there were taken 150,664 pounds of various species, valued at $14,254. The largest item in this catch was 84,121 pounds of soft crabs, valued at $12,592. The products of the vessel and shore fisheries are shown separately by counties in the appended tables:

Yield of the vessel fisheries of North Carolina in 1923, by counties, apparatus, and species

Apparatus and species	Brunswick		Cartaret		New Hanover		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines: Menhaden	20,289,600	$99,398	39,207,940	$196,139	2,292,400	$22,930	61,789,940	$318,467
Haul seines:								
Angel fish			4,000	200			4,000	200
Bluefish			79,200	3,960			79,200	3,960
Butterfish			35,600	1,780			35,600	1,780
Croaker			1,220,000	24,400			1,220,000	24,400
Drum, red			52,620	1,380			52,620	1,380
Flounders			4,535	199			4,535	199
Harvest fish or "star-fish"			48,000	2,400			48,000	2,400

Yield of the vessel fisheries of North Carolina in 1923, by counties, apparatus, and species—Continued

Apparatus and species	Brunswick		Cartaret		New Hanover		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
King whiting			11,900	$595			11,900	$595
Pigfish			138,000	2,760			138,000	2,760
Pompano			6,300	630			6,300	630
Sheepshead			2,000	200			2,000	200
Spanish mackerel			3,950	395			3,950	395
Spot			128,000	2,560			128,000	2,560
Squeteague ("sea trout"), gray			189,200	9,460			189,200	9,460
Squeteague ("sea trout"), speckled			205,200	20,520			205,200	20,520
Total			2,128,505	71,439			2,128,505	71,439
Lines:								
Angel fish			360	20			360	20
Bluefish			61,800	13,476			61,800	13,476
Flounders			900	50			900	50
Grunt			800	24			800	24
Pigfish			300	9			300	9
Pinfish or sailor's choice			660	26			660	26
Red snapper			700	49			700	49
Sea bass			66,700	5,400			66,700	5,400
Total			132,220	19,054			132,220	19,054
Otter trawls: Shrimp	50,524	$1,515					50,524	1,515

Apparatus and species	Beaufort		Carteret		Craven		Dare	
Dredges:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, hard							26,600	$500
Oysters, market, public	291,200	$22,875	753,963	$42,947	28,000	$1,800	14,000	1,000
Oysters, market, private	4,200	600						
Total	295,400	23,475	753,963	42,947	28,000	1,800	40,600	1,500
Tongs: Oysters, market, public			171,885	11,000			7,000	500

Apparatus and species	Hyde		Pamlico		Pasquotank		Total	
Dredges:	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crabs, hard							26,600	$500
Oysters, market, public	104,300	$6,015	823,795	$43,005	29,050	$2,450	2,044,308	120,092
Oysters, market, private							4,200	600
Total	104,300	6,015	823,795	43,005	29,050	2,450	2,075,108	121,192
Tongs: Oysters, market, public							178,885	11,500

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species

BY PURSE SEINES

Species	Carteret		Dare		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Menhaden	1,500,000	$7,500			1,500,000	$7,500
Squeteague, speckled			500	$73	500	73
Striped bass			15,523	2,252	15,523	2,252
Total	1,500,000	7,500	16,023	2,325	1,516,023	9,825

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY HAUL SEINES

Species	Beaufort		Brunswick		Cartaret		Craven	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	40,285	$424			5,000	$50	36,000	$280
Angel fish					540	27		
Black bass	1,500	75						
Bluefish					186,045	12,198		
Bonito					1,600	32		
Butterfish					20,475	784		
Carp, German							2,025	21
Catfish	28,368	292					21,400	428
Croaker	7,150	191	500	$20	345,840	6,903	73,500	2,940
Drum, red, or redfish	4,350	174			42,035	1,903		
Eels	8,475	340						
Flounders	1,280	111			13,842	687	2,150	194
Garfish							2,150	20
Harvest fish or "starfish"					11,050	590		
Hickory shad	26,859	1,260			8,150	417		
King whiting			500	25	37,860	1,846		
Mullet, fresh			9,000	740	227,500	16,025	15,500	1,550
Mullet, salted			271,000	27,400				
Pigfish	78,165	1,604			124,600	2,509		
Pompano					8,145	815		
Shad	11,141	2,562			4,265	1,725		
Sheepshead					21,220	1,082		
Spanish mackerel					38,535	3,800		
Spot, fresh	3,890	311	7,300	335	417,950	9,057	36,500	1,460
Spot, salted			66,000	4,800				
Squeteague, gray	7,800	338	2,000	200	126,975	8,172	33,900	2,712
Squeteague, speckled	3,880	659			184,275	22,069	73,000	10,950
Striped bass	8,190	1,232					13,200	2,376
Sunfish	100	10						
White perch	5,900	307					8,100	810
Yellow perch	24,475	1,224						
Other fish [1]			100	4	75	5		
Crabs, soft					96,543	14,881		
Shrimp					115,673	4,430		
Total	261,808	11,114	356,400	33,524	2,038,193	110,007	317,425	23,741

Species	Currituck		Dare		Duplin		Hertford	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	2,450	$42	4,000	$215	80	$3	15,000	$188
Alewives, salted			8,000	160			15,000	225
Angel fish			613	37				
Black bass	268,700	39,389	40,750	4,830				
Bluefish	2,200	176	43,425	2,872				
Bonito	800	19	4,400	112				
Bowfin	15,000	151	100	2				
Butterfish	500	10	2,300	46				
Carp, German	154,037	7,760	15,000	490				
Catfish	65,526	1,400	13,075	238				
Cod			182	5				
Croaker	10,200	204	105,682	3,519				
Drum, black			64	2				
Drum, red, or redfish	1,100	19	36,829	1,753				
Flounders	7,900	289	51,832	2,266				
Harvest fish or "starfish"	1,550	31	6,800	136				
Hickory shad	1,000	35	10,000	600	170	30		
King whiting	38,000	760	221,402	4,470				
Mullet, fresh			2,574	97				
Pigfish			10,000	400				
Pike	3,550	320	1,300	142				
Pompano	3,500	166	19,620	1,005				
Shad			52,035	12,381	1,925	520		
Sheepshead	2,000	138	9,200	552				
Spanish mackerel	1,050	105	6,900	656				
Spot, fresh	44,000	880	387,476	11,226				
Squeteague, gray	10,600	444	119,176	5,574				
Squeteague, speckled	8,400	840	107,860	13,094				
Striped bass	24,140	3,869	45,917	5,681				
Suckers	1,300	13						
Sunfish	30,765	308	200	8				
White perch	189,400	12,225	24,000	920			100	10
Yellow perch	75,012	3,821	9,000	300				
Total	962,680	73,414	1,359,712	73,789	2,175	553	30,100	423

[1] Crevalle, hogfish, pinfish, and tautog.

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY HAUL SEINES—Continued

Species	Hyde		Martin		New Hanover		Onslow	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, salted			310,000	$5,425				
Angel fish					200	$10		
Bluefish	620	$37			5,700	1,425	6,300	$504
Croaker	2,800	43			13,400	670		
Drum, black					500	75		
Drum, red, or redfish	5,000	100			3,400	170		
Flounders	40	2			100	15		
Harvest fish or "starfish"	835	25						
Hickory shad			1,450	59				
King whiting	225	10			5,500	290	45,650	2,282
Mullet, fresh	5,000	500			254,700	21,770	20,200	1,544
Pigfish	750	11			10,450	778		
Pompano					200	25		
Shad			2,192	392				
Sheepshead	100	10						
Spot, fresh	10,700	160			50,000	3,750		
Squeteague, gray	63,500	1,715					14,452	1,011
Squeteague, speckled	5,250	525			6,300	1,260	5,267	532
Striped bass			5,300	795			2,400	415
White perch			12,600	810	500	25		
Other fish [1]					575	29		
Shrimp					48,000	1,440		
Total	94,820	3,138	331,542	7,481	399,525	31,732	94,269	6,288

Species	Pamlico		Pender		Washington		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh							102,815	$1,202
Alewives, salted					1,200,000	$24,000	1,533,000	29,810
Angel fish			400	$20			1,753	94
Black bass							310,950	44,294
Bluefish	300	$36	2,500	250			247,090	17,498
Bonito							6,800	163
Bowfin							15,100	153
Butterfish							23,275	840
Carp, German							171,062	8,271
Catfish	400	10					128,769	2,368
Cod							182	5
Croaker	77,000	1,545	8,000	400			644,072	16,435
Drum, black							564	77
Drum, red, or redfish	8,300	189	8,000	460			109,014	4,768
Eels							8,475	340
Flounders	2,400	210	1,500	240			81,044	4,014
Garfish							2,150	20
Harvest fish or "starfish"							20,235	782
Hickory shad							47,629	2,401
King whiting			3,000	120			352,137	9,803
Mullet, fresh			48,000	4,670			582,474	46,896
Mullet, salted							271,000	27,400
Pigfish	200	12	800	80			224,965	5,394
Pike							4,850	462
Pompano	675	81	250	25			32,390	2,117
Shad					5,000	1,270	76,558	18,850
Sheepshead			500	75			33,020	1,857
Spanish mackerel	300	45					46,785	4,606
Spot, fresh	10,000	345	72,500	4,125			1,040,316	31,649
Spot, salted							66,000	4,800
Squeteague, gray	26,936	845	4,000	160			409,339	21,171
Squeteague, speckled	13,965	2,082	9,000	1,275			417,197	53,286
Striped bass	9,500	1,900	500	100	80,000	12,000	189,147	28,368
Suckers							1,300	13
Sunfish							31,065	326
White perch					50,000	3,000	290,600	18,107
Yellow perch							108,487	5,345
Other fish [1]							750	38
Crabs, soft							96,543	14,881
Shrimp							163,673	5,870
Total	149,976	7,300	158,950	12,000	1,335,000	40,270	7,892,575	434,774

[1] Crevalle, hogfish, pinfish, and tautog.

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Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY GILL NETS

Species	Beaufort		Bladen		Brunswick		Camden	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	1,975	$22						
Angel fish	100	8						
Black bass	2,250	270						
Bluefish	400	40						
Catfish	1,580	81			1,300	$130		
Croaker	19,200	1,000			1,560	151		
Drum, black					1,140	114		
Drum, red, or redfish	1,700	63			13,825	1,323		
Flounders	765	56			5,500	550		
Hickory shad	9,620	678			110	22		
King whiting					1,050	105		
Mullet, fresh	13,000	1,200			23,500	2,100		
Mullet, salted					69,050	7,115		
Pigfish					70	7		
Pike	1,750	140						
Pinfish or sailor's choice	2,700	54			975	97		
Shad	7,968	1,575	6,000	$1,600	1,750	385	9,500	$2,400
Sheepshead	100	16			1,050	158		
Spanish mackerel	100	15						
Spot, fresh	13,000	650			12,800	695		
Spot, salted					12,500	950		
Squeteague, gray	3,365	317			7,700	1,430		
Squeteague, speckled	19,515	3,023						
Striped bass	2,510	411			3,800	760		
Sunfish	100	10						
White perch							234	19
Yellow perch	13,815	699					866	69
Total	118,513	10,328	6,000	1,600	157,680	16,092	10,600	2,488

Species	Carteret		Chowan		Craven		Cumberland	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	12,500	$625	6,910	$190				
Black bass					100	$12		
Bluefish	182,090	15,380						
Bonito	30,000	2,400						
Butterfish	375	30						
Carp, German			550	17				
Catfish			4,300	172				
Cero	500	60						
Croaker	113,370	2,479						
Drum, red, or redfish	715	49						
Flounders	1,540	103			5,000	460		
Harvest fish or "starfish"	2,025	117						
Hickory shad	39,300	2,080	23,022	2,453	100	6		
King whiting	140,555	8,520						
Mullet, fresh	267,904	18,340			26,300	2,630		
Mullet, salted	6,800	760						
Pigfish	14,735	430						
Shad	39,740	11,929	115,580	26,457	205,637	54,510	9,500	$2,200
Sheepshead	12,815	1,025						
Spanish mackerel	49,570	5,462						
Spot, fresh	199,225	5,790						
Squeteague, gray	134,755	8,849						
Squeteague, speckled	28,925	4,035						
Striped bass	24,960	4,747	13,300	2,261	6,225	1,246		
Sunfish					2,500	150		
White perch	300	54	3,050	305	15,100	1,510		
Yellow perch					1,750	105		
Total	1,302,699	93,264	166,712	31,855	262,712	60,629	9,500	2,200

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY GILL NETS—Continued

Species	Currituck		Dare		Duplin		Gates	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	1,000	$35	4,300	$212	70	$3	8,000	$100
Alewives, salted							8,000	120
Bluefish			267,989	12,910				
Catfish							1,375	55
Croaker			9,418	428				
Drum, red, or redfish			24,674	1,480				
Hickory shad			6,070	426	145	27		
King whiting			371	19				
Mullet, fresh			47,716	3,887				
Shad	4,025	1,350	463,673	116,616	2,045	575	9,563	1,987
Sheepshead			75	7				
Spanish mackerel			200	16				
Spot, fresh			6,168	286				
Squeteague, gray			511,145	25,557				
Squeteague, speckled			93,732	13,578				
Striped bass	400	120	17,802	2,577				
Sturgeon			10,500	1,750				
Sturgeon caviar			145	193				
White perch	7,500	1,125					1,225	123
Total	12,925	2,630	1,463,978	179,942	2,260	605	28,163	2,385

Species	Hertford		Hyde		Jones		Martin		New Hanover	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	4,600	$58	2,000	$50	2,000	$40				
Alewives, salted							30,000	$525		
Bluefish			21,875	1,312					1,250	$240
Catfish	400	16								
Croaker			4,260	66					1,990	87
Drum, red, or redfish			7,400	143						
Flounders									2,300	115
Hickory shad			2,375	450					1,825	366
King whiting			2,010	101					1,200	60
Mullet, fresh			100	10					127,000	10,670
Mullet, salted			22,150	4,030						
Pigfish			3,100	46					1,800	135
Shad			19,913	5,352					79,650	18,586
Spanish mackerel			500	50					4,400	700
Spot, fresh			9,100	142					55,500	4,075
Squeteague, gray			22,800	743					1,665	333
Squeteague, speckled			11,600	1,560						
Striped bass			4,500	1,100						
Sturgeon									4,800	800
White perch	400	40								
Total	5,400	114	133,683	15,155	2,000	40	30,000	525	283,380	36,167

Species	Onslow		Pamlico		Pasquotank		Pender	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	130,522	$2,292	1,450	$73	10,200	$612	125	$3
Alewives, salted					10,000	50		
Angel fish			445	54				
Black bass			6,075	760				
Bluefish	8,553	685	1,130	113				
Catfish			4,425	140				
Croaker	16,220	1,223	45,085	2,313				
Drum, red, or redfish			310	12				
Flounders			960	59				
Gizard shad					4,536	92		
Hickory shad			5,575	401	4,915	344	150	25
King whiting	15,550	927						
Mullet, fresh	230,790	17,691	36,700	3,670			23,000	2,270
Pike			3,925	314				
Pinfish or sailor's choice			7,575	187				
Shad			5,300	1,040	40,238	11,863	3,150	895
Sheepshead			275	44				
Spanish mackerel			350	54				
Spot, fresh	19,650	1,477	30,865	1,543			6,000	450
Squeteague, gray	75,018	6,384	16,249	627				
Squeteague, speckled	40,109	6,197	8,125	1,335				
Striped bass	3,745	629	6,340	1,104	6,028	904		
White perch			1,050	105	1,500	135		
Yellow perch			32,090	1,614	2,000	160		
Total	540,157	37,505	214,299	15,562	79,417	14,160	32,425	3,643

Yield of shore fisheries of North Carolina in 1923, 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	8,975	$269	2,000	$25			196,627	$4,609
Alewives, salted			11,500	171	14,000	$240	73,500	1,106
Angel fish							545	62
Black bass	400	66					8,825	1,108
Bluefish							483,287	30,680
Bonito							30,000	2,400
Butterfish							375	30
Carp, German	426	17	1,175	35	500	15	2,651	84
Catfish	2,444	73	5,095	204	1,500	50	22,419	921
Cero							500	60
Croaker							211,103	7,747
Drum, black							1,140	114
Drum, red, or redfish							48,624	3,070
Flounders	377	25					16,442	1,368
Gizzard shad	3,665	73					8,201	165
Harvest fish or "starfish"							2,025	117
Hickory shad	17,791	1,834	37,700	3,760	16,500	1,425	165,198	14,297
King whiting							160,736	9,732
Mullet, fresh	50	4					796,060	62,472
Mullet, salted							98,000	11,905
Pigfish							19,705	618
Pike	60	4					5,735	458
Pinfish or sailor's choice							11,250	338
Shad	64,141	13,079	53,250	11,959	42,275	8,962	1,182,898	293,320
Sheepshead							14,315	1,250
Spanish mackerel							55,120	6,297
Spot, fresh							352,308	15,108
Spot, salted							12,500	950
Squeteague, gray							775,697	44,240
Squeteague, speckled							202,006	29,728
Striped bass	18,364	2,921	39,000	7,020	11,150	2,065	158,124	27,865
Sturgeon	90	23					15,390	2,573
Sturgeon caviar							145	193
Sunfish	75	9					2,675	169
White perch	2,229	201	2,020	242	750	79	35,358	3,938
Yellow perch	100	8	950	95	50	5	51,621	2,755
Other fish	95	2					95	2
Total	119,282	18,608	152,690	23,511	86,725	12,841	5,221,200	581,849

BY POUND NETS

Species	Beaufort		Bertie		Carteret		Chowan	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	118,535	$1,404	22,832	$330	7,350	$220	626,600	$9,802
Alewives, salted			111,550	2,123			2,787,600	46,880
Black bass	850	110	180	45				
Bluefish	815	45			1,555	125		
Bonito					6,270	125		
Butterfish	1,400	35			120,976	6,756		
Carp, German							4,381	280
Catfish	3,700	62	975	37			11,415	457
Croaker	26,590	826			55,285	918		
Drum, red, or redfish	1,150	13			1,100	15		
Eels			50	6			6,585	721
Flounders	1,928	129	50	3	14,245	580		
Harvestfish or "starfish"					157,995	4,785		
Hickory shad	35,375	2,586	1,200	98	19,400	902	39,285	3,582
King whiting					335	10		
Pigfish	850	17						
Pike			100	20				
Pinfish or sailor's choice	1,200	30						
Pompano					915	56		
Shad	51,107	9,900	7,555	1,869	59,314	12,390	85,916	19,846
Sheepshead					150	15		
Spanish mackerel	620	74			39,118	3,911		
Spot	27,725	857			21,073	512		
Squeteague, gray	185,549	5,635			363,360	12,492		
Squeteague, speckled	7,511	1,147						
Striped bass	20,195	2,272	3,425	684	11,030	1,755	32,350	4,981
Sunfish	1,350	68						
White perch	1,615	132	1,095	110			26,610	2,667
Yellow perch	1,990	104	100	8			5,122	398
Other fish	375	26	200	2	1,204	81		
Turtles					300	7		
Total	490,430	25,472	149,312	5,335	880,975	45,655	3,625,864	89,614

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY POUND NETS—Continued

Species	Currituck		Dare		Gates		Hertford	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	8,000	$450	267,928	$11,050	6,000	$74	9,000	$113
Alewives, salted	15,000	300	12,400	94	18,000	270	27,000	405
Black bass			395	54	100	18	150	26
Bluefish			15,467	773				
Butterfish			50,964	3,313				
Carp, German	2,500	150	649	29				
Catfish	1,750	93	23,076	711	675	35	1,050	53
Cod			158	5				
Croaker			64,978	2,936				
Drum, red, or redfish			12,435	747				
Eels			89	4	100	10	150	15
Flounders			111,159	7,311				
Harvestfish or "starfish"			148,726	10,268				
Hickory shad			21,349	1,494				
King whiting			8,701	436				
Mullet			577	48				
Pike					25	5	75	15
Pompano			2,592	343				
Shad	7,800	2,655	648,398	170,975	300	64	950	200
Sheepshead			100	9				
Spanish mackerel			18,148	1,452				
Spot			92,701	3,708				
Squeteague, gray			441,807	22,110				
Squeteague, speckled			6,736	947				
Striped bass	3,850	925	16,812	2,552	100	15	300	45
Sturgeon			3,464	556				
Sturgeon caviar			160	400				
Sunfish			85	7				
Trippletail			181	9				
White perch	2,500	300	7,233	671	1,400	140	2,250	225
Yellow perch	900	96	1,250	100	75	6	150	12
Other fish			1,042	31				
Turtles			3,786	76				
Total	42,300	4,969	1,983,546	243,219	26,775	637	41,075	1,109

Species	Hyde		Pamlico		Perquimans	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	46,400	$1,029	38,260	$1,841	75,000	$450
Alewives, salted					25,000	175
Black bass					25	4
Bluefish	6,500	163	480	25		
Butterfish	43,240	1,150	23,160	721		
Carp, German					25	1
Catfish			1,775	34	400	12
Croaker	32,400	550	5,515	111		
Drum, red, or redfish	8,500	170				
Eels					1,000	100
Flounders	12,900	478	740	59		
Harvestfish or "starfish"	143,835	3,865				
Hickory shad	31,450	2,790	16,835	1,070	300	36
King whiting	18,550	505				
Pigfish	1,250	19				
Pike					25	4
Pompano	7,350	535				
Shad	161,075	33,270	50,712	11,503	4,500	624
Sheepshead	2,100	90				
Spanish mackerel	12,950	1,295	6,250	710		
Spot	6,285	115	650	32		
Squeteague, gray	482,035	12,541	220,550	6,705		
Squeteague, speckled	9,050	1,735	65,210	8,805		
Striped bass	16,750	2,528	2,020	311	150	27
White perch	600	18	575	58	250	25
Yellow perch	4,000	120	635	40	250	20
Other fish					50	8
Total	1,047,220	62,966	433,367	32,025	106,975	1,486

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY POUND NETS—Continued

Species	Tyrrell		Washington		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh			7,900	$99	1,233,805	$26,862
Alewives, salted	240,000	$3,600	90,000	1,275	3,326,550	55,122
Black bass	1,550	279	600	108	3,850	644
Bluefish					24,817	1,131
Bonito					6,270	125
Butterfish					239,740	11,975
Carp, German	250	7	375	10	8,180	477
Catfish	13,500	540	7,250	242	65,566	2,276
Cod					158	5
Croaker					184,768	5,341
Drum, red, or redfish					23,185	945
Eels	2,000	200	675	71	10,649	1,127
Flounders					141,022	8,560
Harvestfish or "starfish"					450,556	18,918
Hickory shad	3,100	310	400	32	168,694	12,900
King whiting					27,586	951
Mullet					577	48
Pigfish					2,100	36
Pike	1,000	230	350	88	1,575	362
Pinfish or sailor's choice					1,200	30
Pompano					10,857	934
Shad	6,600	1,485	26,451	5,640	1,110,678	270,421
Sheepshead					2,350	114
Spanish mackerel					77,086	7,442
Spot					148,434	5,224
Squeteague, gray					1,693,301	59,483
Squeteague, speckled					88,507	12,634
Striped bass	2,000	360	1,625	293	110,607	16,748
Sturgeon					3,464	556
Sturgeon caviar					160	400
Sunfish					1,435	75
Trippleptail					181	9
White perch	28,150	3,378	15,000	1,650	87,278	9,374
Yellow perch	2,200	220	740	63	17,412	1,187
Other fish					2,871	148
Turtles					4,086	83
Total	300,350	10,609	151,366	9,571	9,279,555	532,667

BY FYKE NETS

Species	Camden		Currituck		Gates		Pasquotank		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives, fresh	500	$10	1,600	$35					2,100	$45
Black bass	250	40	2,050	344	1,600	$288	3,636	$509	7,536	1,181
Bowfin	800	16	1,950	39	2,000	160	976	19	5,726	234
Carp, German	3,000	180	22,500	1,350			1,554	70	27,054	1,600
Catfish	500	20	3,750	150	10,800	324	23,214	813	38,264	1,307
Flounders							630	43	630	40
Mullet							601	48	601	48
Pike							1,750	131	1,750	131
Striped bass	500	100	3,100	620					3,600	720
Suckers							69	3	69	3
Sunfish	1,000	20	5,200	104			1,008	121	7,208	245
White perch	500	38	4,000	293	12,600	1,260	7,606	685	24,706	2,276
Yellow perch	9,000	675	76,000	5,575	3,600	288	2,277	182	90,877	6,720
Total	16,050	1,099	120.150	8,510	30,600	2,320	43,321	2,624	210,121	14,553

BY LINES

Species	Carteret		Dare		Hyde		New Hanover		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angel fish	100	$5							100	$5
Bluefish	500	60							500	60
Drum, red, or redfish							12,000	$600	12,000	600
Flounders	200	10							200	10
Grunt	300	9							300	9
Pigfish	200	6							200	6
Pinfish or sailor's choice	400	14							400	14
Red snapper	500	35							500	35
Sea bass	35,000	2,800							35,000	2,800
Squeteague, gray	1,000	100			1,000	$50			2,000	150
Squeteague, speckled	500	75							500	75
Crabs, hard			304,750	$4,895					304,750	4,895
Crabs, soft			300	19					300	19
Total	38,700	3,114	305,050	4,914	1,000	50	12,000	600	356,750	8,678

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY OTTER TRAWLS

Species	Brunswick		Carteret		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Croaker	2,365	$70			2,365	$70
Flounders	14,500	475	500	$40	15,000	515
King whiting	7,800	245			7,800	245
Spot	3,165	106			3,165	106
Squeteague, gray	900	27			900	27
Shrimp	1,307,160	39,211	133,784	4,076	1,440,944	43,287
Total	1,335,890	40,134	134,284	4,116	1,470,174	44,250

BY EELPOTS AND SPEARS

Counties	Eelpots		Spears	
	Eels		Flounders	
	Pounds	*Value*	*Pounds*	*Value*
Beaufort	13,000	$2,600		
Camden	1,000	100		
Carteret	15,535	2,325	35,000	$1,750
Currituck	95,192	7,980		
Dare	23,000	990		
Hyde	250	13	2,000	100
New Hanover			23,000	3,450
Pamlico	10,325	1,326		
Pasquotank	2,100	235		
Pender			13,000	1,980
Total	160,402	15,569	73,000	7,280

BY DREDGES

Counties	Oyster dredges		Scallop dredges	
	Oysters, market, public		Scallops	
	Pounds	*Value*	*Pounds*	*Value*
Beaufort	56,700	$5,250		
Carteret	12,950	1,203	439,128	$36,594
Dare	7,000	500		
Hyde	117,600	8,400		
Pamlico	292,250	16,675		
Total	486,500	32,028	439,128	36,594

BY TONGS, RAKES, AND HAND

Apparatus and species	Brunswick		Carteret		Dare		Hyde	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Tongs:								
Clams, hard	30,400	$7,600	600	$150	344	$97		
Oysters, market, public			383,600	22,101	14,637	1,242	316,442	$15,063
Oysters, market, private			1,750	125				
Total	30,400	7,600	385,950	22,376	14,981	1,339	316,442	15,063
Rakes:								
Clams, hard	71,200	17,800	79,728	18,860			3,200	600
Crabs, soft			1,332	200				
Oysters, market, public			5,180	444	14,651	1,243		
Scallops			112,698	9,391				
Total	71,200	17,800	198,938	28,895	14,651	1,243	3,200	600
Hand:								
Clams, hard	2,400	600	34,864	7,282				
Oysters, market, public	25,900	925	263,578	11,782				
Total	28,300	1,525	298,442	19,064				

Yield of shore fisheries of North Carolina in 1923, by apparatus, counties, and species—Continued

BY TONGS, RAKES, AND HAND—Continued

Apparatus and species	New Hanover		Onslow		Pamlico		Pender		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Tongs:										
Clams, hard							2,800	$700	34,144	$8,547
Oysters, market, public			58,415	$6,021	54,950	$3,110	21,000	1,000	849,044	48,537
Oysters, market, private					7,000	500			8,750	625
Total			58,415	6,021	61,950	3,610	23,800	1,700	891,938	57,709
Rakes:										
Clams, hard	18,000	$5,375					7,200	1,800	179,328	44,435
Crabs, soft									1,332	200
Oysters, market, public									19,831	1,687
Scallops									112,698	9,391
Total	18,000	5,375					7,200	1,800	313,189	55,713
Hand:										
Clams, hard			12,800	3,200					50,064	11,082
Oysters, market, public	28,000	1,400					8,400	400	325,878	14,507
Total	28,000	1,400	12,800	3,200			8,400	400	375,942	25,589

BY OTHER APPARATUS

Species	Carteret		Dare		Martin		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Alewives					54,000	$648	54,000	$648
Carp					200	6	200	6
Catfish					300	5	300	5
White perch					600	54	600	54
Crabs, soft	84,121	$12,592					84,121	12,592
Shrimp	3,335	100					3,335	100
Scallops	2,748	229					2,748	229
Turtles			360	$120			360	120
Terrapin			5,000	500			5,000	500
Total	90,204	12,921	5,360	620	55,100	713	150,664	14,254

INDUSTRIES

Wholesale trade.—The wholesale trade in fresh fish, oysters, etc., in North Carolina in 1923 was conducted by 54 firms, having an investment of $301,192. The number of persons employed was 475 and the wages paid amounted to $112,646. In the salt-fish trade there were 22 establishments with an investment of $282,428. There were 194 persons employed and the wages paid amounted to $82,459. The products salted included alewives, 8,200 pounds, valued at $202; mullet, 531,000 pounds, valued at $56,895; and spot, 271,000 pounds, valued at $21,775; a total of 810,200 pounds, valued at $78,872. Most of these firms engaged in the fresh-fish trade also.

Oyster-canning industry.—There were six establishments, valued at $144,440, engaged in canning oysters, having a working capital of $20,500 and employing 300 persons, to whom $50,548 were paid in wages. The products included 37,857 cases of canned oysters, valued at $190,613, and 4,400 tons of lime made from oyster shells, valued at $23,750.

Statistics of these industries are given in detail in the following tables:

Wholesale fresh-fish trade of North Carolina in 1923

Items	Number	Value
Establishments	54	$213,092
Cash capital		88,100
Persons engaged	475	
Wages paid		112,646

Salt-fish trade of North Carolina in 1923

Items	Number	Value
Establishments	22	$241,428
Cash capital		41,000
Persons engaged	194	
Wages paid		82,459
PRODUCTS SALTED		
Alewives	8,200	202
Mullet	531,000	56,895
Spot	271,000	21,775
Total	810,200	78,872

NOTE.—Most of the above firms also handled fresh fish.

Oyster canning and by-products industries of North Carolina in 1923

Items	Number	Value
Establishments	6	$144,440
Cash capital		20,500
Persons engaged	300	
Wages paid		50,548
PRODUCTS		
Oysters, canned:		
4-ounce (4 dozen) cases	667	3,337
5-ounce (4 dozen) do	33,222	167,958
10-ounce (2 dozen) do	3,968	19,318
Total	37,857	190,613
BY-PRODUCTS		
Lime tons	4,400	23,750

NOTE.—The poultry grit output of two firms is included under South Carolina. The statistics for one firm canning shrimp are included under the east coast of Florida. In addition to the canned products and by-products above, there were produced canned alewives and porpoise oil having a combined value of $11,119.

FISHERIES OF SOUTH CAROLINA

The fisheries of South Carolina are less extensive than those of the other South Atlantic States. In 1923 the number of persons engaged was 2,164, of whom 1,052 were fishermen in the vessel and shore fisheries, 94 were on transporting vessels, and 1,018 were engaged in fishery industries, including the wholesale fishery trade and canning industry.

The investment in the fisheries was $606,781, which included 50 fishing and transporting vessels of 597 net tons, valued at $73,300, with outfits valued at $8,200; 750 boats, valued at $38,025; fishing apparatus used on vessels and boats to the value of $24,872; shore and accessory property valued at $366,884; and cash or working capital amounting to $95,500.

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The total yield of the fisheries in 1923 was 6,763,279 pounds, valued at $284,791. The most important species taken, arranged in order of value, were oysters, 5,032,342 pounds or 718,906 bushels valued at $113,955; shad, 183,916 pounds, valued at $43,721; mullet, 152,500 pounds fresh and 253,000 pounds salted, valued together at $35,200; sea bass, 218,000 pounds, valued at $20,300; and sturgeon, including sturgeon caviar, 49,981 pounds, valued at $16,708.

Compared with 1918 there was an increase of 164, or 8.20 per cent, in the number of persons engaged; $385,530, or 174.25 per cent, in the investment; and 3,016,347 pounds, or 80.50 per cent, in the quantity and $77,101, or 37.12 per cent, in the value of the products. There was an increase in the oyster production of 321,216 bushels, or 81 per cent, and $17,413, or 18 per cent, in value. There was also an increase in the catch of shad, mullet, sea bass, and various other species. In the catch of sturgeon and a few other species there was a decrease.

The following tables give, by counties, the number of persons engaged, investment, and products of the fisheries of South Carolina in 1923:

Persons engaged in the fisheries of South Carolina in 1923, by counties

Counties	On vessels fishing	On vessels transporting	In shore fisheries	Shoremen	Total
Beaufort		84	225	622	931
Charleston	8	10	283	331	632
Colleton			72		72
Georgetown			284	60	344
Horry			180	5	185
Total	8	94	1,044	1,018	2,164

Investment in the fisheries of South Carolina, in 1923, by counties

Items	Beaufort		Charleston		Colleton		Georgetown		Horry		Total	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels, fishing:												
Gasoline			1	$3,500							1	$3,500
Tonnage			11								11	
Outfit				2,000								2,000
Vessels, transporting:												
Gasoline	9	$37,500	6	10,200							15	47,700
Tonnage	156		68								224	
Outfit		2,700		550								3,250
Sail	34	22,100									31	22,100
Tonnage	362										362	
Outfit		2,950										2,950
Power boats	2	1,000	16	4,750			38	$16,300	2	$275	58	22,325
Sailboats			10	1,000			8	800			18	1,800
Rowboats	243	4,960	181	2,365	49	$1,110	147	4,075	54	1,390	674	13,900
Apparatus, vessel fisheries:												
Lines				100								100
Apparatus, shore fisheries:												
Haul seines							3	350	13	1,345	16	1,695
Gill nets	30	700	40	2,500	52	2,690	144	14,070	15	1,500	281	21,460
Stop nets									7	210	7	210
Lines				150								150
Spears							30	25	25	22	55	47
Otter trawls	1	50					7	300			8	350
Tongs	20	120	6	30			20	100			46	250
Rakes			3	3			56	45	25	22	84	70
Grabs	248	310	132	165	25	40	20	25			425	540
Shore and accessory property		149,898		195,159				20,177		1,650		366,884
Cash capital		52,000		38,000				4,500		1,000		95,500
Total		274,288		260,472		3,840		60,767		7,414		606,781

Yield of the fisheries of South Carolina in 1923, by counties and species

Species	Beaufort		Charleston		Colleton	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Catfish			2,000	$60		
Crevalle			7,000	350		
Croaker			20,000	1,000		
Drum, black			10,000	300		
Drum, red, or redfish			17,000	850		
Flounders			1,000	50		
Groupers			8,000	480		
King whiting			60,000	6,000		
Red snapper			2,000	200		
Scup or porgy			7,500	525		
Sea bass			218,000	20,300		
Shad	23,450	$6,900	27,440	5,880	34,867	$7,584
Sharks			18,000	360		
Sheepshead			1,000	80		
Skates			3,000	60		
Spot, fresh			500	30		
Squeteague or "sea trout"			60,000	6,000		
Sturgeon			3,213	1,125		
Sturgeon caviar			30	90		
Crabs, hard			9,000	270		
Shrimp	20,000	700				
Clams, hard			776	125		
Oysters, market, public	3,080,875	71,405	1,305,157	23,967	89,194	1,912
Oysters, market, private	67,116	2,921	343,000	10,750	35,000	750
Total	3,191,441	81,926	2,123,616	78,852	159,061	10,246

Species	Georgetown		Horry		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish	2,000	$300	5,000	$400	7,000	$700
Catfish	500	19			2,500	79
Crevalle					7,000	350
Croaker	4,200	166	1,800	108	26,000	1,274
Drum, black	3,050	92			13,050	392
Drum, red, or redfish	8,000	400	6,000	480	31,000	1,730
Flounders	6,600	510	20,050	1,604	27,650	2,164
Groupers					8,000	480
Hickory shad	7,500	750			7,500	750
King whiting	2,300	135	21,100	1,688	83,400	7,823
Mullet, fresh	20,000	1,000	132,500	10,600	152,500	11,600
Mullet, salted	85,000	6,800	168,000	16,800	253,000	23,600
Red snapper					2,000	200
Scup or porgy			1,000	80	8,500	605
Sea bass					218,000	20,300
Shad	82,619	19,997	15,540	3,360	183,916	43,721
Sharks					18,000	360
Sheepshead					1,000	80
Skates					3,000	60
Spot, fresh	21,000	1,050	35,000	2,800	56,500	3,880
Spot, salted	10,000	600	40,000	4,000	50,000	4,600
Squeteague or "sea trout"	6,500	650	3,800	304	70,300	6,954
Sturgeon	46,193	13,858			49,406	14,983
Sturgeon caviar	545	1,635			575	1,725
Sunfish			1,500	120	1,500	120
Crabs, hard					[1] 9,000	270
Shrimp	335,000	11,725			355,000	12,425
Clams, hard	64,360	6,923	20,504	2,563	[2] 85,640	9,611
Oysters, market, public	105,000	1,500	7,000	750	[3] 4,587,226	99,534
Oysters, market, private					[4] 445,116	14,421
Total	810,367	68,110	478,794	45,657	6,763,279	284,791

[1] 27,000 in number. [2] 10,705 bushels. [3] 655,318 bushels. [4] 63,588 bushels.

FISHERIES BY APPARATUS

In South Carolina in 1923 there was only one vessel engaged in fishing. The entire catch, consisting of groupers, red snappers, and sea bass, was taken with lines and amounted to 160,000 pounds, valued at $14,180. In the shore or boat fisheries a number of forms of fishing apparatus were used, the most productive of which were grabs, taking 4,884,362 pounds or 697,766 bushels, of oysters, valued at $101,134. The catch with haul seines, consisting chiefly of mullet and spot, amounted to 443,900 pounds, valued at $39,011. The catch with gill nets, consisting chiefly of shad, mullet, and sturgeon, amounted to 351,897 pounds, valued at $68,774. Lines, which were used only in Charleston County, took 284,000 pounds of various species, valued at $22,735. The principal species taken with this apparatus were king whiting, sea bass, and squeteague or "sea trout." The catch of shrimp, amounting to 355,000 pounds, valued at $12,425, was taken with otter trawls. The catch with tongs included oysters, 140,980 pounds or 20,140 bushels, valued at $12,071; and hard clams 22,448 pounds or 2,806 bushels, valued at $1,684. Hard clams taken with rakes amounted to 63,192 pounds or 7,899 bushels, valued at $7,927. Oysters taken by hand without apparatus amounted to 7,000 pounds or 1,000 bushels, valued at $750. The catch with stop nets, consisting of mullet and spot, amounted to 19,000 pounds, valued at $1,580, and the catch with gigs or spears, consisting of redfish or red drum, flounders, and squeteague or "sea trout," amounted to 31,500 pounds, valued at $2,520.

The products of the vessel and shore or boat fisheries by counties, apparatus, and species are given in the following tables:

Yield of the vessel fisheries of South Carolina in 1923, by counties, apparatus, and species

Apparatus and species	Charleston	
	Pounds	*Value*
Lines:		
Groupers	8,000	$480
Red snappers	2,000	200
Sea bass	150,000	13,500
Total	160,000	14,180

Yield of the shore fisheries of South Carolina in 1923, by counties, apparatus, and species

Items	Beaufort		Charleston		Colleton	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Gill nets:						
Shad	23,450	$6,900	27,440	$5,880	34,867	$7,584
Sturgeon			3,213	1,125		
Sturgeon caviar			30	90		
Total	23,450	6,900	30,683	7,095	34,867	7,584
Lines:						
Catfish			2,000	60		
Croaker			20,000	1,000		
Crevalle			7,000	350		
Drum, black			10,000	300		
Drum, red, or redfish			17,000	850		
Flounders			1,000	50		
King whiting			60,000	6,000		
Scup or porgy			7,500	525		
Sea bass			68,000	6,800		
Sheepshead			1,000	80		
Sharks			18,000	360		
Skates			3,000	60		
Spot			500	30		
Squeteague or "sea trout"			60,000	6,000		
Crabs, hard			9,000	270		
Total			284,000	22,735		
Otter trawls: Shrimp	20,000	700				
Tongs:						
Oysters, market, public	83,321	5,952				
Oysters, market, private	29,659	2,119	28,000	4,000		
Total	112,980	8,071	28,000	4,000		
Grabs:						
Oysters, market, public	2,997,554	65,453	1,305,157	23,967	89,194	1,912
Oysters, market, private	37,457	802	315,000	6,750	35,000	750
Total	3,035,011	66,255	1,620,157	30,717	124,194	2,662
Rakes: Clams, hard			776	125		
Grand total	3,191,441	81,926	1,963,616	64,672	159,061	10,246

Yield of the shore fisheries of South Carolina in 1923, by counties, apparatus, and species—Continued

Items	Georgetown		Horry		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Haul seines:						
Bluefish			5,000	$400	5,000	$400
Catfish	300	$9			300	9
Croaker	200	6	1,800	108	2,000	114
Drum, black	50	2			50	2
Drum, red, or redfish			1,000	80	1,000	80
Flounders	300	15	50	4	350	19
King whiting	300	15	21,100	1,688	21,400	1,703
Mullet, fresh	5,000	250	117,500	9,400	122,500	9,650
Mullet, salted	30,000	2,400	165,000	16,500	195,000	18,900
Scup or porgy			1,000	80	1,000	80
Spot, fresh	6,000	300	34,000	2,720	40,000	3,020
Spot, salted	10,000	600	40,000	4,000	50,000	4,600
Sunfish			1,500	120	1,500	120
Squeteague or "sea trout"	500	50	3,300	264	3,800	314
Total	52,650	3,647	391,250	35,364	443,900	39,011
Gill nets:						
Bluefish	2,000	300			2,000	300
Catfish	200	10			200	10
Croaker	4,000	160			4,000	160
Drum, black	3,000	90			3,000	90
Drum, red, or redfish	8,000	400			8,000	400
Flounders	300	15			300	15
Hickory shad	7,500	750			7,500	750
King whiting	2,000	120			2,000	120
Mullet, fresh	15,000	750			15,000	750
Mullet, salted	55,000	4,400			55,000	4,400
Shad	82,619	19,997	15,540	$3,360	183,916	43,721
Spot	15,000	750			15,000	750
Sturgeon	46,193	13,858			49,406	14,983
Sturgeon caviar	545	1,635			575	1,725
Squeteague or "sea trout"	6,000	600			6,000	600
Total	247,357	43,835	15,540	3,360	351,897	68,774
Stop nets:						
Mullet, fresh			15,000	1,200	15,000	1,200
Mullet, salted			3,000	300	3,000	300
Spot			1,000	80	1,000	80
Total			19,000	1,580	19,000	1,580
Lines:						
Catfish					2,000	60
Croaker					20,000	1,000
Crevalle					7,000	350
Drum, black					10,000	300
Drum, red, or redfish					17,000	850
Flounders					1,000	50
King whiting					60,000	6,000
Scup or porgy					7,500	525
Sea bass					68,000	6,800
Sheepshead					1,000	80
Sharks					18,000	360
Skates					3,000	60
Spot					500	30
Squeteague or "sea trout"					60,000	6,000
Crabs, hard					9,000	270
Total					284,000	22,735
Gigs or spears:						
Drum, red, or redfish			5,000	400	5,000	400
Flounders	6,000	480	20,000	1,600	26,000	2,080
Squeteague or "sea trout"			500	40	500	40
Total	6,000	480	25,500	2,040	31,500	2,520
Otter trawls: Shrimp	335,000	11,725			355,000	12,425
Tongs:						
Clams, hard	22,448	1,684			22,448	1,684
Oysters, market, public					83,321	5,952
Oysters, market, private					57,659	6,119
Total	22,448	1,684			163,428	13,755

Yield of the shore fisheries of South Carolina in 1923, by counties, apparatus, and species—Continued

Items	Georgetown		Horry		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Grabs:						
Oysters, market, public	105,000	$1,500			4,496,905	$92,832
Oysters, market, private					387,457	8,302
Total	105,000	1,500			4,884,362	101,134
Rakes: Clams, hard	41,912	5,239	20,504	$2,563	63,192	7,927
By hand: Oysters, market, public			7,000	750	7,000	750
Grand total	810,367	68,110	478,794	45,657	6,603,279	270,611

INDUSTRIES

Wholesale trade.—In the wholesale fish trade in 1923 there were 7 establishments, valued at $55,162, with cash capital amounting to $8,500, employing 43 persons, to whom $35,073 were paid in wages. These firms handled fresh fish, oysters, and hard clams.

Oyster-canning industry.—There were 14 establishments engaged in canning oysters and in utilizing oyster shells, valued at $309,922, with cash capital amounting to $77,100, and employing 973 persons, to whom $135,522 were paid in wages. The pack of canned oysters amounted to 103,956 cases, or 4,546,800 cans of various sizes, valued at $510,829. In addition to this pack there were prepared from osyter shells, including the product of three plants in other States, 8,586 tons of poultry grit, valued at $82,048, and 1,324 tons of lime, valued at $9,775. The following tables give statistics of the wholesale trade and oyster-canning industry of South Carolina in 1923.

Wholesale fishery trade of South Carolina in 1923

Items	Number	Value
Establishments	7	$55,162
Cash capital		8,500
Persons engaged	43	
Wages paid		35,073

Oyster canning and by-products industries of South Carolina in 1923

Items	Number	Value
Establishments	14	$309,922
Cash capital		77,100
Persons engaged	973	
Wages paid		135,522
PRODUCTS		
Oysters canned:		
3-ounce (4 dozen) cases	591	2,945
4-ounce (4 dozen) do	12,412	58,156
5-ounce (4 dozen) do	72,387	365,300
6-ounce (4 dozen) do	104	1,040
8-ounce (2 dozen) do	2,195	10,293
10-ounce (2 dozen)	16,267	73,095
Total	103,956	510,829
BY-PRODUCTS		
Poultry grit tons	[1] 8,586	82,048
Lime do	[2] 1,324	9,775
Total	9,910	91,823
Grand total		602,652

[1] Includes poultry grit from oyster shells, made by one firm in Georgia and two firms in North Carolina.
[2] Includes lime from oyster shells made by one firm on the east coast of Florida.

NOTE.—The statistics for one firm canning shrimp are included under the east coast of Florida.

FISHERIES OF GEORGIA

The fisheries of Georgia in 1923 gave employment to 2,019 persons, of whom 186 were on vessels fishing, 29 on vessels transporting fishery products, 620 in the shore or boat fisheries, and 1,184 were shoremen in the wholesale fishery trade and oyster and shrimp canning industries.

The investment amounted to $1,378,704, which includes 42 fishing vessels and transporting vessels, valued at $202,275, with a net tonnage of 679 and outfits valued at $36,443; 492 power and other boats, valued at $137,765; fishing apparatus employed on vessels and boats valued at $19,832; shore and accessory property valued at $859,889; and cash capital amounting to $122,500.

The products amounted to 39,896,386 pounds, valued at $668,129. The most important species, arranged in the order of their value, were shrimp, 10,668,380 pounds, valued at $373,303; menhaden, 26,973,000 pounds, valued at $149,850; oysters, 1,720,334 pounds or 245,762 bushels, valued at $86,771; shad, 133,750 pounds, valued at $27,890; sea bass, 104,090 pounds, valued at $8,327; red snapper, 104,970 pounds, valued at $7,347; and hard crabs, 120,000 pounds, valued at $7,000.

Compared with 1918 there was an increase of 339, or 20.18 per cent, in the number of persons engaged in the fisheries and fishery industries; $608,706, or 79.05 per cent, in the investment; and 2,742,433 pounds, or 7.38 per cent, in the quantity and $252,086, or 60.59 per cent, in the value of the products. There was an increase in the catch of shrimp of 4,874,915 pounds and $199,313 in value and a considerable increase in the catch of shad and oysters. The catch of menhaden decreased 2,511,600 pounds in quantity but increased $61,397 in value. There was a decrease in the catch of red snapper and sea bass but a large increase in the catch of hard crabs.

The following tables give, by counties, the number of persons employed, investment, and the quantity and value of the products of the fisheries in 1923:

Persons engaged in the fisheries of Georgia in 1923, by counties

Counties	On vessels fishing	On vessels transporting	In shore fisheries	Shoremen	Total
Bryan			36		36
Camden	122		36	91	249
Chatham	42	16	207	175	440
Effingham			16		16
Glynn	22	7	190	545	764
Liberty		2	36	46	84
Long			2		2
McIntosh		4	83	327	414
Wayne			14		14
Total	186	29	620	1,184	2,019

Investment in the fisheries of Georgia in 1923, by counties

Items	Bryan		Camden		Chatham		Effingham		Glynn	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels, fishing:										
Gasoline			5	$122,000	8	$33,440			11	$26,635
Tonnage			201		185				83	
Outfit				19,918		11,270				3,575
Vessels transporting:										
Gasoline					1	1,000			6	5,100
Tonnage					5				53	
Outfit						75				650
Sail					8	8,500				
Tonnage					111					
Outfit						455				
Power boats			13	13,000	11	2,700			85	85,000
Rowboats	18	$360	10	200	173	3,440	8	$160	24	550
Apparatus, vessel fisheries:										
Purse seines			4	7,200						
Lines						300				
Otter trawls			1	50	4	180			11	550
Dredges					2	100				
Apparatus, shore fisheries:										
Gill nets	18	540	10	300	46	1,400	8	240	20	600
Otter trawls			13	650					85	4,250
Grabs					104	131			4	4
Tongs					104	520				
Lines						40				
Shore and accessory property				78,000		518,229				160,109
Cash capital				15,000		37,000				40,000
Total		900		256,318		618,780		400		327,023

Items	Liberty		Long		McIntosh		Wayne		Total	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels fishing:										
Gasoline									24	$182,075
Tonnage									469	
Outfit										34,763
Vessels transporting:										
Gasoline	1	$2,000			2	$3,600			10	11,700
Tonnage	20				21				99	
Outfit		200				300				1,225
Sail									8	8,500
Tonnage									111	
Outfit										455
Power boats	9	5,700			27	23,900			145	130,300
Rowboats	36	1,040	1	$20	68	1,515	9	$180	347	7,465
Apparatus, vessel fisheries:										
Purse seines									4	7,200
Lines										300
Otter trawls									16	780
Dredges									2	100
Apparatus, shore fisheries:										
Gill nets			6	30	19	1,180	19	270	146	4,560
Otter trawls					20	1,000			118	5,900
Grabs	36	45			39	66			183	246
Tongs	24	144			6	42			134	706
Lines										40
Shore and accessory property		10,400				93,151				859,889
Cash capital		4,000				26,500				122,500
Total		23,529		50		151,254		450		1,378,704

Yield of the fisheries of Georgia in 1923, by counties and species

Species	Bryan		Camden		Chatham		Effingham		Glynn	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Drum, red, or redfish									600	$36
Flounders									200	12
Groupers					11,413	$571				
Grunts					123	10				
Jewfish					2,767	111				
King whiting									1,000	100
Menhaden			26,973,000	$149,850						
Mullet									4,000	240
Pinfish or sailor's choice					400	24				
Red snapper					104,970	7,347				
Scup or porgy					1,601	182				
Sea bass					104,090	8,327				
Shad	35,640	$7,560	7,000	600	65,230	14,260	15,840	$3,360	3,300	700
Spot									600	36
Squeteague or "sea trout"									5,000	500
Striped bass					360	29				
Crabs, hard					120,000	7,000				
Shrimp			560,000	19,600	135,000	4,725			7,982,380	279,293
Oysters, market, public					712,775	50,913			49,595	1.063
Oysters, market, private					139,125	8,336			3,500	250
Octopus					50	10				
Terrapin					1,200	1,000				
Total	35,640	7,560	27,540,000	170,050	1,399,104	102,845	15,840	3,360	8,050,175	282,230

Species	Liberty		Long		McIntosh		Wayne		Total	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Drum, red, or redfish									600	$36
Flounders									200	12
Groupers									11,413	571
Grunts									123	10
Hickory shad			1,000	$100	5,660	$576	3,850	$390	10,510	1,066
Jewfish									2,767	111
King whiting									1,000	100
Menhaden									26,973,000	149,850
Mullet									4,000	240
Pinfish or sailor's choice									400	24
Red snapper									104,970	7,347
Scup or porgy									1,601	182
Sea bass									104,090	8,327
Shad			330	70	4,100	850	2,310	490	133,750	27,890
Spot									600	36
Squeteague, or "sea trout"									5,000	500
Striped bass									360	29
Sturgeon					32,000	3,600			32,000	3,600
Sturgeon caviar					38	114			38	114
Crabs, hard									[1] 120,000	7,000
Shrimp					1,991,000	69,685			10,668,380	373,303
Oysters, market, public	45,731	$1,960			140,686	3,444			[2] 948,787	57,380
Oysters, market, private	284,522	10,025			344,400	10,780			[3] 771,547	29,391
Octopus									50	10
Terrapin									1,200	1,000
Total	330,253	11,985	1,330	170	2,517,884	89,049	6,160	880	39,896,386	668,129

[1] 360,000 in number. [2] 135,541 bushels. [3] 110,221 bushels.

FISHERIES BY APPARATUS

The yield of all forms of apparatus employed in the vessel fisheries of Georgia in 1923 amounted to 28,233,374 pounds, valued at $203,602. The catch by purse seines, consisting entirely of menhaden, amounted to 26,973,000 pounds, valued at $149,850. The catch with lines, consisting of various species, the more important of which were red snapper and sea bass, amounted to 225,774 pounds, valued at $16,611. Otter trawls were used in taking shrimp, the catch amounting to 1,006,600 pounds, valued at $35,141. The catch with dredges consisted of 28,000 pounds, or 4,000 bushels, of oysters, valued at $2,000.

In the shore or boat fisheries the catch amounted to 11,663,012 pounds, valued at $464,527. The apparatus used included gill nets, grabs, tongs, otter trawls, and lines. The catch with gill nets, consisting of a number of species and including as its most important item the entire catch of shad, amounted to 188,298 pounds, valued at $34,094. The catch with grabs consisted of 824,670 pounds, or 117,810 bushels, of oysters, valued at $38,918, and with tongs, 776,545 pounds, or 110,935 bushels, valued at $43,865. Otter trawls took 9,661,780 pounds of shrimp, valued at $338,162. The entire catch of shrimp in both the vessel and shore fisheries was taken with this apparatus, but no other species was taken. Lines were used in taking hard crabs, the catch amounting to 120,000 pounds, valued at $7,000, which was the total catch of this species for the State. There were taken by hand, without apparatus, 91,119 pounds, or 13,017 bushels, of oysters, valued at $1,988, and 600 pounds of terrapin, valued at $500.

The products taken with the various forms of fishing apparatus employed in the vessel and shore or boat fisheries are given by counties and species in the appended tables:

Yield of the vessel fisheries of Georgia in 1923, by apparatus, species, and counties

Apparatus and species	Camden		Chatham		Glynn		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines: Menhaden	26,973,000	$149,850					26,973,000	$149,850
Lines:								
Groupers			11,413	$571			11,413	571
Grunts			123	10			123	10
Jewfish			2,767	111			2,767	111
Pinfish or sailor's choice			400	24			400	24
Red snapper			104,970	7,347			104,970	7,347
Scup or porgy			1,601	182			1,601	182
Sea bass			104,090	8,327			104,090	8,327
Striped bass			360	29			360	29
Octopus			50	10			50	10
Total			225,774	16,611			225,774	16,611
Otter trawls: Shrimp	100,000	3,500	135,000	4,725	771,600	$26,916	1,006,600	35,141
Dredges: Oysters, market, private			28,000	2,000			28,000	2,000
Grand total	27,073,000	153,350	388,774	23,336	771,600	26,916	28,233,374	203,602

Yield of the shore fisheries of Georgia in 1923, by apparatus, species, and counties

Apparatus and species	Bryan		Camden		Chatham		Effingham		Glynn	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Gill nets:										
Drum, red, or redfish									600	$36
Flounders									200	12
King whiting									1,000	100
Mullet									4,000	240
Shad	35,640	$7,560	7,000	$600	65,230	$14,260	15,840	$3,360	3,300	700
Spot									600	36
Squeteague or "sea trout"									5,000	500
Terrapin					600	500				
Total	35,640	7,560	7,000	600	65,830	14,760	15,840	3,360	14,700	1,624
Grabs:										
Oysters, market, public					285,110	20,365			39,676	850
Oysters, market, private					39,375	2,212			2,800	200
Total					324,485	22,577			42,476	1,050

Yield of the shore fisheries of Georgia in 1923, by apparatus, species, and counties—Continued

Apparatus and species	Bryan		Camden		Chatham		Effingham		Glynn	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Tongs:										
Oysters, market, public					427, 665	$30, 548				
Oysters, market, private					71, 750	4, 124				
Total					499, 415	34, 672				
Otter trawls: Shrimp			460, 000	$16, 100					7, 210, 780	$252, 377
Lines: Crabs, hard					120, 000	7, 000				
By hand:										
Oysters, market, public									9, 919	213
Oysters, market, private									700	50
Terrapin					600	500				
Total					600	500			10, 619	263
Grand total	35, 640	$7, 560	467, 000	16, 700	1, 010, 330	79, 509	15, 840	$3, 360	7, 278, 575	255, 314

Apparatus and species	Liberty		Long		McIntosh		Wayne		Total	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Gill nets:										
Drum, red, or redfish									600	$36
Flounders									200	12
Hickory shad			1, 000	$100	5, 660	$576	3, 850	$390	10, 510	1, 066
King whiting									1, 000	100
Mullet									4, 000	240
Shad			330	70	4, 100	850	2, 310	490	133, 750	27, 890
Spot									600	36
Squeteague or "sea trout"									5, 000	500
Sturgeon					32, 000	3, 600			32, 000	3, 600
Sturgeon caviar					38	114			38	114
Terrapin									600	500
Total			1, 330	170	41, 798	5, 140	6, 160	880	188, 298	34, 094
Grabs:										
Oysters, market, public	22, 862	$980			60, 186	1, 719			407, 834	23, 914
Oysters, market, private	142, 261	5, 012			232, 400	7, 580			416, 836	15, 004
Total	165, 123	5, 992			292, 586	9, 299			824, 670	38, 918
Tongs:										
Oysters, market, public	22, 869	980							450, 534	31, 528
Oysters, market, private	142, 261	5, 013			112, 000	3, 200			326, 011	12, 337
Total	165, 130	5, 993			112, 000	3, 200			776, 545	43, 865
Otter trawls: Shrimp					1, 991, 000	69, 685			9, 661, 780	338, 162
Lines: Crabs, hard									120, 000	7, 000
By hand:										
Oysters, market, public					80, 500	1, 725			90, 419	1, 938
Oysters, market, private									700	50
Terrapin									600	500
Total					80, 500	1, 725			91, 719	2, 488
Grand total	330, 253	11, 985	1, 330	170	2, 517, 884	89, 049	6, 160	880	11, 663, 012	464, 527

INDUSTRIES

Wholesale trade.—In 1923 there were 13 establishments in the wholesale fresh-fish trade in Georgia, valued at $175,701, with cash capital amounting to $37,000 and employing 179 persons, to whom $85,462 were paid in wages. These firms handled fresh fish, oysters, and shrimp.

Canning industry.—There were 13 establishments, including 2 firms on the east coast of Florida, in the canning industry, valued at $294,578. The cash capital used amounted to $83,000. There were 1,050 persons employed, to whom $150,859 were paid in wages. These firms were engaged in canning oysters, shrimp, and other fishery products and also in the preparation of poultry grit from oyster shells, which is included in the statistics for South Carolina. The canned products included 24,449 cases, or 1,154,736 cans, of canned oysters, valued at $126,877, and 93,019 cases, or 4,315,488 cans, valued at $554,660. Other canned fishery products were valued at $3,200. Statistics of the wholesale fresh fish trade and canning industry in 1923 are given in the following tables:

Wholesale fishery trade of Georgia in 1923

Items	Number	Value
Establishments	13	$175, 701
Cash capital		37, 000
Persons engaged	179	
Wages paid		85, 462

NOTE.—The statistics for Georgia's one menhaden plant are included under the general tables for the South Atlantic States, and the output of its one shell plant is included under South Carolina.

Oyster and shrimp canning industry of Georgia in 1923 [1]

Items	Number	Value
Establishments	13	$294, 578
Cash capital		83, 000
Persons engaged	1, 050	
Wages paid		150, 859
Total		528, 437
PRODUCTS		
Oysters canned:		
5-ounce (4 dozen) ... cases	23, 665	123, 051
8-ounce (2 dozen) ... do	278	1, 251
10-ounce (2 dozen) ... do	506	2, 575
Total	24, 449	126, 877
Shrimp canned:		
No. 1 (4 dozen) ... cases	86, 793	518, 563
No. 1½ (2 dozen) ... do	6, 226	36, 097
Total	93, 019	554, 660
Grand total	117, 468	681, 537

[1] Includes two firms in Florida (east coast).

NOTE.—In addition to canned shrimp and oysters there were produced $3,200 worth of miscellaneous canned fishery products.

FISHERIES OF EAST COAST OF FLORIDA

The statistics here presented are for the east coast of Florida, which among the South Atlantic States was surpassed in the extent of its fisheries only by North Carolina. The number of persons engaged in the fisheries in 1923 was 2,807, of whom 237 were on fishing and transporting vessels, 1,810 were in the shore or boat fisheries, and 760 in the wholesale fish trade, menhaden industry, and canning industry.

The investment amounted to $2,320,880 and includes 14 fishing and transporting vessels, valued at $226,400, with a net tonnage of 594 tons and outfits valued at $46,033; 1,306 power and row boats, valued at $532,550; fishing apparatus used on vessels and boats, valued at $131,614; shore and accessory property to the value of $1,106,083; and cash capital amounting to $278,200.

The products amounted to 86,895,922 pounds, valued at $1,719,921. The principal species taken, arranged in the order of their value, were shrimp, 11,024,045 pounds, valued at $385,361; menhaden, 57,918,030 pounds, valued at $276,209; mullet, 6,198,200 pounds, valued $194,092; Spanish mackerel 2,469,400 pounds, valued at $187,247; cero and kingfish, 1,965,457 pounds, valued at $161,077; bluefish, 1,100,550 pounds, valued at $147,321; squeteague or "sea trout," 1,198,400 pounds, valued at $122,854; shad, 502,866 pounds, valued at $62,447; catfish, 783,440 pounds, valued at $38,372; alewives, 1,048,000 pounds, valued at $26,700; sunfish, 476,809 pounds, valued at $19,672; oysters, 502,264 pounds, or 71,752 bushels, valued at $17,835; and sea crawfish or spiny lobster, 156,200 pounds, valued at $11,634.

Compared with 1918, there was a decrease of 523, or 15.71 per cent, in the number of persons engaged but an increase of $110,201, or 4.98 per cent, in the investment. There was an increase of 5,684,434 pounds, or 7 per cent, in the quantity, with a decrease of $26,254, or 1.5 per cent, in the value of the products. There was an increase in the catch of alewives, bluefish, blue runner or hardtail, catfish, menhaden, squeteague or "sea trout," shrimp, crabs, sea crawfish or spiny lobster, oysters, and various other species. There was a decrease in a number of species, the more important of which were mullet, pinfish or sailor's choice, pompano, sergeant fish or snook, shad, Spanish mackerel, and spot.

Statistics of the number of persons engaged, investment, and products of the fisheries of the east coast of Florida in 1923, by counties, are given in the following table:

Persons engaged in the fisheries of the east coast of Florida in 1923

Counties	On vessels fishing	On vessels transporting	In shore fisheries	Shoresmen	Total
Brevard			149	18	167
Broward			10		10
Clay			17		17
Dade	8		104	13	125
Duvall	99		156	90	345
Lake			12		12
Nassau	124	4	433	534	1,095
Palm Beach			377	47	424
Putnam			164	3	167
St. John		2	51	31	84
St. Lucie			212	24	236
Seminole			65		65
Volusia			60		60
Total	231	6	1,810	760	2,807

Investment in the fisheries of the east coast of Florida in 1923, by counties

Items	Brevard		Broward		Clay		Dade		Duvall		Lake		Nassau	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels fishing:														
Steam									1	$30,600			3	$124,700
Tonnage									64				289	
Outfit										10,000				16,683
Gasoline							1	$1,500	2	26,200			4	39,300
Tonnage							9		93				106	
Outfit								250		14,000				4,550
Vessels transporting:														
Gasoline													2	1,600
Tonnage													24	
Outfit														450
Power boats	68	$21,500	3	$1,000	4	$800	39	20,650	71	28,450	2	$400	207	292,800
Rowboats	139	4,020	1	75	13	330			35	1,050	6	165	36	850
Apparatus, vessel fisheries:														
Purse seines							1	1,000	3	2,100			4	7,200
Otter trawls													3	150
Apparatus, shore fisheries:														
Purse seines							4	6,000						
Haul seines			1	400	4	750			10	420	6	1,300		
Gill nets	141	16,950	2	300			20	2,500	72	10,200			10	300
Lines				30		90		700		120				
Otter trawls									10	400			204	11,000
Crab traps									30	75				
Dip nets							31	62						
Grabs													4	4
Shore and accessory property		43,200				40		19,000		418,369		2,000		363,686
Cash capital		9,000						7,500		109,500				98,000
Total		94,670		1,805		2,010		59,162		651,484		3,865		961,273

Items	Palm Beach		Putnam		Seminole		St. John		St. Lucie		Volusia		Total	
	No.	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*	*No.*	*Value*
Vessels fishing:														
Steam													4	$155,300
Tonnage													353	
Outfit														26,683
Gasoline													7	67,000
Tonnage													208	
Outfit														18,800
Vessels transporting:														
Gasoline							1	$2,500					3	4,100
Tonnage							9						33	
Outfit								100						550
Power boats	202	$73,250	34	$7,850	14	$2,650	27	14,250	105	$50,000	16	$4,050	792	517,650
Rowboats	11	1,090	105	2,675	44	1,125	26	650	30	1,000	68	1,870	514	14,900
Apparatus, vessel fisheries:														
Purse seines													8	10,300
Otter trawls													3	150
Apparatus, shore fisheries:														
Purse seines	1	1,500											5	7,500
Haul seines	3	1,800	27	6,100	27	4,350	5	590	1	400	1	50	85	16,160
Gill nets	126	20,325	29	2,750			2	100	125	21,250	41	5,800	568	80,475
Lines		2,675						100		860		20		4,595
Cast nets							6	30					6	30
Spears							3	3					3	3
Otter trawls							12	600					226	12,000
Crab traps													30	75
Dip nets													31	62
Tongs	1	7					12	90	5	35	17	119	35	251
Rakes							12	9					12	9
Grabs													4	4
Shore and accessory property		111,300		15,723		2,025		43,392		82,248		5,100		1,106,083
Cash capital		28,200		2,000				2,500		21,500				278,200
Total		240,147		37,098		10,150		64,914		177,293		17,009		2,320,880

Yield of the fisheries of the east coast of Florida in 1923 by counties and species

Species	Brevard		Broward		Clay		Dade		Duval	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Angel fish							100	$4		
Barracuda							500	20		
Black bass					2, 400	$360				
Bluefish			6, 200	$930			23, 100	915	1, 150	$103
Blue runner or hardtail			6, 000	300			600	48		
Catfish					100, 000	5, 000				
Cero and kingfish			15, 000	1, 200			258, 857	25, 885		
Crappie					2, 200	154				
Crevalle	400	$12					500	20	300	15
Croaker	500	20								
Drum, black	11, 600	348							2, 100	105
Drum, red, or redfish	20, 400	612	300	21					2, 750	195
Flounders	500	17							200	12
Groupers							6, 000	360		
Grunts							300	24		
Hogfish							350	28		
King whiting	14, 800	1, 160							13, 600	960
Menhaden									24, 639, 030	109, 643
Mullet	3, 148, 200	107, 382	20, 000	600			810, 000	15, 700	26, 000	1, 350
Permit			500	15						
Pigfish	5, 800	174								
Pinfish or sailor's choice	26, 200	786					100	5		
Pompano	200	40					200	40	150	38
Scup or porgy							1, 000	80		
Sea bass			150	12					1, 000	70
Shad									134, 750	17, 150
Sheepshead	5, 200	156								
Snapper, mangrove							2, 000	200		
Snapper, mutton	2, 100	63					5, 600	560		
Snapper, red							3, 000	300	800	56
Snook or sergeant fish	500	15								
Spanish mackerel			12, 000	1, 200			29, 000	3, 045		
Spot	18. 400	552							600	45
Squeteague or "sea trout"	436, 000	47, 410							29, 500	3, 540
Sunfish					28, 000	1, 680				
Yellowtail or "silver perch"							400	32		
Crabs, hard									72, 000	3, 600
Sea crawfish or spiny lobster							156, 200	11, 634		
Shrimp									150, 000	5, 250
Total	3, 690, 800	158, 747	60, 150	4, 278	132, 600	7, 194	1, 297, 807	58, 900	25, 073, 930	142, 132

Species	Lake		Nassau		Palm Beach		Putnam		St. Johns	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Alewives, fresh	260, 000	$6, 500					760, 000	$19, 000		
Alewives, salted							28, 000	1, 200		
Amberfish					3, 900	$122				
Angel fish					2, 300	72				
Barracuda					1, 600	48				
Black bass	20, 200	2, 020					30, 100	3, 040		
Bluefish					658, 700	98, 295			600	$60
Blue runner or hardtail					125, 000	2, 650				
Bonito					350	12				
Catfish	92, 000	4, 700					350, 000	16, 600		
Cero and kingfish					1, 587, 000	126, 670				
Crappie	10, 800	548					34, 000	1, 910		
Crevalle					73, 200	2, 206			200	6
Croaker					11, 650	351			900	45
Drum, black					1, 200	38			3, 000	100
Drum, red, or redfish					4, 600	204			8, 000	420
Flounders					400	23			1, 750	105
Groupers					8, 800	444				
Grunts					2, 850	136			100	3
Hogfish					200	6				
Jewfish					250	7				
King whiting			100, 000	$2, 000	9, 500	424			1, 600	140
Leatherjacket or "turbot"					400	16				
Menhaden			33, 279, 000	166, 566						
Moonfish					1, 400	45				
Mullet					355, 400	11, 512	24, 000	1, 000	11, 000	610
Permit					1, 600	56				
Pigfish					300	16			250	11
Pinfish or sailor's choice					3, 530	107			700	33
Pompano					29, 700	2, 628			1, 000	200
Porkfish					2, 000	60				
Scup or porgy					1, 000	30				

Yield of the fisheries of the east coast of Florida in 1923 by counties and species—Continued

Species	Lake		Nassau		Palm Beach		Putnam		St. Johns	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Sea bass					725	$44			500	$30
Shad	27,000	$3,397	7,000	$600			272,800	$33,256		
Sheepshead					15,950	772			350	21
Snapper, mangrove					9,900	328				
Snapper, mutton					76,000	2,440				
Snapper, red					4,000	230				
Snook or sergeant fish					45,100	1,362				
Spanish mackerel					1,163,400	92,642				
Spot					3,500	188			3,000	150
Squeteague or "sea trout"			10,000	300	97,500	9,750			23,500	2,350
Sunfish	81,000	3,240					299,000	12,000		
Yellowtail or "silver perch"					22,650	697				
Shrimp			10,424,045	364,341					450,000	15,770
Clams, hard									4,560	1,665
Oysters, market, public			224,000	4,200	1,050	120			126,000	3,750
Oysters, market, private			5,250	885					16,800	1,800
Total	491,000	20,405	44,049,295	538,892	4,326,605	354,751	1,797,900	88,006	653,810	27,269

Species	St. Lucie		Seminole		Volusia		Total	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Alewives, fresh							1,020,000	$25,500
Alewives, salted							28,000	1,200
Amberfish	200	$6					4,100	128
Angel fish	800	42					3,200	118
Barracuda	600	18					2,700	86
Black bass			29,593	$2,959			82,293	8,379
Bluefish	409,800	46,868			1,000	$150	1,100,550	147,321
Blue runner or hardtail	47,800	1,246					179,400	4,244
Bonito							350	12
Catfish			241,440	12,072			783,440	38,372
Cero and kingfish	104,600	7,322					1,965,457	161,077
Crappie			18,403	920			65,403	3,532
Crevalle	89,000	2,730			1,000	60	164,600	5,049
Croaker	8,200	246			300	12	21,550	674
Drum, black	22,400	676			6,400	252	46,700	1,519
Drum, red, or redfish	78,200	2,614			7,600	368	121,850	4,434
Flounders	1,600	278			1,400	54	5,850	489
Groupers	2,400	96					17,200	900
Grunts	4,400	144					7,650	307
Hogfish	1,000	30					1,550	64
Jewfish							250	7
King whiting	22,200	948			13,600	1,180	175,300	6,812
Leatherjacket or "turbot"							400	16
Menhaden							57,918,030	276,209
Moonfish	800	24					2,200	69
Mullet	1,361,600	41,868			442,000	14,070	6,198,200	194,092
Permit	3,600	108					5,700	179
Pigfish	800	24			7,000	210	14,150	435
Pinfish or sailor's choice	17,600	540			3,000	90	51,130	1,561
Pompano	23,400	4,680			6,000	1,300	60,650	8,926
Porkfish							2,000	60
Scup or porgy							2,000	110
Sas bass	1,800	108					4,175	264
Shad			61,316	8,044			502,866	62,447
Sheepshead	9,000	326			1,600	54	32,100	1,329
Snapper, mangrove	14,600	476					26,500	1,004
Snapper, mutton	39,400	1,242					123,100	4,305
Snapper, red	3,800	190					11,600	776
Snook or sergeant fish	93,800	2,887			300	9	139,700	4,273
Spanish mackerel	1,265,000	90,360					2,469,400	187,247
Spot	32,000	1,390			14,200	552	71,700	2,877
Squeteague or "sea trout"	504,500	50,970			97,400	8,534	1,198,400	122,854
Sunfish			68,809	2,752			476,809	19,672
Yellowtail or "silver perch"	5,600	168					28,650	897
Crabs, hard							[1] 72,000	3,600
Sea crawfish or spiny lobster							156,200	11,634
Shrimp							11,024,045	385,361
Clams, hard							[2] 4,560	1,665
Oysters, market, public	17,500	2,000			97,664	4,405	[3] 466,214	14,475
Oysters, market, private					14,000	675	[4] 36,050	3,360
Total	4,188,000	260,625	419,561	26,747	714,464	31,975	86,895,922	1,719,921

[1] 216,000 in number. [2] 570 bushels. [3] 66,602 bushels. [4] 5,150 bushels.

FISHERIES BY APPARATUS

The total catch taken by vessels in the fisheries of the east coast of Florida in 1923 amounted to 58,118,030 pounds, valued at $280,709, the species taken being menhaden, mullet, and shrimp. The only forms of fishing apparatus used on vessels were purse seines and otter trawls. The catch with purse seines included 57,918,030 pounds of menhaden, valued at $276,209, which was the entire catch of this species. There were also taken with this apparatus 100,000 pounds of mullet, valued at $1,500. The catch with otter trawls consisted of 100,000 pounds of shrimp, valued at $3,000.

In the shore or boat fisheries the catch amounted to 28,777,892 pounds, valued at $1,439,212. The forms of fishing apparatus used include purse seines, haul seines, gill nets, lines, otter trawls, cast nets, spears, crab traps, dip nets, tongs, rakes, and grabs. Gill nets were the most productive form of apparatus used, the catch amounting to 11,038,780 pounds, valued at $675,056. The principal species taken with gill nets were mullet, 5,381,200 pounds, valued at $175,562; Spanish mackerel, 2,418,500 pounds, valued at $183,110; squeteagues or "sea trout," 1,056,900 pounds, valued at $108,834; bluefish, 980,800 pounds, valued at $133,240; and shad 278,750 pounds, valued at $38,935. The catch with otter trawls, which was next in importance, amounted to 11,034,045 pounds, valued at $384,661, and included 10,924,045 pounds of shrimp, valued at $382,361; 100,000 pounds of king whiting, valued at $2,000; and 10,000 pounds of squeteague or "sea trout," valued at $300. The entire catch of shrimp was taken with this form of apparatus. The catch with seines amounted to 3,565,611 pounds, valued at $148,551. Purse seines took 684,000 pounds, valued at $16,050, including 660,000 pounds of mullet, valued at $14,850, and 24,000 pounds of bluefish, valued at $1,200.

The catch with haul seines amounted to 2,881,611 pounds, valued at $132,501. The principal species taken were alewives, 1,048,000 pounds, valued at $26,700; catfish, 743,440 pounds, valued at $36,372; shad, 224,116 pounds, valued at $23,512; and sunfish, 476,809 pounds, valued at $19,672. The catch with lines amounted to 2,434,782 pounds, valued at $197,663. Among the more important species taken with lines were bluefish, 76,200 pounds, valued at $10,544; catfish, 40,000 pounds, valued at $2,000; cero and kingfish, 1,962,457 pounds, valued at $160,777; snook or sergeant fish, 36,900 pounds, valued at $1,116; Spanish mackerel, 32,900 pounds, valued at $2,457; squeteague or "sea trout," 118,000 pounds, valued at $12,110; and hard crabs, 40,000 pounds, valued at $2,000. The catch of mullet and various other species with cast nets amounted to 8,150 pounds, valued at $457. There were taken with spears 1,500 pounds of flounders, valued at $90. Crab traps were used in taking hard crabs, the catch amounting to 32,000 pounds, valued at $1,600. The total catch of sea crawfish or spiny lobster, amounting to 156,200 pounds, valued at $11,634, was taken with dip nets. The forms of apparatus used in taking oysters and hard clams were tongs, rakes, and grabs. The catch of hard clams with tongs amounted to 3,040 pounds, or 380 bushels, valued at $1,110; and with rakes 1,520 pounds, or 190 bushels, valued at $555. The catch of oysters with tongs amounted to 155,414 pounds, or 22,202 bushels, valued at $9,900; with rakes to 12,600 pounds, or 1,800 bushels, valued at $1,350; and with grabs to 14,000 pounds, or 2,000 bushels, valued at $1,490. There were also taken by hand, without apparatus, 320,250 pounds of oysters, or 45,750 bushels, valued at $5,095. The products of the vessel and shore fisheries of the east coast of Florida taken by each form of fishing apparatus in 1923 are given by counties and species in the following tables:

Yield of vessel fisheries of the east coast of Florida in 1923, by counties, apparatus, and species

Apparatus and species	Dade		Duvall		Nassau		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Menhaden			24, 639, 030	$109, 643	33, 279, 000	$166, 566	57, 918, 030	$276, 209
Mullet	100, 000	$1, 500					100, 000	1, 500
Total	100, 000	1, 500	24, 639, 030	109, 643	33, 279, 000	166, 566	58, 018, 030	277, 709
Otter trawls: Shrimp					100, 000	3, 000	100, 000	3, 000
Grand total	100, 000	1, 500	24, 639, 030	109, 643	33, 379, 000	169, 566	58, 118, 030	280, 709

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species

BY SEINES

Apparatus and species	Broward		Clay		Dade		Duvall	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Bluefish					20, 000	$600		
Mullet					550, 000	11, 000		
Total					570, 000	11, 600		
Haul seines:								
Black bass			2, 400	$360				
Bluefish	1, 200	$180					150	$23
Catfish			60, 000	3, 000				
Crappie			2, 200	154				
Crevalle							300	15
Drum, black							600	30
Drum, red, or red fish							1, 250	90
Flounders							200	12
King whiting							5, 600	480
Mullet	15, 000	450					2, 000	150
Pompano							150	38
Spot							600	45
Squeteague or "sea trout"							5, 500	660
Sunfish			28, 000	1, 680				
Total	16, 200	630	92, 600	5, 194			16, 350	1, 543
Grand total	16, 200	630	92, 600	5, 194	570, 000	11, 600	16, 350	1, 543

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species—Continued

BY SEINES—Continued

Apparatus and species	Lake		Palm Beach		Putnam		Seminole	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Bluefish			4,000	$600				
Mullet			110,000	3,850				
Total			114,000	4,450				
Haul seines:								
Alewives, fresh	260,000	$6,500			760,000	$19,000		
Alewives, salted					28,000	1,200		
Black bass	20,200	2,020			30,100	3,040	29,593	$2,959
Bluefish			14,000	1,600				
Blue runner or hardtail			2,000	100				
Bonito			100	4				
Catfish	92,000	4,700			350,000	16,600	241,440	12,072
Cero and kingfish			3,000	300				
Crappie	10,800	548			34,000	1,910	18,403	920
Crevalle			8,000	240				
King whiting			200	10				
Mullet			25,000	750	4,000	200		
Permit			100	5				
Pinfish or sailor's choice			3,000	90				
Pompano			2,000	400				
Shad	27,000	3,397			135,800	12,071	61,316	8,044
Snapper, mutton			60,000	1,800				
Spanish mackerel			18,000	1,680				
Sunfish	81,000	3,240			299,000	12,000	68,809	2,752
Total	491,000	20,405	135,400	6,979	1,640,900	66,021	419,561	26,747
Grand total	491,000	20,405	249,400	11,429	1,640,900	66,021	419,561	26,747

Apparatus and species	St. John		St. Lucie		Volusia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Purse seines:								
Bluefish							24,000	1,200
Mullet							660,000	14,850
Total							684,000	16,050
Haul seines:								
Alewives, fresh							1,020,000	25,500
Alewives, salted							28,000	1,200
Barracuda			200	$6			200	6
Black bass							82,293	8,379
Bluefish			3,200	384	1,000	$150	19,550	2,337
Blue runner or hardtail			5,000	150			7,000	250
Bonito							100	4
Catfish							743,440	36,372
Cero and kingfish							3,000	300
Crappie							65,403	3,532
Crevalle			8,000	240	1,000	60	17,300	555
Croaker	400	$20	1,000	30			1,400	50
Drum, black	1,000	30	2,000	60	2,000	120	5,600	240
Drum, red, or redfish	5,000	250			4,000	240	10,250	580
Flounders							200	12
Grunts			800	24			800	24
King whiting	1,000	80	4,000	120	5,000	400	15,800	1,090
Moonfish			400	12			400	12
Mullet			1,000	30	4,000	240	51,000	1,820
Permit			400	12			500	17
Pigfish	100	5	400	12			500	17
Pinfish or sailor's choice	500	25					3,500	115
Pompano	1,000	200	2,000	400	2,000	500	7,150	1,538
Sea bass			800	48			800	48
Shad							224,116	23,512
Sheepshead	200	12					200	12
Snapper, mutton							60,000	1,800
Snook or sergeant fish			1,000	30			1,000	30
Spanish mackerel							18,000	1,680
Spot	2,000	100			200	12	2,800	157
Squeteague or "sea trout"	5,000	500			3,000	450	13,500	1,610
Sunfish							476,809	19,672
Yellowtail			1,000	30			1,000	30
Total	16,200	1,222	31,200	1,588	22,200	2,172	2,881,611	132,501
Grand total	16,200	1,222	31,200	1,588	22,200	2,172	3,565,611	148,551

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species—Continued

BY GILL NETS

Apparatus and species	Brevard		Broward		Dade		Duval	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Bluefish			5,000	$750	3,000	$300		
Blue runner or hardtail			6,000	300				
Crevalle	400	$12						
Croaker	500	20						
Drum, black	11,600	348						
Drum, red, or redfish	20,400	612	300	21				
Flounders	500	17						
King whiting	14,800	1,160						
Mullet	3,148,200	107,382	5,000	150	160,000	3,200	24,000	$1,200
Permit			500	15				
Pigfish	5,800	174						
Pinfish or sailor's choice	26,200	786						
Pompano	200	40						
Sea bass			150	12				
Shad							134,750	17,150
Sheepshead	5,200	156						
Snapper, mutton	2,100	63						
Snook, or sergeant fish	500	15						
Spanish mackerel			12,000	1,200	27,500	2,820		
Spot	18,400	552						
Squeteague or "sea trout"	436,000	47,410						
Total	3,690,800	158,747	28,950	2,448	190,500	6,320	158,750	18,350

Apparatus and species	Nassau		Palm Beach		Putnam		St. Johns	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Angel fish			300	$12				
Bluefish			592,400	88,850				
Blue runner or hardtail			123,000	2,550				
Crevalle			49,200	1,486			200	$6
Croaker			11,650	351				
Drum, black			800	26			500	15
Drum, red, or redfish			2,100	46			1,000	50
Flounders			300	18				
Grunts			600	32				
King whiting			8,900	402			600	60
Moonfish			1,400	45				
Mullet			220,400	6,912	20,000	$800	5,000	250
Permit			1,500	51				
Pigfish			300	16			50	3
Pinfish or sailor's choice			530	17			100	5
Pompano			27,700	2,228				
Porkfish			2,000	60				
Scup or porgy			1,000	30				
Sea bass			300	16				
Shad	7,000	$600			137,000	21,185		
Sheepshead			10,800	504			100	6
Snapper, mangrove			6,600	206				
Snapper, mutton			12,600	428				
Snook or sergeant fish			12,400	372				
Spanish mackerel			1,140,000	90,550				
Spot			3,500	188			600	30
Squeteague or "sea trout"			68,500	6,850			3,000	300
Yellowtail or "silver perch"			22,650	697				
Total	7,000	600	2,321,430	202,943	157,000	21,985	11,150	725

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species—Continued

BY GILL NETS—Continued

Apparatus and species	St. Lucie		Volusia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberfish	200	$6			200	$6
Angel fish	800	42			1,100	54
Barracuda	400	12			400	12
Bluefish	380,400	43,340			980,800	133,240
Blue runner or hardtail	42,800	1,096			171,800	3,946
Crevalle	76,200	2,346			126,000	3,850
Croaker	7,200	216	300	$12	19,650	599
Drum, black	20,400	616	4,400	132	37,700	1,137
Drum, red, or redfish	68,000	2,206	3,000	110	94,800	3,045
Flounders	1,400	270	1,400	54	3,600	359
Grunts	3,600	120			4,200	152
Hogfish	1,000	30			1,000	30
King whiting	17,200	798	8,600	780	50,100	3,200
Moonfish	400	12			1,800	57
Mullet	1,360,600	41,838	438,000	13,830	5,381,200	175,562
Permit	3,200	96			5,200	162
Pigfish	400	12	7,000	210	13,550	415
Pinfish or sailor's choice	17,600	540	3,000	90	47,430	1,438
Pompano	19,400	3,880	4,000	800	51,300	6,948
Porkfish					2,000	60
Scup or porgy					1,000	30
Sea bass	1,000	60			1,450	88
Shad					278,750	38,935
Sheepshead	6,800	260	1,600	54	24,500	980
Snapper, mangrove	7,600	266			14,200	472
Snapper, mutton	37,400	1,182			52,100	1,673
Snook or sergeant fish	88,600	2,731	300	9	101,800	3,127
Spanish mackerel	1,239,000	88,540			2,418,500	183,110
Spot	32,000	1,390	14,000	540	68,500	2,700
Squeteague or "sea trout"	467,000	47,160	82,400	7,114	1,056,900	108,834
Yellowtail or "silver perch"	4,600	138			27,250	835
Total	3,905,200	239,203	568,000	23,735	11,038,780	675,056

BY LINES

Apparatus and species	Broward		Clay		Dade		Duval		Palm Beach	
	Lbs.	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*	*Lbs.*	*Value*
Amberfish									3,900	$122
Angelfish					100	$4			2,000	60
Barracuda					500	20			1,600	48
Bluefish					100	15	1,000	$80	48,300	7,245
Blue runner or hardtail					600	48				
Bonito									250	8
Catfish			40,000	$2,000						
Cero and kingfish	15,000	$1,200			258,857	25,885			1,584,000	126,370
Crevalle					500	20			16,000	480
Drum, black							1,500	75	400	12
Drum, red, or redfish							1,500	105	2,500	158
Flounders									100	5
Groupers					6,000	360			8,800	444
Grunts					300	24			2,250	104
Hogfish					350	28			200	6
Jewfish									250	7
King whiting							8,000	480	400	12
Leatherjacket or "turbot"									400	16
Pinfish or sailor's choice					100	5				
Pompano					200	40				
Scup or porgy					1,000	80				
Sea bass							1,000	70	425	28
Sheepshead									5,150	268
Snapper, mangrove					2,000	200			3,300	122
Snapper, mutton					5,600	560			3,400	212
Snapper, red					3,000	300	800	56	4,000	230
Snook or sergeant fish									32,700	990
Spanish mackerel					1,500	225			5,400	412
Squeteague or "sea trout"							24,000	2,880	29,000	2,900
Yellowtail or "silver perch"					400	32				
Crabs, hard							40,000	2,000		
Total	15,000	1,200	40,000	2,000	281,107	27,846	77,800	5,746	1,754,725	140,259

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species—Continued

BY LINES—Continued

Apparatus and species	St. Johns		St. Lucie		Volusia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Amberfish							3,900	$122
Angelfish							2,100	64
Barracuda							2,100	68
Bluefish	600	$60	26,200	$3,144			76,200	10,544
Blue runner or hardtail							600	48
Bonito							250	8
Catfish							40,000	2,000
Cero and kingfish			104,600	7,322			1,962,457	160,777
Crevalle			4,800	144			21,300	644
Drum, black	500	15					2,400	102
Drum, red, or redfish	2,000	120	10,200	408	600	$18	16,800	809
Flounders	150	9	200	8			450	22
Groupers			2,400	96			17,200	900
Grunts	100	3					2,650	131
Hogfish							550	34
Jewfish							250	7
King whiting			1,000	30			9,400	522
Leatherjacket or "turbot"							400	16
Pigfish	100	3					100	3
Pinfish or sailor's choice							100	5
Pompano			2,000	400			2,200	440
Scup or porgy							1,000	80
Sea bass	500	30					1,925	128
Sheepshead			2,200	66			7,350	334
Snapper, mangrove			7,000	210			12,300	532
Snapper, mutton			2,000	60			11,000	832
Snapper, red			3,800	190			11,600	776
Snook or sergeant fish			4,200	126			36,900	1,116
Spanish mackerel			26,000	1,820			32,900	2,457
Squeteague or "sea trout"	15,500	1,550	37,500	3,810	12,000	970	118,000	12,110
Yellowtail or "silver perch"							400	32
Crabs, hard							40,000	2,000
Total	19,450	1,790	234,100	17,834	12,600	988	2,434,782	197,663

BY CAST NETS, SPEARS, AND OTTER TRAWLS

Apparatus and species	Duval		Nassau		St. Johns		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Cast nets:								
Croaker					500	$25	500	$25
Drum, black					1,000	40	1,000	40
Flounders					100	6	100	6
Mullet					6,000	360	6,000	360
Pinfish or sailor's choice					100	3	100	3
Sheepshead					50	3	50	3
Spot					400	20	400	20
Total					8,150	457	8,150	457
Spears: Flounders					1,500	90	1,500	90
Otter trawls:								
King whiting			100,000	$2,000			100,000	2,000
Squeteague or "sea trout"			10,000	300			10,000	300
Shrimp	150,000	$5,250	10,324,045	361,341	450,000	15,770	10,924,045	382,361
Total	150,000	5,250	10,434,045	363,641	450,000	15,770	11,034,045	384,661

BY CRAB TRAPS AND DIP NETS

Apparatus and species	Dade		Duval		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Crab traps: Crabs, hard			32,000	$1,600	32,000	$1,600
Dip nets: Sea crawfish or spiny lobsters	156,200	$11,634			156,200	11,634

Yield of the shore fisheries of the east coast of Florida in 1923, by counties, apparatus, and species—Continued

BY TONGS, RAKES, GRABS, AND HAND

Apparatus and species	Nassau		Palm Beach		St. Johns	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Tongs:						
Clams, hard					3,040	$1,110
Oysters, market, public			1,050	$120	14,000	1,500
Oysters, market, private					11,200	1,200
Total			1,050	120	28,240	3,810
Rakes:						
Clams, hard					1,520	553
Oysters, market, public					7,000	750
Oysters, market, private					5,600	600
Total					14,120	1,905
Grabs:						
Oysters, market, public	10.500	$900				
Oysters, market, private	3,500	590				
Total	14,000	1,490				
By hand:						
Oysters, market, public	213,500	3,300			105,000	1,500
Oysters, market, private	1,750	295				
Total	215,250	3,595			105,000	1,500

Apparatus and species	St Lucie		Volusia		Total	
	Pounds	*Value*	*Pounds*	*Value*	*Pounds*	*Value*
Tongs:						
Clams, hard					3,040	$1,110
Oysters, market, public	17,500	$2,000	97,664	$4,405	130,214	8,025
Oysters, market, private			14,000	675	25,200	1,875
Total	17,500	2,000	111,664	5,080	158,454	11,010
Rakes:						
Clams, hard					1,520	555
Oysters, market, public					7,000	750
Oysters, market, private					5,600	600
Total					14,120	1,905
Grabs:						
Oysters, market, public					10,500	900
Oysters, market, private					3,500	590
Total					14,000	1,490
By hand:						
Oysters, market, public					318,500	4,800
Oysters, market, private					1,750	295
Total					320,250	5,095

INDUSTRIES

Wholesale trade.—There were 50 establishments on the east coast of Florida in 1923 engaged in the wholesale trade in fishery products, valued at $524,475. The cash capital amounted to $115,700. There were 321 persons employed, to whom $172,064 were paid in wages.

Canning industry.—In the shrimp-canning industry in 1923 there were 7 establishments, including 1 in North Carolina and 1 in South Carolina, valued at $210,970. The cash capital amounted to $40,000, and 501 persons were employed, to whom $114,909 were paid in wages. The pack of canned shrimp in these canneries amounted to 53,857 cases, or 2,074,392 cans of various sizes, valued at $302,199. By-products to the value of $10,600 were also prepared from shrimp on the east coast of Florida. Two oyster canneries on the east coast of Florida are included in the statistics for Georgia, and the lime from oyster shells at one plant with the statistics for South Carolina.

The following tables give statistics of the wholesale fish trade and shrimp-canning industry:

Wholesale fishery trade of the east coast of Florida in 1923

Items	Number	Value
Establishments	50	$524,475
Cash capital		115,700
Persons engaged	321	
Wages paid		172,064

Shrimp-canning industry of the east coast of Florida in 1923 [1]

Items	Number	Value
Establishments	7	$210,970
Cash capital		40,000
Persons engaged	501	
Wages paid		114,909
PRODUCTS		
Shrimp canned:		
No. 1 (4 dozen) ... cases	32,576	198,025
No. 1½ (2 dozen) ... do	4,370	24,692
5½-ounce (2 dozen) ... do	16,911	79,482
Total	53,857	302,199

[1] Includes one firm in North Carolina and one firm in South Carolina.

NOTE.—In addition to canned shrimp on the east coast of Florida there were $10,600 worth of by-products from shrimp. Two firms canning oysters on the east coast of Florida are included under Georgia, and the output of lime from one shell plant is included under South Carolina. The statistics for its two menhaden plants are included under the general tables for the South Atlantic States.

FURTHER EXPERIMENTS ON THE PRESERVATION OF FISH NETS[1]

By Harden F. Taylor, formerly *chief technologist*, and Arthur W. Wells, *assistant technologist, U. S. Bureau of Fisheries*

CONTENTS

INTRODUCTION

In a previous paper,[2] published in 1923, results were reported of a series of tests made on cotton and linen thread with the view of determining what preservatives were most effective. Copper oleate, a substance the use of which for purposes of net preservation was first proposed and tried by the writers, was given particular consideration. Data of much value were obtained from this series, but there still remained many phases of the work upon which more complete information was desired. Therefore, a second series of tests was prepared, much larger than that already reported and including, in addition to cotton and linen thread, a number of samples of manila hemp. The results of these experiments, together with information obtained from actual trials by fishermen of some of the preservatives, are reported in this paper.

The preservatives and preservative methods tested included copper oleate alone and in combination, tar, tanbark, and numerous proprietary substances used as preservatives. The tests were made in salt water at two places in the Atlantic Ocean, one place in the Pacific Ocean, and in fresh water at four places.

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[1] Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 998. Technological contribution No. 23.

[2] Properties and Values of Certain Fish-net Preservatives. Appendix I, Report of the U. S. Commissioner of Fisheries for 1923, 69 pp., 35 figs. B. F. Doc. 947, 1923.

Note.—The Bureau of Standards, Department of Commerce, through its division of textiles, cooperated freely with the Bureau of Fisheries in furnishing apparatus and facilities in a room of constant temperature and humidity for making the measurements of tensile strength.

CONCLUSIONS

The principal results and conclusions drawn from the present work are as follows:

1. The combination of copper oleate with coal tar was the best preservative of tensile strength of those tested.
2. Both the proprietary waterproofing material and the proprietary wood preservative did some good as preservatives, but neither one was as effective as copper oleate or coal tar.
3. At all places where tests were made linen lines, both treated and untreated, were completely rotten in less than two months.
4. Azulmic acid, a dye tested as a preservative, proved to be of no value for this purpose.
5. The combination of rare earths and copper oleate was very little better than copper oleate used alone.
6. Combinations of copper oleate with paraffin, boiled, and raw linseed oil did not preserve tensile strength any better than copper oleate alone.
7. The copper oleate and linseed oil combinations appeared to wash out less rapidly than copper oleate alone, but did not prevent fouling by marine growth as well.
8. With the exception of the quercitron-ammoniacal copper-sulphate treatment, the effectiveness of the several preservatives is of the same order on hemp as on cotton.
9. For hemp lines the copper oleate-coal tar mixture was the best preservative of tensile strength, copper oleate coming second at all places except Fairport, Iowa, where coal tar was second best.
10. The quercitron-ammoniacal copper-sulphate treatment (L) did not make as good a showing on cotton samples in the 1923 tests as it did in 1922. We do not know of any cause for this other than that due to the variation in water conditions at different localities and in the same locality from one year to another.
11. The quercitron-ammoniacal copper-sulphate treatment (L) made a very poor showing on hemp samples. The hot-water solution of quercitron seems to damage hemp, causing an exceedingly large diminution of tensile strength, and probably is the cause of the poor results of this treatment on hemp.
12. In fresh water of the Mississippi River at Fairport, Iowa, sample lines suffered more rapid deterioration than at any other point where tests were made. Coal tar preserved cotton lines at Fairport for three months. Lines treated by all other methods were completely rotten after two months' exposure.
13. Twine that is removed from the water every 30 days, dried, and treated with copper oleate lasts more than twice as long as that which is treated but once.
14. In fresh water at Put in Bay, Ohio, results with copper oleate were more satisfactory than in the previous series there.
15. The results at Put in Bay, Ohio, indicate that the rate of deterioration of nets not only varies from one locality to another but differs in different years in the same locality.

EXPERIMENTAL EXPOSURE AND TESTING OF LINES

Eight series of experiments were undertaken, some of which were for the purpose of determining the effects which various preservatives would have in the several geographical regions chosen and others were for the purpose of obtaining certain special information which could best be obtained at the particular location chosen. These regular and special tests will be described later in connection with the experiments. The cotton twine used throughout the experiments was No. 24 cable-laid, hard-finish; the linen line was 10-ply 40, Irish flax, salmon thread, and the hemp was 2-ply manila lobster marlin.

NOTATION OF SAMPLES

Cotton lines

A.......Untreated—used as a control.

EE.....Copper oleate—15 per cent concentration in gasoline. The lines were dipped into this solution and allowed to become thoroughly saturated. This required but two or three minutes. The lines were then removed and spread out to dry (not piled in a heap).

FF.....Copper oleate, to which was added 25 per cent of paraffin (by weight)—15 per cent concentration in gasoline. Applied same as EE.

GG.....Copper oleate, to which was added 15 per cent of boiled linseed oil (by weight)—15 per cent concentration in gasoline. Applied same as EE.

HH.....Copper oleate, to which was added 15 per cent of raw linseed oil (by weight)—15 per cent concentration in gasoline. Applied same as EE.

L.......Quercitron and ammoniacal copper sulphate (called Dutch method in former paper). The lines were steeped in a hot solution of quercitron, 1 pound to 2 gallons of water, until the solution was cold, dried, again steeped in the same way, and again dried. They were then immersed for a few minutes in an ammoniacal solution of copper sulphate containing 1 pound of copper sulphate and 3 pounds of 25 per cent ammonia for every 12½ gallons of water. For a full description of this method see Olie (1918).

JJ......This is a proprietary waterproofing substance manufactured and sold under a trade name. It is especially recommended as a mildew proofing for canvas. The product is ready for use as purchased from the manufacturer and is applied by immersing the twine in the solution for a short time, then removing and allowing it to dry.

KK.....Coal tar. The coal tar used for these experiments was slightly lighter than that used in 1922. (The specific gravity was about 1.16.) Equal weights of this tar and benzol were mixed, the benzol thinning the tar sufficiently so that no heating was necessary. The lines were immersed in this mixture, surplus tar removed by passing them between the fingers, and the lines strung up to dry. It should be noted that this is not the commonly used method of tarring nets. They are usually drawn through hot tar.

LL.....This is a proprietary wood and twine preservative sold under a trade name. The lines were steeped in the solution two hours, then removed and dried.

MM....Azulmic acid. The dye was dissolved in N/10 sodium hydroxide solution and the twine immersed in this solution for two hours in the cold. The twine was then rinsed in pure water containing a very small amount of hydrochloric acid.

RE.....Rare earths. Samples of twine were treated by a company having a special process for waterproofing materials with certain rare-earths compounds which they believed would have a preservative effect.

RC.....Rare earths and copper oleate. Samples of twine that had been treated by the rare-earths process were treated with copper oleate in the regular way, the same as EE.

Y.......This preservative is a mixture of 50 per cent coal tar, 35 per cent benzol, and 15 per cent copper oleate (each by weight), applied same as KK.

Linen lines

T------Untreated—used as a control.
NN-----Copper oleate—15 per cent concentration in gasoline. This is the same preservative as was described under EE for cotton thread.
OO-----Copper oleate—paraffin combination. This is the same preservative as was described under FF for cotton thread.
PP-----Copper oleate—boiled linseed oil combination. This is the same preservative as was described under GG for cotton thread.
QQ-----Copper oleate—raw linseed oil combination. This is the same preservative as was described under HH for cotton thread.
W------Quercitron and ammoniacal copper sulphate. This is the same method as was described under L for cotton thread.
RR-----Copper sulphate. The lines were steeped in a 3 per cent aqueous solution of copper sulphate, removed, and dried.

Manila hemp lines

DD-----Untreated—used as a control.
SS------Copper oleate—15 per cent solution in gasoline. This is the same preservative as was described under EE for cotton thread.
TT-----Copper oleate—paraffin combination. This is the same preservative as described under FF for cotton thread.
UU-----Copper oleate—boiled linseed oil combination. This is the same preservative as described under GG for cotton thread.
VV-----Copper oleate—raw linseed oil combination. This is the same preservative as described under HH for cotton thread.
WW----Quercitron and ammoniacal copper sulphate. This is the same preservative method as described under L for cotton thread.
XX-----Coal tar. The same preservative as described under KK for cotton thread.
YY-----Copper oleate—coal-tar combination. The same preservative as described under Y for cotton thread.

METHOD OF TAKING SAMPLES

Irregularities in the previous year's results, which are thought to have been due to variations in the samples used, made it seem desirable to standardize the samples more strictly. The method of measuring the samples under a given pull, described in the previous report on this subject, was again used. In addition to this, however, the number of strands was counted in both ends of each individual sample.

It was found that many of the lines were "off-count"; that is, instead of containing 24 threads, as they were supposed to, many of them contained 23, 26, 27, etc. All "off-count" samples were discarded. The samples containing the proper number of threads were then weighed and the average weight determined. All samples weighing more than 1 gram heavier or lighter than the determined average were discarded. The procedure followed gave the investigators a series of experimental lines all measured under a given pull, of correct thread count, and not varying more than ± 1 gram in weight per 75 feet of sample. After the samples had thus been carefully selected they were treated with a preservative and again accurately weighed and measured.

By the above method a set of samples was obtained very much more uniform than those used for previous experiments. The results indicate by the smoothness of the curves that the samples were more uniform. Even with this special attention to the proper selection of samples there are certain irregularities in the curves which can only be explained by the fact that there were differences in the physical properties of the original samples. A rise in the curve at some point during the course of the test must not be taken as indicative of an increase in the tensile strength of the line, but rather of a difference in the tensile strength of the original sample.

SERIES EXPOSED IN SEA WATER AT BEAUFORT, N. C.

MATERIALS TESTED

Cotton-line samples were prepared with each of the following preservatives according to the preservative methods described: Copper oleate in four different combinations (EE, FF, GG, and HH), quercitron and ammoniacal copper sulphate (L); the proprietary waterproofing (JJ), coal tar (KK), the copper oleate-coal tar combination (Y), a proprietary wood preservative (LL), azulmic acid (MM), rare-earths treatment (RE), rare earths and copper oleate combined (RC), and untreated line (A) used as a control. Seven samples were prepared by each treatment, one to be held as an unexposed check and the other six to be exposed. The exposures were made in the water of Beaufort Harbor at the wharf of the Bureau of Fisheries biological laboratory from June 1 to December 1, 1923. Water conditions at this point were discussed in the previous report. Temperatures and salinities of the water over the period of the test are given in Table 1.

TABLE 1.—*Water conditions at Beaufort, N. C.*

Year and month	Temperature						Specific gravity		
	Maximum		Minimum		Average		Maximum	Minimum	Average
1923	°F.	°C.	°F.	°C.	°F.	°C.			
June	81	27	73	23	79	26	1.023	1.021	1.021
July	86	30	77	25	81	27	1.023	1.017	1.023
August	88	31	81	27	86	30	1.022	1.017	1.020
September	86	30	68	20	79	26	1.022	1.017	1.019
October	77	25	57	14	66	19	1.020	1.015	1.017
November	63	17	50	10	55	13	1.025	1.017	1.018

TENSILE STRENGTH

Most of the preservatives here considered caused an immediate decrease in tensile strength of the lines, the exceptions being the proprietary wood preservative (LL), azulmic acid (MM), and the rare-earths treatment (RE). The results of tensile-strength measurements of the individual samples are shown graphically in Figure 1.

Upon exposure the preservative (Y), a mixture of copper oleate and coal tar, proved to be a better preservative of tensile strength than any other tested. The sample treated with this material, together with two samples preserved with the copper oleates (EE and GG) and one preserved with coal tar (KK), were the only ones that lasted over a period of six months at Beaufort. The last three were of about equal value. Next in order of diminishing tensile strength come the lines treated with the copper oleate-paraffin mixture (FF), copper oleate and raw linseed oil (HH), and the proprietary wood preservative (LL). Samples treated with the three last-named preservatives were completely rotten at the end of five months. The quercitron-ammoniacal copper sulphate method (L), and the proprietary waterproofing (JJ) seemed to be of little value as preservatives. Samples treated with these materials were completely rotten in four months, while the untreated white line (A) lasted for three months. The quercitron method did not show as satisfactory results during this test at Beaufort as it did during the 1922 test. Azulmic acid (MM) showed no preservative qualities.

SUMMARY OF RESULTS AT BEAUFORT

1. In the preservation of tensile strength of cotton lines the materials tested may be divided into five groups, according to their value, as follows: (1) The copper oleate-coal tar mixture, (2) coal tar, copper oleate, and the copper oleate-boiled linseed oil combina-

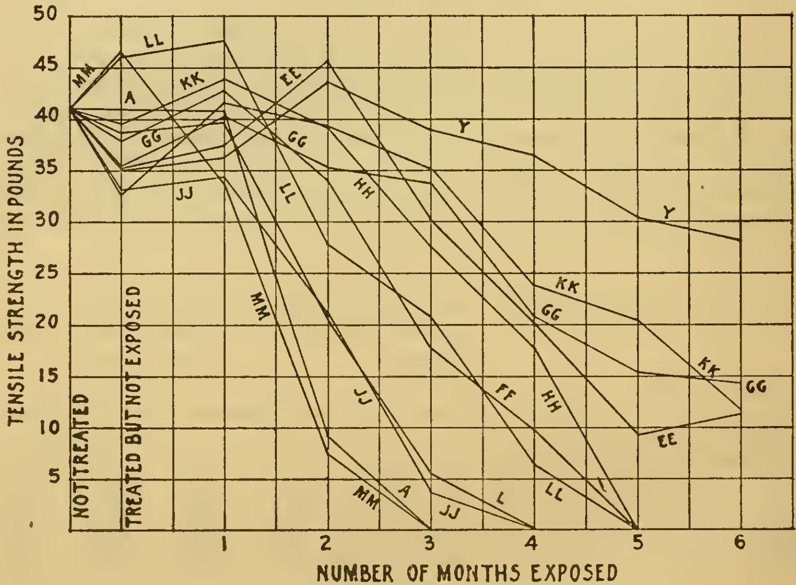

FIG. 1.—Tensile strength of cotton line at Beaufort, N. C.

tion, (3) copper oleate-raw linseed oil, copper oleate-paraffin combinations, and the proprietary wood preservative, (4) the quercitron-ammoniacal copper sulphate treatment and the proprietary waterproofing, and (5) azulmic acid.

2. The quercitron-ammoniacal copper sulphate method was less effective as a preservative in 1923 than it was during the previous year's tests. This may be due to a difference in water conditions.

3. The addition of linseed oil to copper oleate appeared to decrease the solubility of the latter to a slight degree. However, this combination was less resistant to fouling by marine growth than copper oleate alone.

SERIES EXPOSED IN SEA WATER AT BOOTHBAY HARBOR, ME.

PURPOSE OF THE EXPERIMENT

Beginning June 19 and extending to December 19, 1923, two series of cotton lines preserved with various materials were exposed in sea water at Boothbay Harbor, Me. Some question had arisen as to whether or not twine deteriorated more rapidly when continuously or when periodically submerged. The experiment here described was intended to furnish some information regarding this point. The location at Boothbay Harbor was chosen because it afforded facilities at the Bureau of Fisheries hatchery for suspending sample lines in sea water in such a manner that one set would be submerged continuously while a second set, identical with the first, would be submerged only at high tide.

WATER CONDITIONS AT BOOTHBAY HARBOR

The average monthly temperatures of the water at Boothbay Harbor over the period of the test are given in Table 2. Salinity records are not available.

Table 2.—*Water conditions at Boothbay Harbor, Me.*

Year and month	Temperature					
	Maximum		Minimum		Average	
1923	°F.	°C.	°F.	°C.	°F.	°C.
July	66	19	56	13.0	61	16
August	64	18	52	11.0	59	15
September	62	17	52	11.0	58	14
October	52	11	47	8.0	51	11
November	48	9	40	5.0	44	7
December	44	7	33	0.5	41	5

MATERIALS TESTED

The twine used in this series of tests was of the same kind as that used in the preceding experiments—No. 24 cable-laid hard-finish cotton. The preservatives and preservative methods tested were copper oleate in four variations (EE, FF, GG, and HH); quercitron and ammoniacal copper sulphate (L), a proprietary waterproofing (JJ), coal tar (KK), and the coal tar-copper oleate mixture (Y). The lines were measured, weighed, treated, and again measured and weighed, as previously described. The shrinkage and increase in weight will be discussed under a separate heading.

TENSILE STRENGTH

The results of tensile-strength measurements on the continuously exposed series are shown graphically in Figure 2. Here it will be noted that coal tar, the copper oleate-coal tar mixture, and all copper oleate samples except the one combined with paraffin preserve lines well throughout the period of exposure. Sample lines treated with the copper oleate-paraffin mixture (FF), the proprietary waterproofing (JJ), and the quercitron-ammoniacal copper sulphate preservative (L) lasted throughout the six months' test, but showed a marked diminution of tensile strength near the end of the period. The untreated line (A) lasted for four months, as against two months at Beaufort, N. C. All sample lines deteriorated much less rapidly at Boothbay Harbor than at Beaufort.

In Figure 3 are shown graphically the results of tensile-strength tests on the lines that were submerged only at high tide at Boothbay

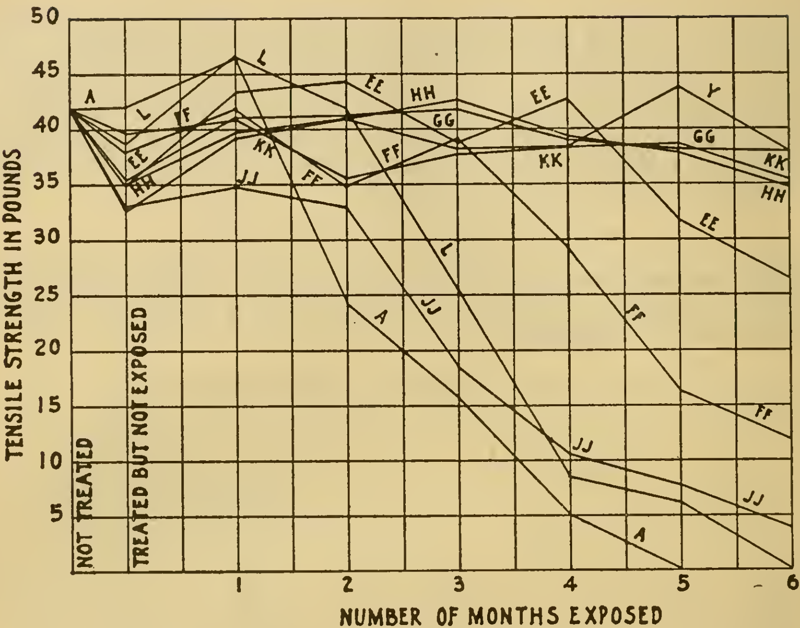

FIG. 2.—Tensile strength of cotton lines immersed continuously at Boothbay Harbor, Me.

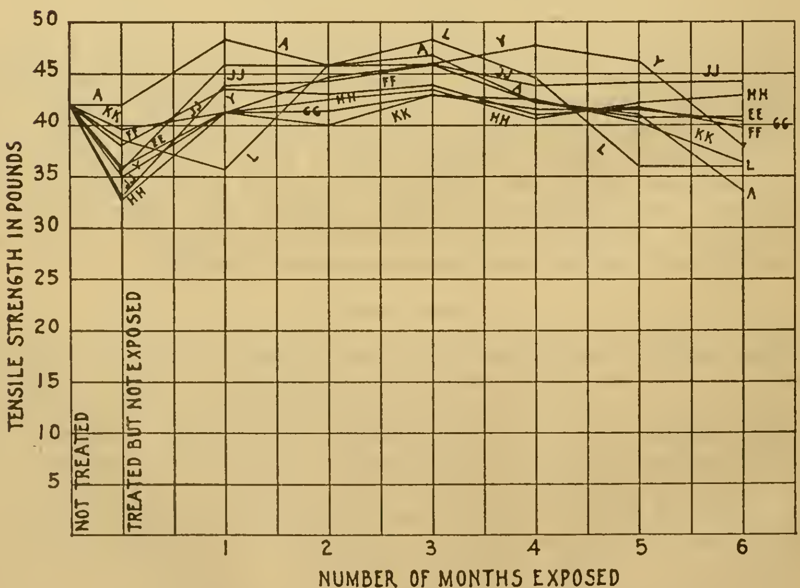

FIG. 3.—Tensile strength of cotton lines immersed intermittently at Boothbay Harbor, Me.

Harbor. In this case there was only a very slight decrease in tensile strength of any of the samples, even the untreated line lasting for six months with very little decrease in strength. These results indicate that twine undergoes a much more rapid disintegration when continuously submerged in water than it does when periodically submerged.

SUMMARY OF RESULTS AT BOOTHBAY HARBOR

1. Duplicate sets of test lines were used, one of which was suspended in such a manner as to be continuously submerged in water, the other being suspended so as to be submerged only at high tide.
2. The periodically submerged samples showed very little deterioration over the six-month period of exposure.
3. Sample lines subjected to continuous submersion deteriorated much more rapidly than those submerged periodically.
4. Copper oleate, coal tar, and the copper oleate-coal tar mixture preserved well at Boothbay Harbor.
5. Action of the water at Boothbay Harbor, Me., was much less severe than at Beaufort, N. C., untreated lines at the former location lasting twice as long as at the latter.

SERIES EXPOSED IN SEA WATER AT ASTORIA, OREG.

A series of lines, including cotton, linen, and hemp samples treated with the various materials, was exposed in sea water at the mouth of the Columbia River near Astoria, Oreg., from July 6, 1923, to January·6, 1924.

WATER CONDITIONS AT ASTORIA

Records of the average monthly temperature and salinity of the water at this point are not available. It is known, however, that the temperature during the period of the test varied from about 65° or 70° F. during the summer months to about 40° or 45° F. during the winter months. The salinity of the water at this point also varies over a wide range. At very high tide the water reaches a salinity equal to that of full sea water, while at other times, when immense quantities of water come down from inland, it contains scarcely any salt.

TESTS WITH COTTON LINES

Materials tested.—The twine used for this series of tests was of the same lot as that described in the preceding experiments—No. 24, cable-laid, hard-finish cotton. The preservatives and preservative methods tested were copper oleate in four variations (EE, FF, GG, and HH), quercitron, followed by ammoniacal copper sulphate (L), a proprietary waterproofing (JJ), coal tar (KK), a copper oleate-coal tar mixture (Y), and the untreated cotton line (A) as a control. The lines were measured, weighed, treated with a preservative, and again measured and weighed, as previously described.

Tensile strength.—The results of tensile-strength measurements are shown graphically in Figure 4. The action of the water on lines exposed at this point was very severe. The untreated line (A), that treated with the quercitron-ammoniacal copper sulphate method (L), and the one treated with the proprietary waterproofing (JJ) were completely rotten at the end of two months, the two preservatives apparently doing very little good. Here it will be noted that tar is a better preservative than copper oleate, but the copper oleate-coal tar mixture is much better than either tar or copper oleate used separately. The results are in keeping with results obtained with the same preservatives at Beaufort, N. C.

TESTS WITH LINEN LINES

Materials tested.—In this series of experiments samples of linen lines were also included. The linen selected for this purpose was 10-ply 40 "Irish flax salmon thread," loose-laid, such as is used for gill netting for salmon on the Pacific coast. The preservatives and preservative methods tested on this material were copper oleate in four variations (NN, OO, PP, and QQ), quercitron, followed by

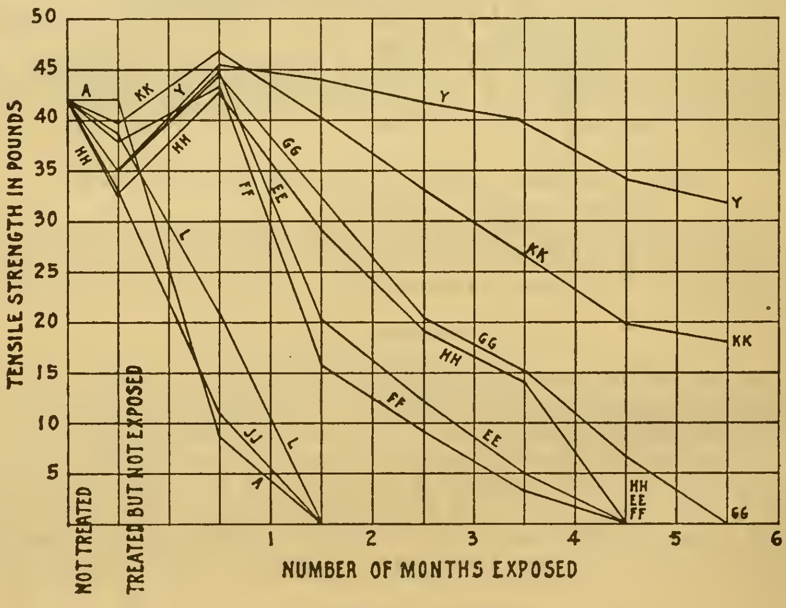

FIG. 4.—Tensile strength of cotton lines at Astoria, Oreg.

ammoniacal copper sulphate (W), copper sulphate (RR), and the untreated sample (T).

Tensile strength.—The results of the measurements of tensile strength are shown graphically in Figure 5. Here the samples treated with copper oleate led at the end of one month, the sample treated with quercitron and ammoniacal copper sulphate coming second, and that treated with copper sulphate alone coming third. The untreated sample was completely rotten at the end of one month. At the end of two months all samples were completely rotten and had fallen from the frames. These results bear out conclusions drawn from previous tests—that is, that linen thread disintegrates much more rapidly than cotton under the same conditions in salt water.

TESTS WITH MANILA HEMP LINES

Materials tested.—Besides the tests made with cotton and linen lines, there were also included at Astoria some samples of manila hemp. The twine selected was two-ply manila hemp lobster marlin, such as is used by many lobster fishermen for funnels in lobster pots. The tensile strength of the untreated, unexposed line was 230.8 pounds. The preservatives tested on the manila samples were as follows: Copper oleate in four variations (SS, TT, UU, and VV), the quercitron-ammoniacal copper sulphate treatment (WW), coal tar (XX), the copper oleate-coal tar mixture (YY), and the untreated sample (DD).

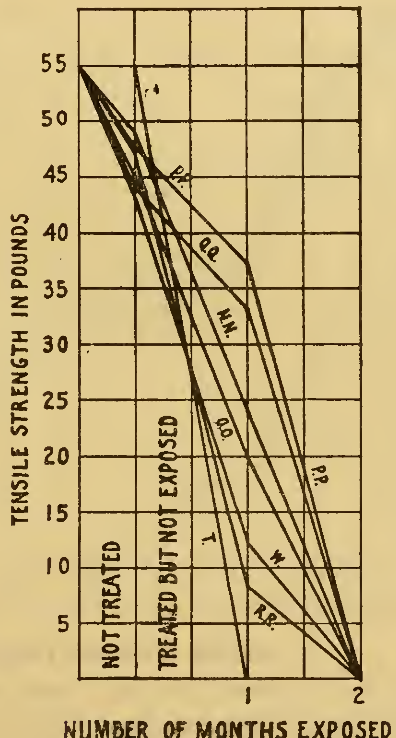

Fig. 5.—Tensile strength of linen lines at Astoria, Oreg.

Tensile strength.—The results of tensile-strength measurements of the individual samples are shown graphically in Figure 6. The effectiveness of the various preservatives used is of the same order on manila as on cotton. The four copper oleates, coal tar, and the copper oleate-coal tar mixture preserved manila over the entire six months of exposure, although in all cases a considerable diminution of strength occurred. The quercitron and ammoniacal copper sulphate treatment (WW) was of no value here as a preservative for manila. This treatment caused an immediate dimunition of tensile strength of 82.7 pounds, or about 35 per cent, and thereafter the tensile strength decreased at about the same rate as in the untreated material.

SUMMARY OF RESULTS OF ASTORIA EXPERIMENTS

1. The best preservative of tensile strength tested on hemp and cotton was the copper oleate-coal tar mixture.
2. As preservatives of tensile strength of manila hemp, there is very little difference between coal tar and the copper oleates.
3. At this place the effectiveness of the several preservatives is the same for hemp as for cotton.
4. The quercitron and ammoniacal copper sulphate mixture caused an immediate decrease in tensile strength of manila hemp and was of no value as a preservative for this material.

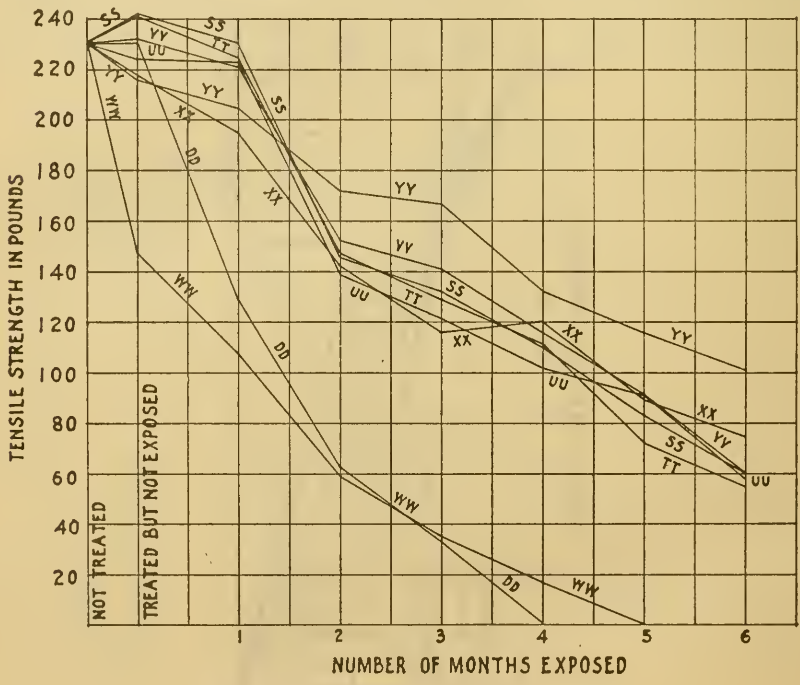

FIG. 6.—Tensile strength of hemp lines at Astoria, Oreg.

SERIES EXPOSED IN FRESH WATER AT PUT IN BAY, OHIO

PURPOSE OF THE EXPERIMENT

For the purpose of obtaining further data upon the variation in rate of deterioration of twine exposed in different years in the same locality a second series of lines was exposed in Lake Erie at Put in Bay, Ohio, from June 25 to December 25, 1923.

WATER CONDITIONS AT PUT IN BAY

The average monthly temperatures of the water at Put in Bay during the period of the test are shown in Table 3.

TABLE 3.—*Temperature of the water at Put in Bay, Ohio*

Year and month	Maximum		Minimum		Average	
1923	°F.	°C.	°F.	°C.	°F.	°C.
July	78	26	70	21	73	22
August	78	26	68	20	75	24
September	75	24	63	17	68	20
October	65	18	50	10	56	13
November	48	9	41	5	44	7
December	42	6	38	3	39	4

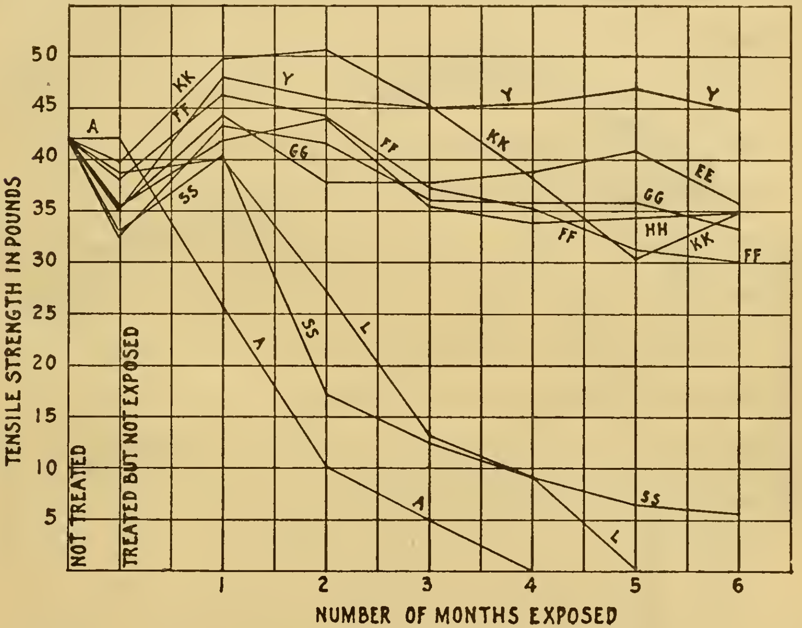

FIG. 7.—Tensile strength of cotton lines at Put in Bay, Ohio

TESTS WITH COTTON LINES

Materials tested.—The preservatives and preservative methods tested on cotton lines were copper oleate in four variations (EE, FF, GG, and HH), the quercitron-ammoniacal copper sulphate method (L), a proprietary waterproofing (JJ), coal tar (KK), the copper oleate-coal tar mixture (Y), and an untreated control (A).

Tensile strength.—The tensile strength of the cotton lines exposed at Put in Bay is shown graphically in Figure 7. Here, again, the copper oleate-tar combination is in the lead as a preservative of tensile strength, keeping twine over a six-months period of exposure with only a very slight diminution of tensile strength. The copper oleates and coal tar used separately also preserved well, each of them keeping sample lines so treated in very good condition. Sample lines treated with the quercitron-ammoniacal copper sulphate treatment were completely rotten at the end of five months. In this connection it is very interesting to note that this same preservative method, used in the same water during 1922, kept twine in good condition for six months, while that treated with copper oleate in 1922 was rotten at the end of five months. This would indicate that there is a considerable seasonal variation in the water at this point. Test lines treated with the proprietary waterproofing substance lasted during the entire six months but were of very low tensile strength at the end of the period.

TESTS WITH MANILA HEMP LINES

Materials tested.—In addition to the samples of cotton twine there were also included a number of samples of manila hemp treated with the various preservatives. The preservatives and preservative

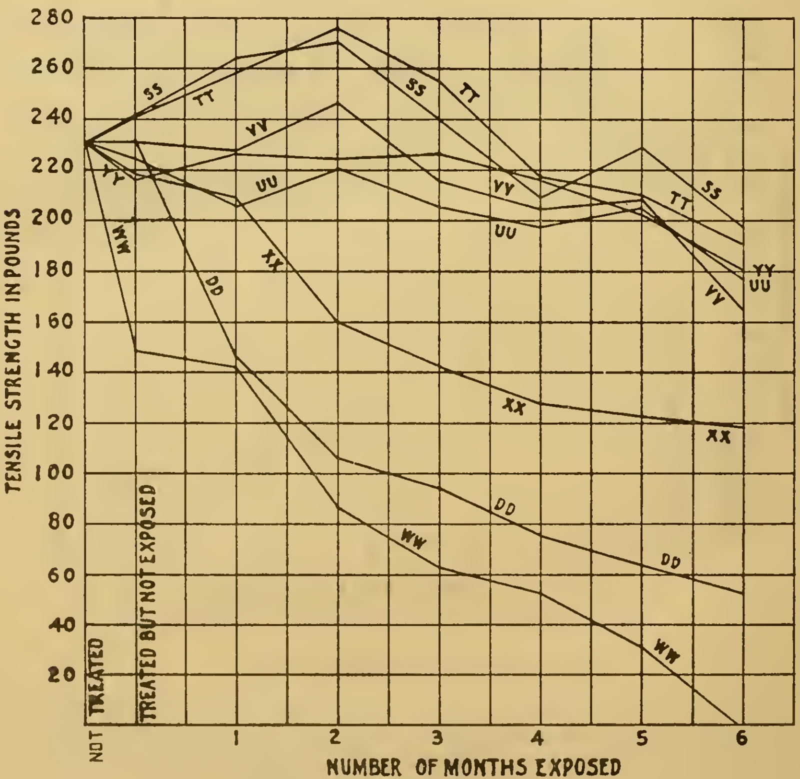

FIG. 8.—Tensile strength of hemp lines at Put in Bay, Ohio

methods tested were copper oleate in four variations (SS, TT, UU, and VV), quercitron and ammoniacal copper sulphate (WW), coal tar (XX), the copper oleate-coal tar mixture (YY), and an untreated control (DD).

Tensile strength.—The tensile strength of the manila lines exposed at Put in Bay is shown graphically in Figure 8. The four copper oleates and the copper oleate-coal tar mixture were all of about equal value as preservatives of tensile strength. Lines treated with each of these preservatives lasted through the entire six months with only very slight diminution of strength. Coal tar was not as effective on hemp at Put in Bay as it was at other places. The lines treated with this material showed a considerable depreciation of tensile strength at the end of two months and continued to lose throughout the period of test. The quercitron-ammoniacal copper sulphate treatment caused an immediate weakening of the manila fiber, and the lines deteriorated even more rapidly than the untreated samples.

SUMMARY OF RESULTS AT PUT IN BAY, OHIO

1. Cotton lines treated with copper oleate were preserved much more satisfactorily than during the previous year, lasting six months with only slight diminution of strength, whereas in 1922 lines similarly treated were completely rotten in five months.
2. Cotton lines treated by the quercitron-ammoniacal copper sulphate method were completely rotten at the end of five months, whereas in 1922 similar samples remained well preserved for six months.
3. Copper oleate and the copper oleate-tar mixture proved to be the best preservatives for manila hemp at Put in Bay.
4. Coal tar did not preserve hemp as satisfactorily at Put in Bay as at most other places.
5. The quercitron-ammoniacal copper sulphate treatment proved injurious to manila fiber, and lines so treated deteriorated more rapidly than the untreated lines.
6. The copper oleate-tar combination proved an excellent preservative of tensile strength for both cotton and hemp lines.

SERIES EXPOSED IN FRESH WATER AT CHARLEVOIX, MICH.

For the purpose of obtaining further data as to the effect of Great Lakes water on twine a series of test lines identical with those exposed at Put in Bay was exposed in Lake Michigan at the Bureau of Fisheries' hatchery at Charlevoix, Mich., from June 19 to December 19, 1923.

WATER CONDITIONS AT CHARLEVOIX

Complete records of temperature conditions of the water at this point are not available, but it is known to vary from a temperature of about 70° F. during the summer months to about 40° F. during the early part of the winter, when these tests were completed.

TESTS WITH COTTON LINES

Materials tested.—The preservatives and preservative methods tested on cotton lines were copper oleate in four variations (EE, FF, GG, and HH), the quercitron-ammoniacal copper sulphate treatment (L), a proprietary waterproofing (JJ), coal tar (KK), the copper oleate-coal tar combination (Y), and an untreated control line (A).

Tensile strength.—The results of tensile-strength measurements of these lines are shown graphically in Figure 9. The water at Charlevoix does not cause as rapid deterioration of twine as the water of Lake Erie at Put in Bay. At the former location the untreated line still possessed some strength at the end of six months' exposure, whereas at the latter place untreated lines were completely rotten at the end of four months. At Charlevoix samples treated with the following preservatives lasted throughout the entire period of the test with almost no diminution of strength: The four copper oleates (EE, FF, GG, and HH), coal tar (KK), and the copper oleate-coal tar combination (Y). Samples treated with quercitron and ammoniacal copper sulphate (L) and the proprietary waterproofing (JJ) also lasted for six months, although they had suffered a considerable decrease in tensile strength.

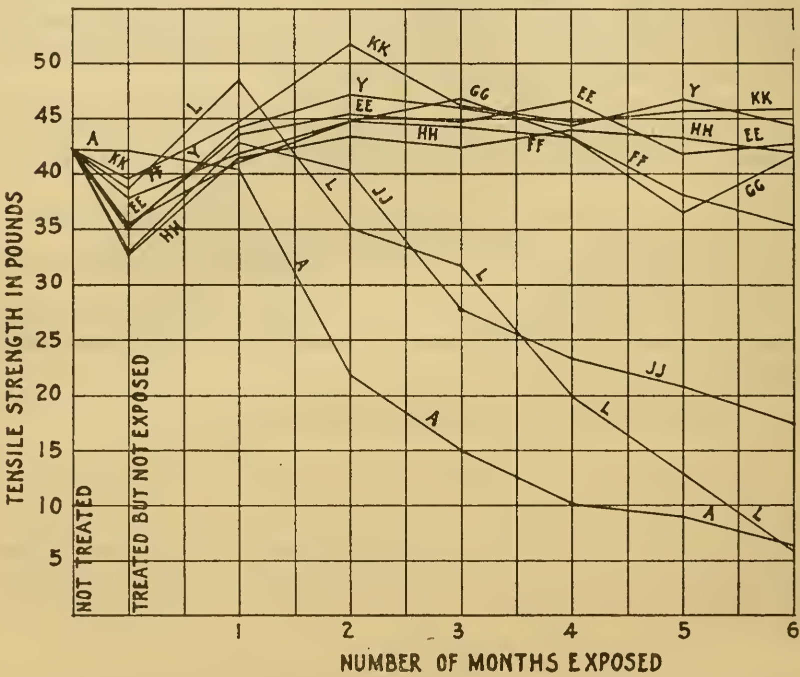

FIG. 9.—Tensile strength of cotton lines exposed at Charlevoix, Mich.

TESTS WITH MANILA HEMP LINES

Materials tested.—The preservatives and preservative methods tested on manila hemp were copper oleate in four variations (SS, TT, UU, and VV), quercitron and ammoniacal copper sulphate (WW), coal tar (XX), the copper oleate-coal tar combination (YY), and the untreated sample (DD).

Tensile strength.—The results of the tensile-strength measurements of the individual samples are shown graphically in Figure 10. Here the preservatives rank higher but in about the same position relative to each other as at Put in Bay. In decreasing order of effectiveness the preservatives tested at Charlevoix arrange themselves in the following order: Copper oleate-coal tar combination, copper oleate, coal tar, and the quercitron-ammoniacal copper sulphate method. The untreated sample lasted longer than the one treated by the quercitron method.

SUMMARY OF RESULTS AT CHARLEVOIX

1. Copper oleate, coal tar, and the copper oleate-coal tar mixtures preserved twine for six months' continuous exposure with but slight diminution of strength.

2. The proprietary waterproofing substance (JJ) did some good as a preservative but did not compare favorably with copper oleate, tar, or the copper oleate-tar mixture.

3. The quercitron-ammoniacal copper sulphate method did no good whatever on cotton and had a harmful effect upon hemp lines.

4. The action of the water at Charlevoix is less severe on twine than it is at Put in Bay, Ohio.

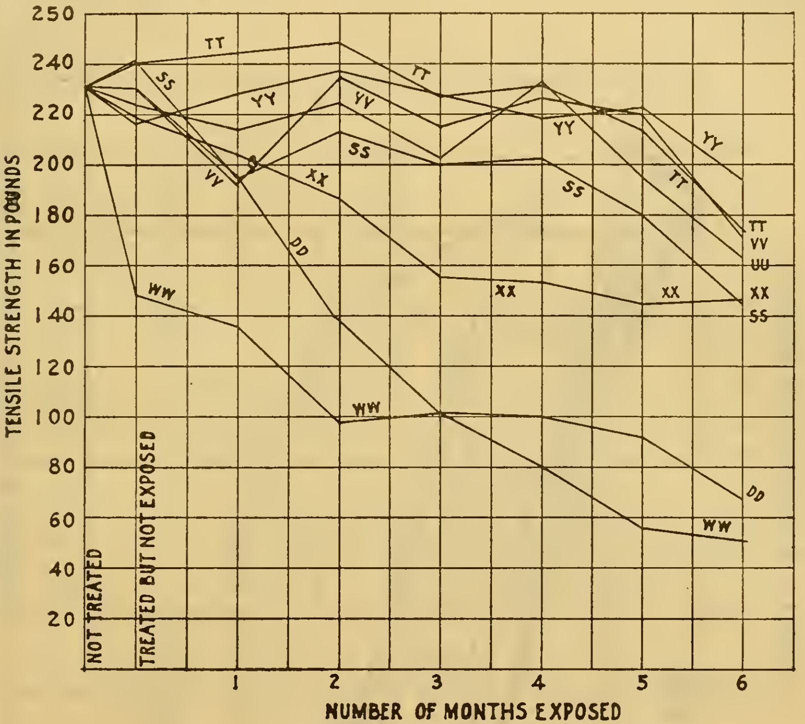

FIG. 10.—Tensile strength of hemp lines at Charlevoix, Mich.

SERIES EXPOSED IN FRESH WATER AT FAIRPORT, IOWA

A series of lines, including cotton, linen, and manila hemp samples, treated with the various preservatives, was exposed in the Mississippi River at the Bureau of Fisheries biological laboratory at Fairport, Iowa, from June 1 to December 1, 1923. On the Fairport samples, in addition to the tensile-strength tests, measurements of the wearing quality and flexibility were also made. These factors will be discussed in connection with the data concerning them.

WATER CONDITIONS AT FAIRPORT

The temperatures of the water at Fairport over the period of the test are given in Table 4.

TABLE 4.—*Temperature of water at Fairport, Iowa*

Year and month	Maximum		Minimum		Average	
1923	°*F.*	°*C.*	°*F.*	°*C.*	°*F.*	°*C.*
June	86	30	69	21	78	26
July	86	30	76	24	82	28
August	83	28	72	22	77	25
September	77	25	62	17	68	20
October	67	19	44	7	56	13
November	46	8	37	3	43	6

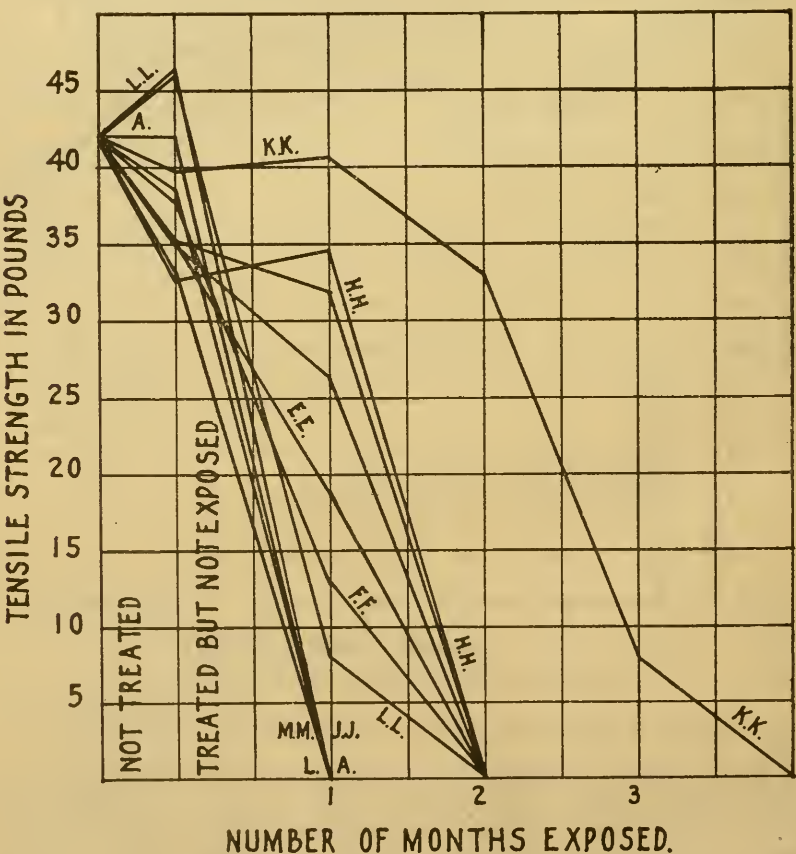

FIG. 11.—Tensile strength of cotton lines exposed at Fairport, Iowa

The water of the Mississippi River carries immense quantities of suspended matter, which settled on the test lines covering them with a heavy coating of mud.

TESTS WITH COTTON LINES

Materials tested.—The preservatives and preservative methods tested on cotton lines were copper oleate in four variations (EE, FF, GG, and HH), the quercitron-ammoniacal copper sulphate method (L), the proprietary waterproofing (JJ), coal tar (KK), the copper oleate-coal tar combination (Y), a proprietary wood preservative (LL), azulmic acid (MM), and the untreated control (A).

Tensile strength.—The results of the tensile-strength measurements are shown graphically in Figure 11. Deterioration of twine submerged at this point was extremely rapid. Sample lines treated with

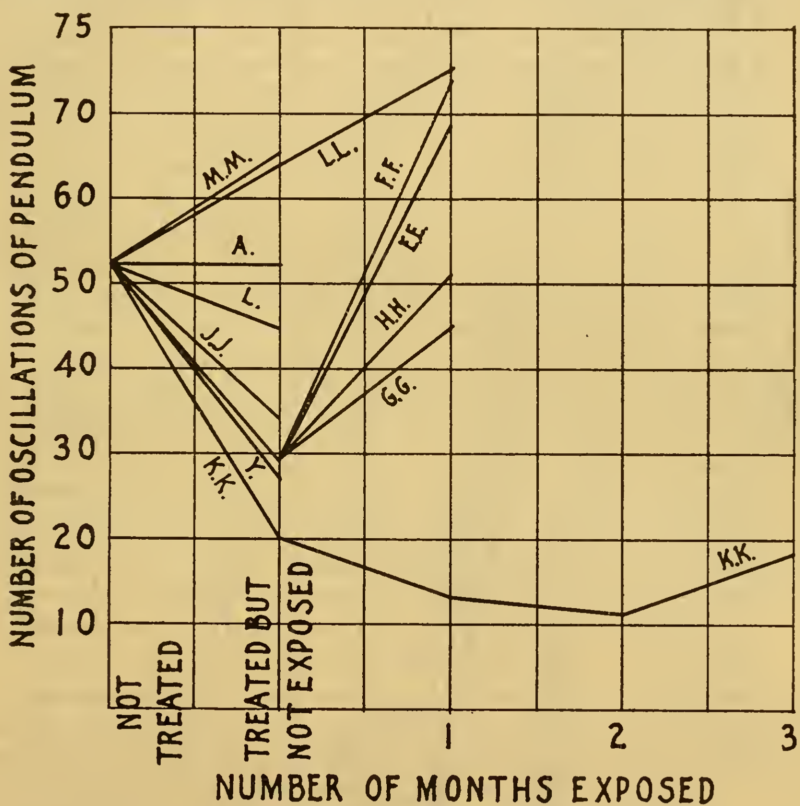

FIG. 12.—Flexibility of cotton lines exposed at Fairport, Iowa

coal tar (KK) lasted only four months; all others were completely disintegrated at the end of two months. Lines treated with the copper oleates (EE, FF, GG, and HH), those treated with the copper oleate-coal tar mixture (Y), and those treated with the proprietary wood preservative (LL) were completely rotten at the end of two months' exposure. Azulmic acid (MM), the quercitron-ammoniacal copper sulphate method (L), and the proprietary waterproofing (JJ) were here of no value as preservatives. Samples treated with the last three materials, together with the untreated sample, were completely rotten at the end of one month.

Flexibility.—The great importance of flexibility in many kinds of fishing gear was discussed at some length in our previous paper on this subject.[3] Measurements made at 30-day intervals throughout the period of submersion showed that the twine became more flexible as its tensile strength decreased. The important factor to consider is the change in flexibility of the twine immediately after treatment

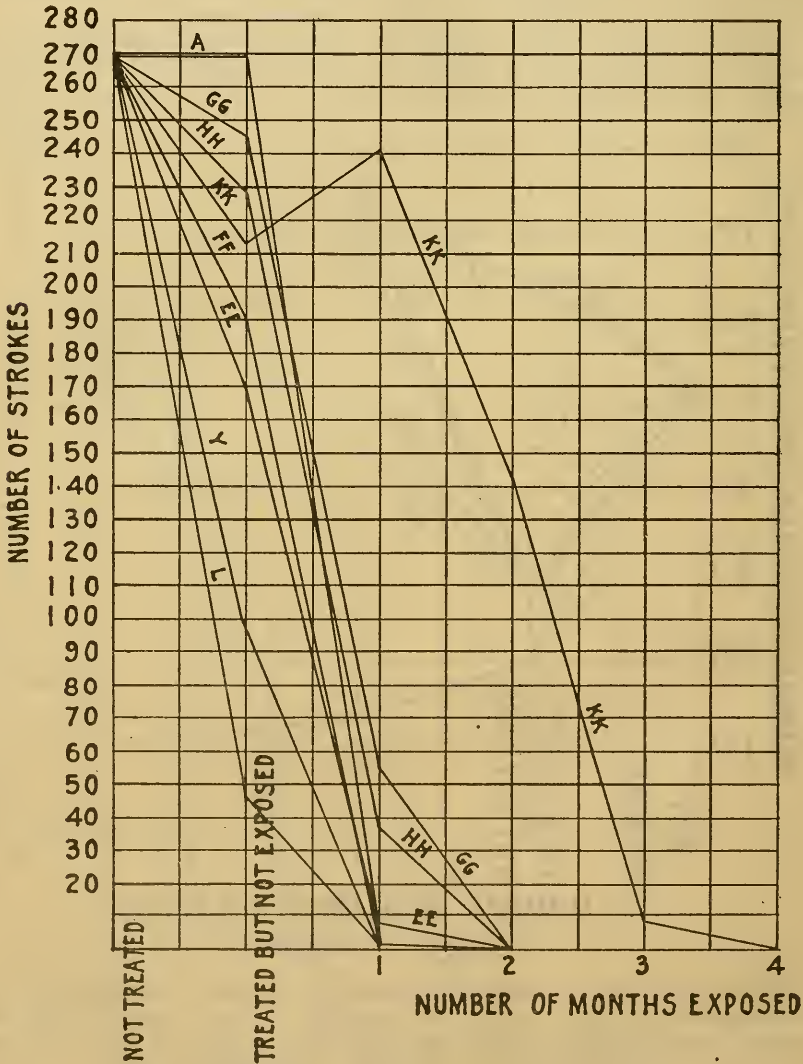

FIG. 13.—Wearing quality of cotton lines exposed at Fairport, Iowa

with a preservative material. Inasmuch as this measurement had already been made for most of the preservatives tested, and also on account of the great amount of time and labor necessary to carry the

[3] Properties and Values of Certain Fish-Net Preservatives, by Harden F. Taylor and Arthur W. Wells. Appendix I, Report of the U. S. Commissioner of Fisheries, 1923, 69 pp., 35 figs. Washington. B. F. Doc. 947.

flexibility tests throughout the entire period of exposure, they were omitted in 1923 on all series except the one exposed at Fairport, Iowa. The results of these measurements are shown graphically in Figure 12.

It will be noted that the twine used during the 1922 season was somewhat less flexible than that used in the present work. The copper oleates caused a slight decrease of flexibility immediately after treatment, which may have been due to the use of a slightly harder material caused by differences in manufacture. At the end of the first month, however, the flexibility showed a marked increase, and it will be remembered that the tensile strength decreased rapidly during this same period. Coal tar (KK) caused an immediate decrease in flexibility, which decrease became gradually greater until the end of the second month, when it began to increase. During the same period the tensile strength remained about constant. However, at the end of the second month a sharp decrease occurred, with a corresponding increase in flexibility. The proprietary wood preservative (LL) and azulmic acid (MM) caused an immediate increase in the flexibility while all others caused a decrease.

Resistance to mechanical wear or abrasion (wearing quality).—Tests of the wearing quality of cotton lines were also made on the test lines at Fairport, Iowa. This work was done by the method described in our previous report. These results are shown graphically in Figure 13. On the unexposed samples the copper oleates (GG and HH) lead in effectiveness. Coal tar (KK) and the copper oleates (FF and EE) follow in the order named. At the end of one month's exposure, however, coal tar was easily first in resisting mechanical wear and continued so throughout the test. Samples that had been exposed for three months still withstood some 8 or 10 strokes on the test apparatus. Of the remaining sample lines, those treated with copper oleate were in the best condition after one month's exposure, withstanding several strokes on the tester, whereas lines treated with other preservatives were completely rotten and showed no wearing resistance whatever at the end of one month.

TESTS WITH MANILA HEMP LINES

Materials tested.—The preservatives and preservative methods tested on hemp were copper oleate in four variations (NN, OO, PP, and QQ), the quercitron-ammoniacal copper sulphate method (WW), coal tar (XX), the copper oleate-coal tar mixture (YY), and the untreated control line (DD).

Tensile strength.—The results of tensile-strength measurements on manila hemp samples are shown graphically in Figure 14. None of the sample lines lasted for the full six-month period of exposure. Coal tar (XX) and the copper oleate-coal tar mixture were about equal in their effects, samples treated with these materials lasting for five months. Lines treated with the copper oleates (SS, TT, UU, and VV) come next, these samples lasting for three months. The samples treated by the quercitron-ammoniacal sulphate method (WW) lasted but two months, while the ·untreated sample (DD) was completely rotten in less than two months.

Flexibility.—The flexibility of hemp lines was measured at Fairport for the first time, and the results of the tests are shown graphically in Figure 15. The coal tar treatment (XX) caused the greatest amount of stiffening, resulting in an immediate drop of about 70 per cent in the number of oscillations of the pendulum. Next in increasing order of flexibility come the lines treated with the copper oleate-coal tar mixture (YY) and next the lines treated with the copper oleate combination (SS, TT, UU, and VV). Lines treated with quercitron and ammoniacal copper sulphate (WW) showed the greatest immediate increase in flexibility, but it will be remembered that these same lines also showed the greatest immediate decrease in tensile strength.

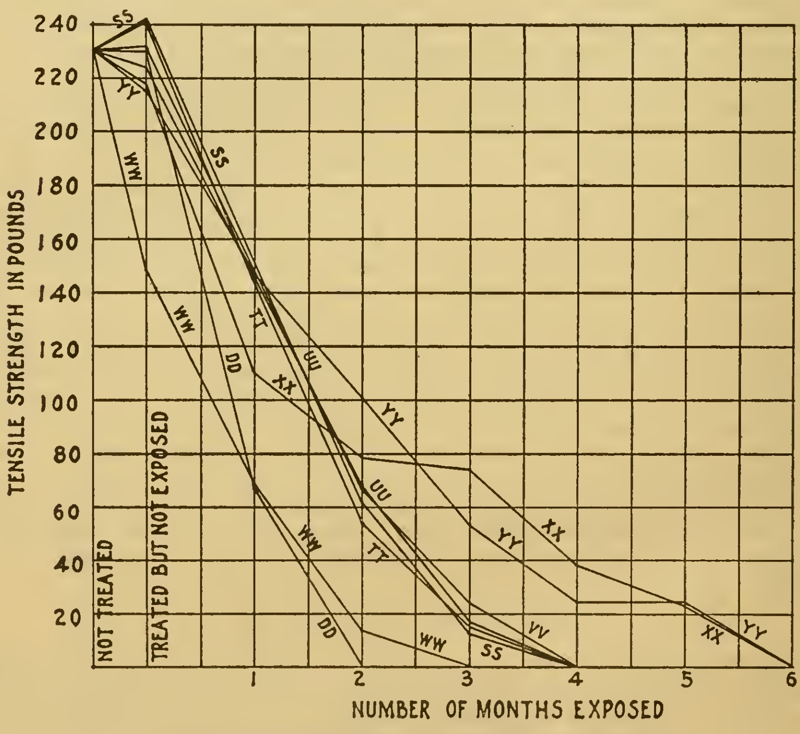

FIG. 14.—Tensile strength of hemp lines exposed at Fairport, Iowa

Resistance to mechanical wear.—Tests upon the wearing quality of manila hemp lines were also made on the series exposed at Fairport, Iowa. Here, again, we find the same general tendencies as were previously noted in the tests on the wearing quality of cotton lines—that is, that the resistance to abrasion decreases directly as the decrease in tensile strength. The results of these measurements are shown graphically in Figure 16. The samples showing the greatest resistance to wear were those treated with the copper oleates (SS, TT, UU, and VV), coal tar (XX), and the copper oleate-coal tar mixture (YY). The quercitron and ammoniacal copper sulphate treatment (WW) caused a decided immediate decrease in wearing quality.

TESTS WITH LINEN LINES

A set of linen lines treated with the various preservatives was also exposed at Fairport, Iowa. The action of the water was so severe at this point, however, that none of the samples lasted until the end of the first month, so that no measurements could be made of the factors under consideration.

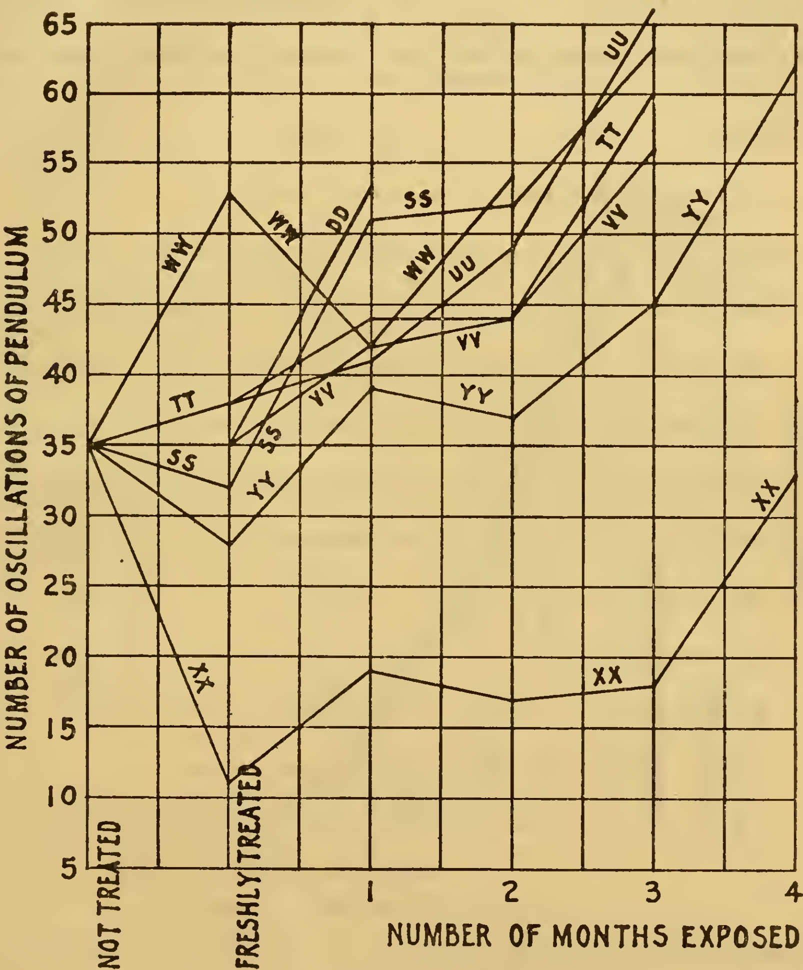

FIG. 15.—Flexibility of hemp lines exposed at Fairport, Iowa

SUMMARY OF RESULTS AT FAIRPORT

1. At Fairport coal tar was the best preservative of the tensile strength of cotton, sample lines so treated lasting four months.
2. The copper oleates and the copper oleate-coal tar mixture preserved cotton lines for two months.
3. All sample lines except those mentioned above were entirely rotten in one month.

4. Coal tar and the copper oleate-coal tar mixture preserved hemp for five months.
5. Copper oleate preserved hemp samples for three months.
6. All linen samples were rotten in less than one month.
7. Lines treated with copper oleate were not as flexible as those used for previous tests. This was due to slight differences in the manufacture of the oleate.
8. It was again shown that as tensile strength decreases flexibility increases.
9. Resistance to mechanical wear decreases in direct proportion to the decrease in tensile strength.

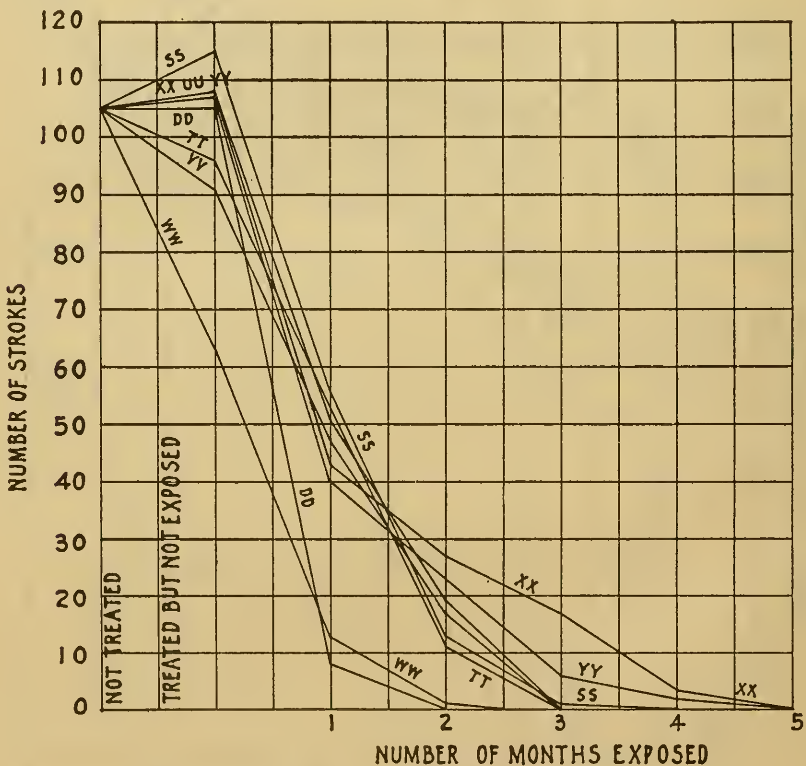

FIG. 16.—Wearing quality of hemp lines exposed at Fairport, Iowa

SERIES EXPOSED IN FRESH WATER OF THE POTOMAC RIVER AT WASHINGTON, D. C.

Two identical series of cotton lines were exposed in the Potomac River under the highway bridge at Washington, D. C. These series were for the special purpose of determining how much the life of twine could be prolonged by removing it from the water every 30 days, washing, drying, and treating it with copper oleate.

MATERIALS TESTED

For this series of tests only cotton twine similar to that used throughout the other tests was used. The preservatives tested were copper oleate (EE), the copper oleate-boiled linseed oil combination (GG), rare-earths treatment (RE), and the rare earths and copper oleate (RC). The untreated line (A) was used as a control. Two sets of six lines each were treated with the preservatives mentioned. One of these sets was to remain in water continuously from May 25, 1923, to November 25, 1923, a sample being removed at the end of each 30 days and tested for tensile strength. The other set was removed at the end of each 30 days, washed, dried, treated with copper oleate, and again placed in the water, a sample line being kept out each month for measurement of tensile strength.

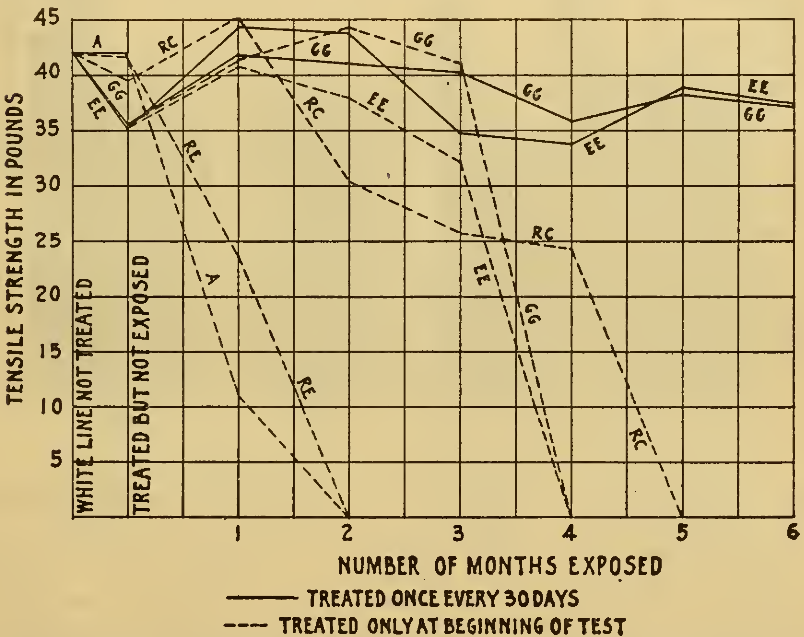

FIG. 17.—Tensile strength of cotton lines exposed in the Potomac River at Washington, D C.

TENSILE STRENGTH

The results of the tensile strength measurements are shown graphically in Figure 17. In this graph the broken lines show the samples that were treated only at the beginning of the test, while the heavy lines show the samples treated with copper oleate every 30 days. The samples receiving only one treatment of copper oleate showed a sharp decline in tensile strength after the third month and were completely rotten at the end of the fourth month. The samples treated every 30 days (represented in the graph by heavy lines) were as strong at the end of six months' exposure as at the beginning of the test.

SUMMARY OF RESULTS IN THE POTOMAC RIVER AT WASHINGTON, D. C.

1. The most important result of this test was the discovery that by removing gear from the water once each month and washing, drying, and treating it with copper oleate the life of twine can be more than doubled.

2. The rare-earths treatment (RE), when used alone, is not very effective as a preservative.

3. When the treatment is not repeated monthly, the combination of copper oleate and rare earths is somewhat better than copper oleate used alone.

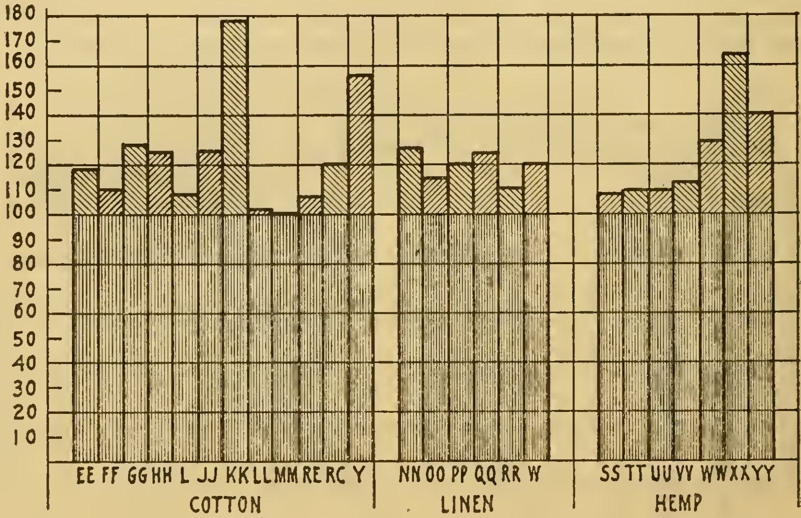

FIG. 18.—Increase of weight caused by one application of preservative

INCREASE IN WEIGHT CAUSED BY APPLICATION OF PRESERVATIVES

In a previous paper on this subject [4] we discussed the desirability of lightness as a property of textiles used for fishing gear. In all experiments described in the present work this factor was again accurately measured. The results of these measurements are shown graphically in Figure 18, where the original weight of the line is represented by the height of the rectangle up to 100. The diagonally hatched part above 100 represents the weight added by the preservative, and the total height of the rectangle represents the total weight of the line after treatment.

SHRINKAGE CAUSED BY APPLICATION OF PRESERVATIVES

The measurements of the sample lines before and after treatment revealed any changes in length. The results so obtained are shown graphically in Figure 19. In the case of hemp the lines treated with

[4] See footnote 2, p. 409.

copper oleate, tar, and the copper oleate-tar mixture showed a slight increase in length after treatment. This was probably due to the decrease in resistance of the fibers against each other, caused by the lubricating effect of the preservatives. The quercitron-ammoniacal copper sulphate caused a very appreciable amount of shrinkage on hemp.

EFFECT OF EXPOSURE TO SUNLIGHT

Attention should be directed to effects of exposure of nets to sunlight. It is common practice for fishermen, whenever opportunity offers, to wash their nets and lay them out on the sand or grass to dry. This practice may have a marked effect on nets, either untreated or treated with a preservative.

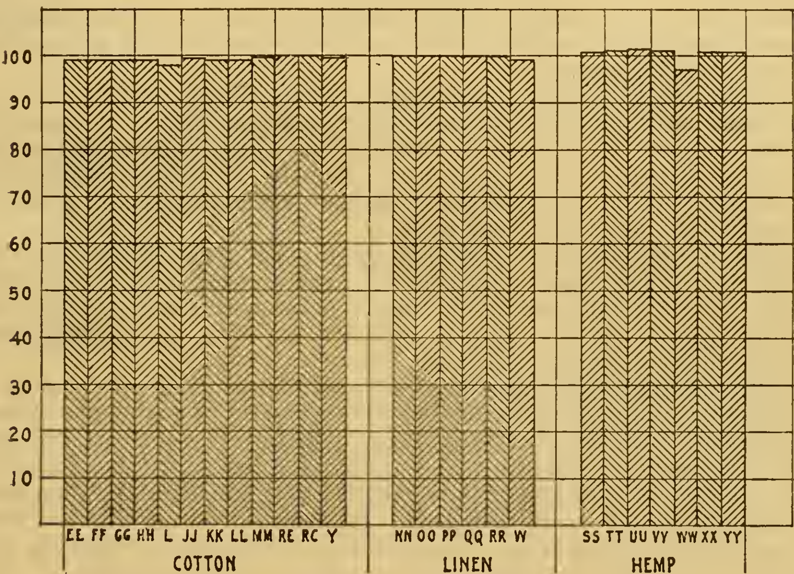

Fig. 19.—Shrinkage of lines, caused by one application of preservative

Waentig (1923) showed that cotton fibers of 7.2 grams tensile strength before illumination were reduced to 3 grams by direct illumination with mercury vapor arc ultra-violet light for 24 hours. Sunlight is known to contain a considerable proportion of these rays.

DePuyster (1923) points out that in the presence of air cotton fibers are yellowed and weakened by exposure to sunlight. He also shows that the presence of salts of copper and iron accelerate this deteriorating action of light. This is an important consideration where copper oleate is concerned. Taken together, with the fact that copper oleate appears to be decomposed by sunlight, this argues strongly against exposure of nets, especially those treated with copper oleate or bluestone, to sunlight. The nets should be dried in the shade or on cloudy days, if possible.

Holman and Jarrell (1923) show that cotton twine suffers deterioration on exposure to the weather under a great variety of protecting treatments, including that of copper oleate. They also show that oleic acid has a marked deteriorating effect. This latter fact is of great importance in its bearing on the possibility that commercial grades of copper oleate may contain some free oleic acid.

RESULTS OF PRACTICAL APPLICATION OF COPPER OLEATE BY FISHERMEN

During the 1923 season between 60,000 and 100,000 pounds of copper oleate were used by fishermen. In order to determine whether these practical trials had produced satisfactory results, we visited the fishermen along the New England and middle Atlantic coasts, examined their nets, and obtained from them their observations and opinions.

Lobster and pound-net fishermen from Maine to Long Island have, with few exceptions, had excellent results. At the time the survey was made copper oleate had been tried on but a very few gill nets in this region.

Those fishermen who used copper oleate found that it was an excellent antifouling agent and preservative as long as it remained in the twine. The length of time during which it remained in the twine varied from 14 days to 5 or 6 months. In those cases where it washed out in 14 days the fishermen believe that the grade of copper oleate used was very poor.

Various combinations of copper oleate with other substances were tried by the fishermen. One of the most successful of these was a mixture of a small amount of copper paint with the kerosene solution of copper oleate. This is reported as being an excellent preservative for use on pound nets.

The fishermen were about equally divided in their opinions as to whether gasoline or kerosene gave better results as a solvent. Gasoline seems to give a more uniform distribution of oleate through twine, drys more rapidly, and leaves twine less oily than kerosene. On the other hand, kerosene is cheaper than gasoline and also safer because it is not so inflammable. It was also found that in most cases better results were obtained when the net or webbing was allowed to steep in the solution for several hours, preferably over night, instead of 5 or 10 minutes, as was first recommended.

The principal suggestions from users of copper oleate were as follows:

1. Steps should be taken to prevent copper oleate from washing out of the webbing as rapidly as it now does.
2. There is need for some substance which, when combined with copper oleate, will give it more body, so that the webbing will be better protected from mechanical wear.
3. When copper oleate is used on seines, some substance should be added to prevent the slipping of knots when the seine is hauled.

With respect to the first of these suggestions, one must remember that if copper oleate is to prevent growth successfully it is necessary for it to be at least slightly soluble in water. An entirely insoluble substance would not preserve at all. It is doubtful, therefore, if it would be advisable to decrease the solubility of copper oleate to any great extent. We have conducted experiments that have indicated that if the solubility is appreciably decreased by such substances as linseed oil or paraffin, copper oleate is less effective as an antifouling agent.

In regard to the second and third suggestions, it has been found from our experiments that a mixture of copper oleate and coal tar makes an excellent preservative; in fact, one of the most effective tested. Where considerable increase in weight and stiffening is objectionable, such a treatment, of course, would not be permissible. This treatment would also eliminate the slipping of knots.

These objections from the users of copper oleate are important. It is believed, however, that if serious effort were made to overcome them this could be done, at least to some extent. Work on these problems is now being done.

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PROPAGATION AND DISTRIBUTION OF FOOD FISHES, FISCAL YEAR 1925[1]

By Glen C. Leach, *Assistant in Charge, Division of Fish Culture*

CONTENTS

[1] Appendix IX to Report of U. S. Commissioner of Fisheries for 1925. B. F. Doc. No. 999.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

INTRODUCTION

The development of a cooperative plan of fish rearing with fish and game associations throughout the country represents the chief change in the fish-cultural methods of the bureau in 1925. This work gives promise of largely increasing the production of fish of the larger fingerling sizes and of arousing the interest of anglers to extend greater assistance to Federal and State officials in the work of maintaining the supply of fish in our streams.

The output of eggs, fry, and fingerling fish was 5,301,862,500, as compared with 5,361,810,600 in the fiscal year 1924. The operation of the bureau's fish-cultural stations has been developed to a high standard of efficiency, and further development will depend upon a larger investment of funds to increase the working capacity of the stations. Only by such methods may the bureau hope to materially increase its output and keep pace with the growing demand for fish.

The demand for fish for stocking interior waters exceeded that of the preceding year to some extent and was much greater than the bureau could meet, especially with regard to the warm-water species. There has been no noteworthy increase in the activities of the various States, respecting the establishment of fish-cultural stations or the enlargement of their game-warden service.

The public demand is for larger fingerling fish for stocking purposes, but owing to shortage of funds and insufficient rearing facilities it has not been possible for the bureau to produce them in adequate numbers at its hatcheries. To meet this condition it was deemed essential to solicit the aid of fish and game organizations, and this was done by addressing a letter signed by the Secretary of Commerce, to such organizations throughout the country. In this letter the Secretary called attention to the ability of the organizations to render practical assistance to the Government in its efforts to produce fingerling fish for stocking public waters, especially such fishes as the black basses and crappie.

Numerous responses and offers of assistance were received from fishing clubs in different parts of the country, and as a result approximately 20 cooperative fish nurseries were placed in operation before the close of the fiscal year. Thus far their activities have been directed mainly to the rearing of small fingerling trout to a length of 4 or 5 inches before liberating them in open waters. Such work in the eastern sections of the country, notably in New York and Pennsylvania, has been begun on a very encouraging basis. As an illustration, the organization known as the Central Pennsylvania Fish and Game Protective Association, of Harrisburg, Pa., purchased a

16-acre tract of land containing a large spring, and constructed ponds with the view of holding and feeding until October the small trout turned over to them during the spring months by the bureau's hatcheries. In cases of this kind the bureau will inspect the projects at regular intervals during the summer, and will assume charge of the distribution of the fish in the fall of the year. The Texas and Blockhouse Fish and Game Association, Williamsport, Pa., was the first to undertake cooperative trout culture in the eastern part of the United States. The ponds and troughs of this organization were built under the supervision of the Bureau of Fisheries.

Judging from the information now at hand, it is probable that a number of cooperative nurseries will be established in the Southern States and in sections where warm-water pondfishes, especially the basses, are in great demand. The production of fingerling fish by this method will greatly lessen the dependence heretofore placed on the collection of rescued fishes from overflowed lands along the Mississippi River to supplement the general distributions. The facilities at the bureau's fish-cultural stations are too limited to meet the demands for the so-called warm-water fishes, and it is not considered good policy to draw heavily on the supply of fish salvaged from the upper Mississippi River for shipment to remote sections of the United States. It is the intention of the bureau to make each section self-supporting, so far as possible, in the production of indigenous fishes.

The bureau has pursued its formerly established policy with regard to the collection of food fishes from overflowed lands bordering the Mississippi River. In the prosecution of such work a great deal of State aid is given in salvaging the fish from landlocked pools and distributing them in interior waters. In this connection, the State conservation commissions of Illinois, Iowa, and Wisconsin have utilized their cars to remove fish from the bureau's retaining stations and plant them in suitable waters. Such assistance permits the bureau to expend a larger portion of its funds on the salvage work, and as its experienced personnel is able to devote more time to that branch of the operations, it can render much more efficient service than would otherwise be possible.

Under the act establishing the upper Mississippi wild life and fish refuge, approved June 7, 1924, certain overflowed lands in the upper Mississippi River district will be purchased by the Federal Government and set aside as natural hatcheries for the production of native fishes. The lakes included in this territory will be supervised by the fish-cultural force in that region and utilized in connection with the rescue operations. It is the eventual aim of the bureau to produce the entire stock of bass and other fishes needed for distribution to applicants and to return to the river all fish salvaged from the overflowed lands. It is probable that the adjacent States will aid in the project, not only in a police capacity but in the acquirement of additional land for its enlargement. The pursuance of such a policy will be of great benefit to the States, as it will mean the expansion of their conservation work.

The bureau has followed its usual custom with regard to placing spawn takers on the commercial fishing boats in the Great Lakes region to collect eggs of the whitefish, lake trout, and pike perch. The fishermen generally have cooperated in this work, and have

FIG. 1.—Cooperative trout culture. Nursery troughs

FIG. 2.—Cooperative trout culture. Nursery ponds

made it possible to conserve many millions of eggs which would otherwise have gone to market in the fish and been wasted. Besides assisting the bureau to collect the eggs, many of the fishermen have given the use of their boats during the spring months for the purpose of distributing the fry on suitable reefs on the natural spawning grounds.

Very unusual conditions were experienced at the Woods Hole (Mass.) station, in that it proved impossible to obtain a brood stock of cod as a source of egg supply. Cod failed to appear on their usual spawning grounds, and it was not considered feasible to charter a boat to transport brood fish from more remote fields to the hatchery. Under such conditions no cod eggs were available for propagation at this station.

As in past years, spawn takers were placed on the commercial fishing boats operating in fields at a considerable distance from shore during the spring months. Since these boats are absent from the home port for several days on each trip, all eggs thus collected must be fertilized and immediately returned to the native spawning grounds. The object of this work is to prevent the enormous waste of eggs which would otherwise result when dressing the fish for the market.

The bureau has continued its policy of refusing to issue countersigned permits allowing gill-net fishermen to fish for shad in the restricted territory above the railroad bridge at Edenton, N. C. It became apparent, from the small number of eggs obtained from the gill-net fishermen in former years, that greater results might be expected if the shad were permitted to spawn naturally. A number of gill-net and pound-net fishermen operating in other sections have cooperated with the bureau by furnishing considerable numbers of shad and herring eggs.

The decline of the shad in the Potomac River in recent years has been very marked, and it is evident that it will be necessary to enact and enforce very stringent legislation if this important fishery is to be maintained.

Part 1.—FISH PRODUCTION: PROPAGATION AND RESCUE WORK

TABULAR SUMMARIES OF OPERATIONS

SPECIES OF FISHES HANDLED

During the fiscal year 1925 the fish-cultural work of the bureau, including artificial propagation and rescue work, involved the handling of 48 species of fishes, as follows:

LIST OF SPECIES HANDLED

CATFISHES (SILURIDÆ):
- Blue catfish (*Ictalurus furcatus*).
- Channel catfish (*Ictalurus punctatus*).
- Horned pout, bullhead (*Ameiurus nebulosus*).
- Mud catfish (*Leptops olivaris*).

SUCKERS (CATOSTOMIDÆ):
- Common buffalo fish (*Ictiobus cyprinella*).
- Smallmouth buffalo fish (*Ictiobus bubalus*).

CARPS (CYPRINIDÆ): German carp (*Cyprinus carpio*).

SHADS AND HERRINGS (CLUPEIDÆ):
- Shad (*Alosa sapidissima*).
- Glut herring (*Pomolobus æstivalis*).

SALMONS, TROUTS, WHITEFISHES, ETC. (SALMONIDÆ):
- Common whitefishes (*Coregonus albus* and *C. clupeaformis*).
- Cisco (*Argyrosomus 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*).
- Black-spotted trout, redthroat trout (*Salmo lewisi*).
- Loch Leven trout (*Salmo levenensis*).
- Lake trout, Mackinaw trout (*Cristivomer namaycush*).
- Brook trout (*Salvelinus fontinalis*).
- Brown trout (*Salmo fario*).

GRAYLINGS (THYMALLIDÆ): Montana grayling (*Thymallus montanus*).

PIKES (ESOCIDÆ): Common pickerel (*Esox lucius*).

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*).
- Green sunfish (*Apomotis cyanellus*).
- Red-breasted bream (*Lepomis auritus*).
- Bluegill sunfish (*Lepomis pallidus*).
- Long-eared sunfish (*Lepomis megalotis*).
- Common sunfish (*Eupomotis gibbosus*).

PERCHES (PERCIDÆ):
- Pike perch (*Stizostedion vitreum*).
- Sauger (*Stizostedion canadense*).
- Yellow perch, ringed perch (*Perca flavescens*).

SEA BASSES (SERRANIDÆ): White bass (*Roccus chrysops*).

DRUMS (SCIÆNIDÆ): Fresh-water drum, lake sheepshead (*Aplodinotus grunniens*).

MACKEREL (SCOMBER LINNÆUS): Common mackerel (*Scomber scombrus*).

CODS (GADIDÆ):
- Cod (*Gadus callarias*).
- Haddock (*Melanogrammus æglifinus*).
- Pollock (*Pollachius virens*).

FLOUNDERS (PLEURONECTIDÆ): Winter flounder, American flatfish (*Pseudopleuronectes americanus*).

COOPERATION WITH STATES, OTHER FEDERAL AGENCIES, AND FOREIGN GOVERNMENTS

During the year the bureau exchanged eggs with the Dominion of Canada and supplied eggs to several European and South American countries. The exchanges made with the Canadian authorities have been of material advantage to the bureau, since it received in return eggs of the valuable Atlantic salmon. A number of the States have been supplied with fish and eggs in exchange for eggs of species which the bureau would otherwise have had to purchase. In many instances the States have agreed to incubate eggs and distribute the resulting fry without cost to the bureau, which will effect a material saving in the expense of handling such fish.

A large number of fish and game organizations have offered to contribute the use of ponds and lakes under their control for the purpose of rearing to a larger size the small fish which the bureau ordinarily distributes in the spring months, putting them out as fingerlings in September or October. This cooperative assistance will be a great aid to the bureau, and it is believed it will go far toward increasing the supply of fish life in the streams and lakes.

OUTPUT

The output of the fish-cultural stations and of the rescue fields bordering the Mississippi River aggregated 5,301,950,325 fish and fish eggs. Losses in transportation amounted to 87,742, leaving a net output of 5,301,862,583 actually distributed, which shows a falling off of approximately 60,000,000, as compared with last year's figures. Practically the entire production of the commercial fishes was returned to the waters in which the eggs originated.

Summary, by species, of the output of fish and fish eggs during the fiscal year ended June 30, 1925

Species	Eggs	Fry	Fingerlings	Total
Catfish			14, 310, 290	14, 310, 290
Buffalo fish	127, 400, 000	12, 562, 500	4, 261, 430	144, 223, 930
Carp		31, 500, 000	10, 959, 465	42, 459, 465
Shad		17, 158, 671		17, 158, 671
Glut herring		92, 000, 000		92, 000, 000
Whitefish	340, 000	172, 630, 000		172, 970, 000
Cisco	8, 000, 000	118, 900, 000		126, 900, 000
Chinook salmon	7, 504, 880	2, 528, 800	42, 684, 200	52, 717, 880
Chum salmon		16, 051, 650		16, 051, 650
Silver salmon	862, 000	10, 177, 650	3, 797, 639	14, 837, 289
Sockeye salmon	3, 150, 000	28, 070, 000	3, 891, 700	35, 111, 700
Humpback salmon		10, 892, 500		10, 892, 500
Steelhead salmon	604, 000	124, 580	1, 327, 184	2, 055, 764
Atlantic salmon		1, 410, 000	12, 500	1, 422, 500
Landlocked salmon	81, 000	816, 621	219, 825	1, 117, 446
Rainbow trout	3, 008, 754	1, 989, 500	2, 326, 485	7, 324, 739
Black-spotted trout	16, 802, 060	4, 776, 100	1, 584, 817	23, 162, 977
Loch Leven trout	8, 803, 000		784, 341	9, 587, 341
Lake trout	2, 940, 000	32, 822, 613	309, 815	36, 072, 428
Brook trout	500, 000	2, 776, 469	12, 755, 628	16, 032, 097
Silver trout			100, 000	100, 000
Grayling		4, 877, 000	29	4, 877, 029
Pike and pickerel			709, 077	709, 077
Mackerel		3, 517, 000		3, 517, 000
Crappie			16, 884, 251	16, 884, 251
Largemouth black bass		1, 135, 100	1, 615, 021	2, 750, 121
Smallmouth black bass		545, 400	41, 927	587, 327
Rock bass			60, 560	60, 560
Warmouth bass			5, 370	5, 370
Sunfish			13, 894, 947	13, 894, 947
Pike perch	122, 450, 000	116, 100, 000	141, 584	238, 691, 584
Yellow perch	5, 850, 000	83, 988, 800	555, 340	90, 394, 140
White bass			4, 425	4, 425
Fresh-water drum			19, 590	19, 590
Cod	598, 065, 000	462, 712, 000		1, 060, 777, 000
Haddock	139, 366, 000	24, 511, 000		163, 877, 000
Pollock		222, 890, 000		222, 890, 000
Winter flounder	4, 667, 000	2, 637, 051, 000		2, 641, 718, 000
Miscellaneous fishes			3, 696, 495	3, 696, 495
Total	1, 050, 393, 694	4, 114, 514, 954	136, 953, 935	5, 301, 862, 583

Assignments of fish eggs to State and Territorial fish commissions, fiscal year 1925

State and species	Number	State and species	Number
Arizona:		New Hampshire:	
Black-spotted trout	200,000	Chinook salmon	450,000
Rainbow trout	220,000	Lake trout	75,000
California: Black-spotted trout	300,000	Landlocked salmon	20,700
Colorado:		Pike perch	500,000
Black-spotted trout	100,000	New Jersey: Loch Leven trout	500,000
Lake trout	25,000	New Mexico:	
Rainbow trout	25,000	Rainbow trout	117,000
Connecticut: Loch Leven trout	50,000	Steelhead salmon	50,000
Hawaii: Rainbow trout	50,000	New York:	
Idaho:		Black-spotted trout	10,000
Black-spotted trout	175,000	Lake trout	515,000
Lake trout	100,000	Whitefish	140,000
Landlocked salmon	25,000	North Carolina: Rainbow trout	588,430
Rainbow trout	30,000	Oregon:	
Steelhead salmon	46,000	Black-spotted trout	2,000,000
Illinois:		Chinook salmon	7,044,880
Black-spotted trout	25,000	Loch Leven trout	2,185,000
Pike perch	37,800,000	Silver salmon	762,000
Rainbow trout	170,000	Sockeye salmon	3,000,000
Silver salmon	100,000	Pennsylvania:	
Steelhead salmon	25,000	Lake trout	50,000
Iowa: Rainbow trout	143,000	Loch Leven trout	300,000
Maine: Lake trout	100,000	Pike perch	84,150,000
Maryland: Rainbow trout	277,980	Utah: Lake trout	250,000
Massachusetts: Loch Leven trout	50,000	Washington: Black-spotted trout	2,000,000
Michigan:		Wisconsin: Lake trout	500,000
Cisco	8,000,000	Wyoming:	
Whitefish	200,000	Black-spotted trout	425,000
Minnesota:		Loch Leven trout	500,000
Lake trout	500,000	Rainbow trout	350,000
Loch Leven trout	3,000,000	Steelhead salmon	50,000
Missouri: Yellow perch	5,850,000		
Montana:		Total	167,017,990
Black-spotted trout	1,485,000		
Loch Leven trout	1,413,000		

Shipments of fish and fish eggs to foreign countries and the Canal Zone, fiscal year 1925

Country and species	Number of eggs	Number of fish	Country and species	Number of eggs	Number of fish
Canada:			Colombia: Loch Leven trout	50,000	
Lake trout	500,000		Netherlands: Rainbow trout	50,000	
Loch Leven trout	500,000		Panama: Rainbow trout	25,000	
Canal Zone:					
Largemouth black bass		2,250	Total	1,125,000	3,250
Bream		500			
Crappie		500			

EGG COLLECTIONS

The commercial fisheries of the Atlantic coast and the Great Lakes are the principal sources of supply for eggs for the bureau's work. Vast numbers of the eggs available in these fields would be wasted were it not for the efforts put forth by the bureau to conserve them. In some cases the eggs are planted on the spawning grounds immediately after fertilization is accomplished, but whenever conditions make it possible they are transferred to hatcheries, incubated, and the resulting fry liberated on suitable spawning grounds in the region in which the eggs were taken.

As compared with the statement of the preceding year, the records of last year show a slight increase in the total number of eggs collected, the most important increases being among the pike perch, cod, and winter flounder.

Comparison of egg collections, fiscal years 1925 and 1924

Species	1925	1924	Species	1925	1924
Buffalo fish	140, 400, 000	376, 778, 500	Brown trout	31, 000	
Carp	44, 875, 000	55, 325, 000	Lake trout	66, 908, 500	78, 016, 233
Shad	26, 772, 000	16, 452, 000	Brook trout	19, 684, 794	18, 488, 304
Glut herring	336, 700, 000	222, 740, 000	Grayling	917, 000	
Whitefish	252, 925, 000	481, 018, 000	Smelt		18, 000, 000
Cisco	187, 800, 000	200, 790, 000	Mackerel	3, 821, 000	
Chinook salmon	54, 437, 000	55, 474, 800	Pike perch	416, 640, 000	333, 875, 000
Chum salmon	17, 110, 000	25, 344, 700	Sauger		8, 400, 000
Humpback salmon		1, 573, 000	Yellow perch	116, 460, 000	224, 780, 000
Silver salmon	11, 578, 000	22, 722, 000	Cod	1, 356, 823, 000	1, 002, 814, 000
Sockeye salmon	64, 465, 000	46, 688, 000	Haddock	216, 825, 000	239, 610, 000
Steelhead salmon	4, 174, 969	6, 031, 164	Pollock	430, 648, 000	401, 824, 000
Landlocked salmon	1, 263, 000	1, 298, 600	Winter flounder	2, 882, 065, 000	2, 404, 887, 000
Rainbow trout	13, 914, 384	11, 433, 217			
Black-spotted trout	26, 030, 000	39, 859, 500	Total	6, 705, 428, 297	6, 302, 143, 468
Loch Leven trout	12, 160, 650	7, 920, 050			

FISH-RESCUE WORK

Salvage operations in the Mississippi Valley were greatly curtailed owing to the abnormally high water stages which prevailed in the Mississippi River during the greater part of the summer and fall. The territory covered by the work extended from Prescott, Wis., on the north, to Andalusia, Ill., on the south, and the following table shows the results accomplished:

Number and disposition of fish rescued fiscal year 1925

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
Homer, Minn.:			
Black bass	57, 380	129, 170	186, 550
Bream	163, 060	8, 972, 740	9, 135, 800
Buffalo fish		95, 250	95, 250
Carp		3, 438, 020	3, 438, 020
Catfish	44, 900	2, 889, 820	2, 934, 720
Crappie	239, 750	8, 506, 200	8, 745, 950
Fresh-water drum		14, 950	14, 950
Pike perch	30	141, 260	141, 290
White bass		1, 870	1, 870
Yellow perch	18, 400	167, 010	185, 400
Miscellaneous	1, 450	93, 490	94, 940
Total	524, 970	24, 449, 780	24, 974, 750
La Crosse, Wis.:			
Black bass	81, 910	9, 120	91, 030
Bream	12, 960	1, 499, 530	1, 512, 490
Buffalo fish		698, 000	698, 000
Carp		2, 024, 500	2, 024, 500
Catfish	35, 800	3, 176, 450	3, 212, 250
Crappie	29, 640	1, 864, 040	1, 893, 680
Fresh-water drum		5, 000	5, 000
Pike and pickerel		469, 400	469, 400
White bass		2, 100	2, 100
Yellow perch	4, 130	251, 980	256, 110
Miscellaneous		1, 115, 500	1, 115, 500
Total	164, 440	11, 115, 620	11, 280, 060
Lynxville, Wis.:			
Black bass	2, 270	5, 440	7, 710
Bream	5, 380	527, 430	532, 810
Buffalo fish		150, 590	150, 590
Carp		1, 948, 100	1, 948, 100
Catfish	13, 690	2, 775, 460	2, 789, 150
Crappie	23, 350	1, 831, 980	1, 855, 330
Pike and pickerel		91, 670	91, 670
Yellow perch	1, 350	62, 080	63, 430
Miscellaneous		186, 950	186, 950
Total	46, 040	7, 579, 700	7, 625, 740

Number and disposition of fish rescued fiscal year 1925—Continued

Locality and species	Delivered to applicants	Restored to original waters	Total number of fish rescued
Marquette, Iowa:			
Black bass	22,810	23,680	46,490
Bream	7,600	1,353,100	1,360,700
Buffalo fish		644,480	644,480
Carp		688,450	688,450
Catfish		3,451,200	3,451,200
Crappie	3,330	1,505,580	1,508,910
Pike and pickerel		53,510	53,510
Yellow perch	780	46,200	46,980
Miscellaneous		586,800	586,800
Total	34,520	8,353,000	8,387,520
Bellevue, Iowa:			
Black bass	8,720	1,790	10,510
Bream	49,060	119,450	168,510
Buffalo fish	20	1,844,990	1,845,010
Carp	130	1,824,880	1,825,010
Catfish	27,320	841,980	869,300
Crappie	55,060	742,650	797,710
Pike and pickerel	20	1,590	1,610
White bass		340	340
Yellow perch	1,070	310	1,380
Miscellaneous	100	824,900	825,000
Total	141,500	6,202,880	6,344,380
Rock Island, Ill.:			
Black bass		8,500	8,500
Bream		491,000	491,000
Buffalo fish		229,600	229,600
Carp		352,400	352,400
Catfish		325,500	325,500
Crappie		1,711,000	1,711,000
Pike and pickerel		11,750	11,750
White bass		900	900
Miscellaneous		478,000	478,000
Total		3,608,650	3,608,650
Fairport, Iowa:			
Black bass		13,150	13,150
Bream	20,940	59,700	80,640
Buffalo fish		18,580	18,580
Carp		32,000	32,000
Catfish		23,920	23,920
Crappie	1,620	106,910	108,530
Pike and pickerel		80	80
White bass		30	30
Miscellaneous		5,710	5,710
Total	22,560	260,080	282,640
Atchafalaya, La.:			
Black bass	3,300	2,480	5,780
Bream	2,130	96,270	98,400
Buffalo fish		579,600	579,600
Carp		651,000	651,000
Catfish		675,000	675,000
Crappie		227,300	227,300
Pike and pickerel		1,000	1,000
White bass		100	100
Yellow perch		100	100
Miscellaneous		403,600	403,600
Total	5,430	2,636,450	2,641,880

STATIONS AND SUBSTATIONS AND OUTPUT OF EACH

During the fiscal year 1925 fish-cultural work was conducted at 36 stations, 38 substations, and a considerable number of egg-collecting stations, the latter being in operation only during the spawning season of the various fishes handled. The following table lists the stations in alphabetical order with their auxiliary substations immediately following each. The output of fish and fish eggs from each station for the year is also shown.

Stations and substations operated and output of each, fiscal year 1925

(Asterisk (*) denotes transfer of eggs. See table, p. 454)

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Baird, Calif.: Chinook salmon		300,000	833,500	1,133,500
Battle Creek, Calif.: Chinook salmon		250,000	1,059,000	1,309,000
Mill Creek, Calif.: Chinook salmon	(*)	1,598,800		1,598,800
Baker Lake, Wash.: Sockeye salmon	(*)	20,770,000		20,770,000
Birdsview, Wash.:				
Humpback salmon		1,134,000		1,134,000
Silver salmon	100,000	2,845,000	740,000	3,685,000
Sockeye salmon	150,000			150,000
Steelhead salmon	* 100,000		418,000	518,000
Duckabush, Wash.:				
Chinook salmon			497,000	497,000
Chum salmon		12,310,500		12,310,500
Humpback salmon		4,390,000		4,390,000
Silver salmon		2,093,400		2,093,400
Steelhead salmon			90,400	90,400
Quilcene, Wash.:				
Chinook salmon			465,200	465,200
Chum salmon		3,741,150		3,741,150
Humpback salmon		5,368,500		5,368,500
Silver salmon		3,911,250	746,639	4,657,889
Steelhead salmon		50,000	117,875	167,875
Sultan, Wash.:				
Chinook salmon		380,000	198,000	578,000
Silver salmon		454,000	230,000	684,000
Steelhead salmon			83,000	83,000
Berkshire trout hatchery, Mass.:				
Brook trout			85,200	85,200
Pike perch		400,000		400,000
Rainbow trout			54,100	54,100
Smallmouth black bass			640	640
Boothbay Harbor, Me.: Winter flounder		1,884,436,000		1,884,436,000
Bozeman, Mont.:				
Black-spotted trout	310,000	956,000	517,017	1,783,017
Brook trout			1,074,840	1,074,840
Catfish			60	60
Grayling			29	29
Lake trout			9,100	9,100
Loch Leven trout	598,000		155,511	735,511
Rainbow trout		311,000	12,000	323,000
Glacier Park, Mont.:				
Black-spotted trout	245,800	75,000	155,000	475,800
Rainbow trout		342,000		342,000
Meadow Creek, Mont.:				
Black-spotted trout		41,000		41,000
Grayling		4,877,000		4,877,000
Loch Leven trout	* 8,200,000			8,200,000
Rainbow trout	* 230,000	1,308,000		1,538,000
Cape Vincent, N. Y.:				
Brook trout		581,500	19,400	600,900
Cisco	*8,000,000	118,500,000		126,500,000
Lake trout		265,000		265,000
Landlocked salmon		6,000		6,000
Pike perch		5,900,000		5,900,000
Rainbow trout		30,500		30,500
Smallmouth black bass			95	95
Whitefish	*140,000	36,500,000		36,640,000
Yellow perch		3,900,000		3,900,000
Swanton, Vt.:				
Pike perch	*84,650,000	33,000,000		117,650,000
Smallmouth black bass			57	57
Yellow perch	(*)	24,700,000		24,700,000
Central station, Washington, D. C.:				
Black bass			938	938
Brook trout			111,800	111,800
Cisco		400,000		400,000
Rainbow trout			19,000	19,000
Whitefish		200,000		200,000
Yellow perch	5,850,000			5,850,000
Bryans Point, Md.:				
Largemouth black bass			25	25
Shad		16,678,671		16,678,671
Yellow perch	(*)	34,420,800	370	34,421,170
Lakeland, Md.:				
Black bass			47,376	47,376
Brook trout			24	24
Catfish			123	123
Crapple			14,595	14,595
Rainbow trout			150	150
Rock bass			6,900	6,900
Sunfish			43,115	43,115

Stations and substations operated and output of each, fiscal year 1925—Continued

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Clackamas, Oreg.:				
Brook trout			36,000	36,000
Chinook salmon			7,278,000	7,278,000
Silver salmon	237,000			237,000
Silver trout			100,000	100,000
Steelhead salmon	200,000		24,000	224,000
Applegate, Oreg.: Silver salmon	(*)		1,495,000	1,495,000
Big White Salmon, Wash.: Chinook salmon	4,969,880		9,138,800	14,108,680
Little White Salmon, Wash.:				
Brook trout			122,000	122,000
Chinook salmon	*2,525,000		15,047,000	17,572,000
Rogue River, Oreg.:				
Chinook salmon			3,066,200	3,066,200
Landlocked salmon			9,100	9,100
Silver salmon	525,000		586,000	1,111,000
Sockeye salmon			46,700	46,700
Steelhead salmon	*249,000		450,000	699,000
Sandy River, Oreg.:				
Chinook salmon			959,000	959,000
Steelhead salmon	*58,000			58,000
Snake River, Oreg.:				
Chinook salmon			4,142,500	4,142,500
Rainbow trout			100,800	100,800
Cold Spring, Ga.:				
Largemouth black bass		170,100	230,395	400,495
Catfish			4,400	4,400
Sunfish			75,250	75,250
Harris Pond, Ga.:				
Catfish			3,300	3,300
Sunfish			29,850	29,850
Craig Brook, Me.:				
Atlantic salmon		1,410,000	12,500	1,422,500
Brook trout		671,000	355,550	1,026,550
Lake trout		5,500	25,100	30,600
Landlocked salmon	*81,000	528,205	53,725	662,930
Smallmouth black bass			55	55
Grand Lake Stream, Me.: Landlocked salmon	(*)	273,250		273,250
Green Lake, Me.: Landlocked salmon	(*)		134,200	134,200
Duluth, Minn.:				
Brook trout			189,000	189,000
Lake trout	*1,475,000	12,555,000	197,500	14,227,500
Pike perch		13,000,000		13,000,000
Steelhead salmon			29,000	29,000
Whitefish		1,100,000		1,100,000
Edenton, N. C.:				
Largemouth black bass		129,000	26,450	155,450
Crappie			316	316
Glut herring		92,000,000		92,000,000
Shad		480,000		480,000
Sunfish			9,625	9,625
Yellow perch		1,000,000	501	1,000,501
Erwin, Tenn.:				
Largemouth black bass		71,250	2,225	73,475
Brook trout			386,750	386,750
Loch Leven trout			8,530	8,530
Rainbow trout	210,000		155,712	365,712
Rock bass			18,400	18,400
Smallmouth black bass			225	225
Steelhead salmon			27,859	27,859
Sunfish			9,788	9,788
Fairport, Iowa:				
Largemouth black bass			13,151	13,151
Buffalo fish			18,925	18,925
Carp			32,000	32,000
Catfish			23,917	23,917
Crappie			108,585	108,585
Pike and pickerel			78	78
Sunfish			80,637	80,637
White bass			25	25
Miscellaneous			5,710	5,710
Gloucester, Mass.:				
Cod	*598,065,000	462,712,000		1,060,777,000
Haddock	139,366,000	24,511,000		163,877,000
Pollock		222,890,000		222,890,000
White flounder		174,323,000		174,323,000

Stations and substations operated and output of each, fiscal year 1925—Continued

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Homer, Minn.:				
Largemouth black bass			186,550	186,550
Buffalo fish			95,245	95,245
Carp			3,438,015	3,438,015
Catfish			2,934,710	2,934,710
Crappie			8,745,950	8,745,950
Fresh-water drum			14,590	14,590
Pike perch			141,285	141,285
Pike and pickerel			80,079	80,079
Rainbow trout			60,500	60,500
Sunfish			9,135,800	9,135,800
White bass			1,865	1,865
Yellow perch			185,405	185,405
Miscellaneous			94,935	94,935
Atchafalaya, La.:				
Largemouth black bass			5,575	5,575
Buffalo fish	127,400,000	12,562,500	579,600	140,542,100
Carp			651,000	651,000
Catfish			675,000	675,000
Crappie			227,300	227,300
Pike and pickerel			995	995
Sunfish			98,400	98,400
White bass			100	100
Yellow perch			100	100
Miscellaneous			403,600	403,600
Bellevue, Iowa:				
Largemouth black bass			8,495	8,495
Buffalo fish			1,845,000	1,845,000
Carp			1,825,000	1,825,000
Catfish			869,300	869,300
Crappie			797,700	797,700
Pike perch			299	299
Pike and pickerel			1,605	1,605
Sunfish			168,510	168,510
White bass			335	335
Yellow perch			1,375	1,375
Miscellaneous			825,000	825,000
Chicago, Ill.: Rainbow trout			40,500	40,500
La Crosse, Wis.:				
Largemouth black bass			91,030	91,030
Brook trout			643,800	643,800
Buffalo fish			698,000	698,000
Carp			2,024,500	2,024,500
Catfish			3,212,250	3,212,250
Crappie			1,893,675	1,893,675
Fresh-water drum			5,000	5,000
Loch Leven trout			59,300	59,300
Pike and pickerel			469,400	469,400
Rainbow trout			147,100	147,100
Sunfish			1,512,485	1,512,485
White bass			2,100	2,100
Yellow perch			256,100	256,100
Miscellaneous			1,115,500	1,115,500
Lynxville, Wis.:				
Largemouth black bass			7,705	7,705
Buffalo fish			150,585	150,585
Carp			1,948,100	1,948,100
Catfish			2,789,150	2,789,150
Crappie			1,855,325	1,855,325
Pike and pickerel			91,665	91,665
Sunfish			532,800	532,800
Yellow perch			63,425	63,425
Miscellaneous			186,950	186,950
Marquette, Iowa:				
Largemouth black bass			46,485	46,485
Buffalo fish			644,475	644,475
Carp			688,450	688,450
Catfish			3,451,200	3,451,200
Crappie			1,508,900	1,508,900
Pike and pickerel			53,510	53,510
Sunfish			1,360,700	1,360,700
Yellow perch			46,975	46,975
Miscellaneous			586,800	586,800
Rock Island, Ill.:				
Largemouth black bass			8,495	8,495
Buffalo fish			229,600	229,600
Carp			352,400	352,400
Catfish			325,500	325,500
Crappie			1,711,000	1,711,000
Pike and pickerel			11,745	11,745
Sunfish			491,000	491,000
Miscellaneous			478,000	478,000
Yellowstone, Wyo.: Black-spotted trout	*16,246,260	3,710,100		19,956,360

Stations and substations operated and output of each, fiscal year 1925—Continued

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
Leadville, Colo.:				
Black-spotted trout			801,000	801,000
Brook trout	*500,000	400,000	4,503,500	5,403,500
Lake trout			57,000	57,000
Loch Leven trout			42,500	42,500
Rainbow trout			19,000	19,000
Steelhead trout			23,500	23,500
Louisville, Ky.:				
Black bass			4,650	4,650
Rock bass			525	525
Smallmouth black bass		420,000	2,725	2,725
Sunfish			16,700	16,700
Mammoth Spring, Ark.:				
Largemouth black bass			77,135	77,135
Catfish			700	700
Crappie			1,500	1,500
Rock bass			13,850	13,850
Smallmouth black bass		16,000	12,300	28,300
Sunfish			13,950	13,950
Manchester, Iowa:				
Brook trout			535,000	535,000
Catfish			300	300
Rainbow trout	*615,500		141,904	757,404
Rock bass			7,000	7,000
Smallmouth black bass			500	500
Sunfish			600	600
Nashua, N. H.:				
Brook trout			358,335	358,335
Lake trout			3,500	3,500
Landlocked salmon			20,000	20,000
Loch Leven trout			1,200	1,200
Pike perch		660,000		
Rainbow trout			87,850	87,850
Smallmouth black bass		28,400		28,400
Neosho, Mo.:				
Largemouth black bass			57,535	57,535
Catfish			4,050	4,050
Crappie			11,575	11,575
Rainbow trout	*312,000		96,613	96,613
Rock bass			3,450	3,450
Sunfish			75,462	75,462
Yellow perch			1,044	1,044
Bourbon, Mo.: Rainbow trout	747,354		59,445	806,799
Langdon, Kans.:				
Largemouth black bass			15,690	15,690
Catfish			5,525	5,525
Crappie			7,680	7,680
Rock bass			2,050	2,050
Sunfish			46,900	46,900
Yellow perch			45	45
Northville, Mich.:				
Brook trout		290,000	731,920	1,021,920
Rainbow trout			117,800	117,800
Smallmouth black bass		75,000	25,300	100,300
Sunfish			220	220
Alpena, Mich.:				
Lake trout	50,000	3,827,000		3,877,000
Whitefish	200,000	8,750,000		8,950,000
Charlevoix, Mich.:				
Lake trout	*1,415,000	16,000,000		17,415,000
Landlocked salmon		10,000		10,000
Steelhead salmon		35,500		35,500
Whitefish		17,000,000		17,000,000
Orangeburg, S. C.:				
Largemouth black bass		107,500	265,055	372,555
Catfish			225	225
Crappie			200	200
Sunfish			10,815	10,815
Warmouth bass			1,855	1,855
Put in Bay, Ohio:				
Carp		31,500,000		31,500,000
Pike perch	37,800,000	63,140,000		100,940,000
Smallmouth black bass			30	30
Whitefish		109,080,000		109,080,000
Yellow perch	(*)	19,968,000		19,968,000
Quinault, Wash.:				
Brook trout			24,900	24,900
Chinook salmon	* 10,000			10,000
Silver salmon		874,000		874,000
Sockeye salmon	3,000,000	1,000,000	2,845,000	6,845,000

Stations and substations operated and output of each, fiscal year 1925—Continued

Stations, substations, and species	Eggs	Fry	Fingerlings, yearlings, and adults	Total
St. Johnsbury, Vt.:				
Brook trout		527, 500		527, 500
Lake trout		87, 500		87, 500
Landlocked salmon		10, 426	2, 800	13, 226
Rainbow trout			500	500
Steelhead salmon		11, 000	6, 200	17, 200
Holden, Vt.:				
Brook trout		177, 500		177, 500
Lake trout		82, 613	19, 100	101, 713
Landlocked salmon		11, 240		11, 240
York Pond, Vt.:				
Brook trout		129, 969	14, 133	144, 102
Lake trout			165	165
San Marcos, Tex.:				
Largemouth black bass			224, 861	224, 861
Catfish			8, 140	8, 140
Crappie			260	260
Rock bass			85	85
Steelhead salmon			2, 800	2, 800
Sunfish			38, 945	38, 945
Warmouth bass			3, 015	3, 015
Kerr County bass hatchery, Tex.:				
Largemouth black bass			19, 675	19, 675
Sunfish			40, 000	40, 000
Medina Lake, Tex.: Largemouth black bass			22, 237	22, 237
New Braunfels, Tex.:				
Largemouth black bass			36, 473	36, 473
Crappie			500	500
Sunfish			25, 000	25, 000
Warmouth bass			500	500
Saratoga, Wyo.:				
Black-spotted trout			60, 000	60, 000
Brook trout			525, 500	525, 500
Loch Leven trout			34, 000	34, 000
Rainbow trout			156, 000	156, 000
Lost Creek, Wyo.: Rainbow trout	*416, 150			416, 150
Spearfish, S. Dak.:				
Brook trout			874, 600	874, 600
Loch Leven trout			353, 400	353, 400
Rainbow trout			87, 700	87, 700
Steelhead salmon			54, 600	54, 600
Springville, Utah:				
Black-spotted trout			56, 000	56, 000
Brook trout	(*)		375, 400	375, 400
Catfish			600	600
Rainbow trout	*20, 000		450, 050	450, 050
Tupelo, Miss.:				
Largemouth black bass		430, 000	137, 205	567, 205
Catfish			600	600
Crappie			300	300
Rock bass			300	300
Sunfish			73, 375	73, 375
White Sulphur Springs, W. Va.:				
Largemouth black bass			66, 840	66, 840
Brook trout			1, 418, 694	1, 418, 694
Loch Leven trout	5, 000		133, 350	138, 350
Rainbow trout	*256, 550		401, 545	658, 095
Rock bass			6, 000	6, 000
Smallmouth black bass		6, 000		6, 000
Woods Hole, Mass.:				
Mackerel		3, 517, 000		3, 517, 000
Steelhead salmon		28, 080		28, 080
Winter flounder	4, 667, 000	578, 292, 000		582, 959, 000
Wytheville, Va.:				
Largemouth black bass		229, 000	21, 860	250, 860
Brook trout			387, 000	387, 000
Catfish			1, 250	1, 250
Loch Leven trout			750	750
Rainbow trout	201, 200		129, 600	330, 800
Rock bass			2, 000	2, 000
Sunfish			7, 100	7, 100
Yes Bay, Alaska: Sockeye salmon		6, 300, 000	1, 000, 000	7, 300, 000
Gross output	1, 050, 396, 694	4, 114, 548, 204	137, 005, 427	5, 301, 950, 325
Loss in transit	3, 000	33, 250	51, 492	87, 742
Net output	1, 050, 393, 694	4, 114, 514, 954	136, 953, 935	5, 301, 862, 583

TRANSFERS OF EGGS BETWEEN STATIONS

Large numbers of eggs are transferred annually between various stations of the bureau. In every instance such transfers are made in the interest of economy and convenience in the distribution of the product.

Transfer of eggs between stations, fiscal year 1925

Species	Number of eggs	From—	To—
Black-spotted trout	2,588,000	Yellowstone Park, Wyo	Bozeman, Mont.
	484,000	do	Glacier Park, Mont.
	814,000	do	Leadville, Colo.
	300,000	do	Saratoga, Wyo.
Brook trout	500,000	Leadville, Colo	Spearfish, S. Dak.
	500,000	do	Bozeman, Mont.
	500,000	do	Manchester, Iowa.
	100,000	do	Clackamas, Oreg.
	500,000	Springville, Utah	Bozeman, Mont.
Chinook salmon	500,000	Mill Creek, Calif	Battle Creek, Calif.
	1,000,000	Little White Salmon, Wash	Puget Sound stations.
	3,057,000	do	Clackamas, Oreg.
	2,217,600	Upper Clackamas, Oreg	Do.
	13,000	Quinault, Wash	Central Station, Washington, D. C.
Cisco	720,000	Cape Vincent, N. Y	Do.
Cod	1,750,000	Gloucester, Mass	Woods Hole, Mass.
Lake trout	15,000	Grand Lake Stream, Me	Craig Brook, Me.
	75,000	Duluth, Minn	Leadville, Colo.
	15,000	Charlevoix, Mich	Craig Brook, Me.
	200,000	do	Cape Vincent, N. Y.
Landlocked salmon	11,000	Craig Brook, Me	Charlevoix, Mich.
	25,000	do	St. Johnsbury, Vt.
	10,300	do	Cape Vincent, N. Y.
	10,300	do	Bozeman, Mont.
	22,600	do	Nashua, N. H.
	501,000	Grand Lake Stream, Me	Craig Brook, Me.
	142,500	Green Lake, Me	Do.
Loch Leven trout	150,000	Meadow Creek, Mont	White Sulphur Springs, W. Va.
	100,000	do	La Crosse, Wis.
	300,000	do	Spearfish, S. Dak.
	1,393,000	do	Bozeman, Mont.
Pike perch	11,000,000	Swanton, Vt	Cape Vincent, N. Y.
	1,000,000	do	Nashua, N. H.
	500,000	do	Berkshire, Mass.
Rainbow trout	25,000	Meadow Creek, Mont	Erwin, Tenn.
	25,000	do	Manchester, Iowa.
	1,297,000	do	Bozeman, Mont.
	551,000	do	Glacier Park, Mont.
	25,000	do	Salmon, Idaho.
	75,000	Manchester, Iowa	La Crosse, Wis.
	321,000	Neosho, Mo	Do.
	63,000	do	Spearfish, S. Dak.
	28,000	Lost Creek, Wyo	San Marcos, Tex.
	52,920	do	Spearfish, S. Dak.
	75,600	do	Neosho, Mo.
	33,150	do	Leadville, Colo.
	50,160	do	Saratoga, Wyo.
	25,000	Springville, Utah	Wytheville, Va.
	25,000	do	Leadville, Colo.
	50,000	White Sulphur Springs, W. Va.	Berkshire, Mass.
	53,000	do	Nashua, N. H.
Silver salmon	1,329,000	Baker Lake, Wash	Birdsview, Wash.
	237,000	Applegate, Oreg	Clackamas, Oreg.
Sockeye salmon	200,000	Baker Lake, Wash	Birdsview, Wash.
Steelhead salmon	100,000	Birdsview, Wash	Underwood, Wash.
	95,000	Applegate, Oreg	Little White Salmon, Wash.
	232,000	do	Clackamas, Oreg.
	100,000	do	Leadville, Colo.
	50,000	do	Woods Hole, Mass.
	40,000	do	San Marcos, Tex.
	40,000	do	Charlevoix, Mich.
	25,000	Rogue River, Oreg	Mammoth Spring, Ark.
	45,000	Sandy River, Oreg	Duluth, Minn.
Whitefish	280,000	Cape Vincent, N. Y	Central Station, Washington, D. C.
Yellow perch	5,850,000	Bryans Point, Md	Do.
	6,000,000	Put in Bay, Ohio	Mammoth Spring, Ark.
	4,000,000	Swanton, Vt	Cape Vincent, N. Y.

EGG COLLECTING AT AUXILIARY STATIONS

The eggs incubated at the main stations and substations of the bureau are very often transferred from auxiliary collecting stations, which are located as near as possible to the base of egg supply. Such stations are usually temporary in character and are occupied only while egg collecting is in progress. The following table shows the egg-collecting stations, the main stations under which they are operated, the period of operation, and the species handled.

Egg-collecting stations

Station	Period of operation	Species handled
Boothbay Harbor, Me.:		
Casco Bay, Me	Mar. 1-Apr. 30	Winter flounder.
Sheepscot River, Me	do	Do.
Linekins Bay, Me	do	Do.
Johns Bay, Me	do	Do.
Wheelers Bay, Me	do	Do.
Seal Harbor, Me	do	Do.
Ebencook Harbor, Me	do	Do.
Townsend Gut, Me	do	Do.
Pig Cove, Me	do	Do.
Mill Cove, Me	do	Do.
Bozeman, Mont.: Mystic Lake, Mont	Apr. 30-June 16	Rainbow trout.
Cape Vincent, N. Y.:		
Stony Island, N. Y	Oct. 18-Nov. 10	Lake trout.
Pigeon Island, Ontario	Oct. 18-Nov. 9	Do.
Charity Shoals	do	Do.
Chaumont Bay, N. Y	Nov. 15-Dec. 1	Whitefish.
Do	Nov. 20-Dec. 5	Cisco.
Do	Apr. 1-May 20	Yellow perch.
Port Hope, Ontario	Nov. 5-20	Whitefish.
Cobourg, Ontario	do	Do.
Brighton, Ontario	do	Do.
Wellers Bay, Ontario	Nov. 16-30	Cisco.
Fair Haven Bay, N. Y	Nov. 17-Dec. 5	Do.
Sodus Bay, N. Y	Nov. 17-Dec. 3	Do.
Craig Brook, Me.:		
Dennysville, Me	Sept. 1-30	Humpback salmon.
Toddy Pond, Me	Oct. 25-Nov. 18	Landlocked salmon.
Craig Pond, Me	Oct. 20-Nov. 15	Brook trout.
Grand Lake, Me	Oct. 20-Nov. 4	Lake trout.
Duluth, Minn.:		
Marquette, Mich	Oct. 18-Nov. 6	Do.
Au Train, Mich	do	Do.
Munising, Mich	Oct. 18-Nov. 7	Do.
Ontonagon, Mich	do	Do.
Big Traverse Bay, Mich	do	Do.
Grand Marais, Mich	Oct. 19-Nov. 5	Do.
Portage Entry, Mich	Oct. 17-Nov. 8	Do.
Huron Island, Mich	do	Do.
Portage Lake Canal, Mich	Oct. 17-Nov. 5	Do.
Keystone, Mich	Oct. 13-31	Do.
Agate Harbor, Mich	do	Do.
Copper Harbor, Mich	do	Do.
Manitou Island, Mich	Oct. 13-Nov. 4	Do.
Point Abbey, Mich	Oct. 17-Nov. 7	Do.
Isle Royale, Mich	Sept. 28-Nov. 15	Lake trout and whitefish.
Bemidji, Minn	Apr. 17-May 12	Pike perch.
Gloucester, Mass.:		
Plymouth, Mass	November-May	Cod and pollock.
Marblehead, Mass	February and March	Cod.
Ipswich Bay, Mass	November-May	Cod, haddock, and flounder.
Rockport, Mass	do	Cod, pollock, and haddock.
Leadville, Colo.:		
Englebrecht Lakes, Colo	Sept. 25-Nov. 23	Brook trout.
Turquoise Lake, Colo	Oct. 15-Dec. 2	Do.
Mount Massive Club Lakes, Colo	Oct. 17-Dec. 1	Do.
Carroll Lakes, Colo	Oct. 21-Nov. 22	Do.
Wurts Lake, Colo	Oct. 13-Nov. 22	Do.
Baker Lake, Colo	Apr. 24-May 18	Rainbow trout.
Northville, Mich.:		
St. James, Mich	Nov. 3-21	Lake trout and whitefish.
St. Ignace, Mich	Oct. 21-Nov. 28	Do.
Manistique, Mich	Nov. 8-15	Lake trout.
Fairport, Mich	Nov. 9-20	Do.
Northport, Mich	Nov. 8-27	Do.
Leland, Mich	Nov. 8-22	Do.
Naubinway, Mich	Nov. 5-24	Whitefish.
Scotts Point, Mich	Nov. 4-17	Do.

Egg-collecting stations—Continued

Station	Period of operation	Species handled
Put in Bay, Ohio:		
Port Clinton, Ohio	Nov. 13–Dec. 4	Whitefish.
Do	Apr. 6–May 4	Pike perch and yellow perch.
Do	June 2–25	Carp.
Catawba Island, Ohio	Nov. 13–Dec. 1	Do.
Middle Bass, Ohio	do	Do.
Do	Apr. 10–28	Pike perch.
North Bass, Ohio	Nov. 12–Dec. 1	Whitefish.
Do	Apr. 16–28	Pike perch.
Toledo, Ohio	Nov. 19–Dec. 3	Whitefish.
Do	Apr. 7–May 4	Pike perch.
St. Johnsbury, Vt.: Lake Dunmore, Vt.	Oct. 24–Nov. 9	Lake trout.
Saratoga, Wyo.:		
Big Creek Lakes, Wyo	October and November.	Brook trout.
Sage and Canon Creeks, Wyo	March, April, and May.	Rainbow trout.
Springville, Utah:		
Fish Lake, Utah	Nov. 6–Dec. 3	Brook trout.
Panguitch Lake, Utah	Apr. 19–May 26	Rainbow trout, black-spotted trout.
Strawberry Reservoir, Utah	May 29–June 13	Black-spotted trout.
Woods Hole, Mass.:		
Waquoit, Mass	Feb. 1–Apr. 13	Winter flounder.
Menemsha Bight, Mass	Feb. 13–Apr. 13	Do.
Newport, R. I	Mar. 20–Apr. 11	Do.

FISH FOOD USED AT HATCHERIES

The following table shows the amounts and kinds of food used at fish-cultural stations of the bureau during 1925, with the cost per pound of each.

Pounds and cost per pound of fish food used during the fiscal year 1925

PACIFIC SALMON STATIONS

Station	Salted salmon		Canned salmon		Salted salmon eggs		Beef liver	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Baird and substations, Calif	7,000	$0.02					755	$0.10
Baker Lake and substations, Wash	1,100	.0236	6,649	$0.0016			2,308	.09
Clackamas and substations, Oreg	23,000	.01	26,650	.027	400	$0.005	1,469	.10
Quinault, Wash			3,900	.035			68	.06
Yes Bay, Alaska	1,400	.0164	100	.005			200	.11
Total	32,500		37,299		400		4,800	

Station	Beef spleen		Sheep liver		Hog liver		Lights	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Baird and substations, Calif	1,123	$0.08						
Baker Lake and substations, Wash	2,050	.0576						
Clackamas and substations, Oreg	15,394	.0436			641	$0.085	756	$0.085
Quinault, Wash			1,390	$0.0615	50	.06		
Total	18,567		1,390		691		756	

ROCKY MOUNTAIN TROUT STATIONS

Station	Beef liver		Hog liver		Cereal		Beef hearts		Sheep liver	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Bozeman, Mont	11,123	$0.0666	11,314	$0.0543						
Leadville, Colo							2,702	$0.0455		
Saratoga, Wyo	3,740	.065					2,566	.05		
Springville, Utah	11,529	.0454			10,500	$0.0283	13,364	.055		
Spearfish, S. Dak	26	.07					1,950	.0475	8,237	$0.0475
Total	26,418		11,314		10,500		20,582		8,237	

Pounds and cost per pound of fish food used during the fiscal year 1925—Con.

NEW ENGLAND TROUT AND SALMON STATIONS

Station	Beef liver		Beef spleen		Beef hearts	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Berkshire trout hatchery, Mass	696	$0.1197	3,076	$0.0516		
Craig Brook, Me	619	.119			355¼	$0.066
Nashua, N. H	1,104	.0895				
St. Johnsbury, Vt	921	.05			19	.05
York Pond, N. H.[1]	1,637	.05			3,270	.0472
Total	4,980		3,076		3,644¼	

Station	Sheep liver		Hog liver		Fish meal	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Craig Brook, Me	1,244	$0.0664	6,063	$0.054		
Nashua, N. H	7,721	.0462			100	$0.037
Total	8,965		6,063		100	

[1] The York Pond substation also consumed 505 pounds of horse meat at $0.013 per pound, 245 pounds of fish trimmings at $0.04, 100 pounds of beef and bob veal at $0.01, and 2 gallons of cod-liver oil at $3.40.

COMBINATION TROUT AND POND FISH-CULTURAL STATIONS

Station	Beef hearts		Sheep liver		Low-grade flour		Cereals	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Erwin, Tenn	10,904	$0.055	8,856	$0.0525			3,900	$0.0265
Manchester, Iowa	7,783	.0455	9,894	.0426	410	$0.02	250	.02
Neosho, Mo., and substations	8,615	.035	5,897	.035	1,200	.0182		
White Sulphur Springs, W. Va	11,210	.056	15,786	.049				
Wytheville, Va	15,536	.0575			14,842	.005		
Total	54,048		40,433		16,452		4,150	

Station	Fish meal		Hog hearts		Clabbered milk		Beef liver	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Erwin, Tenn	100	$0.037						
Manchester, Iowa	100	.037						
Neosho, Mo., and substations			6,155	$0.035	77	$0.10		
White Sulphur Springs, W. Va							510	$0.08
Wytheville, Va	50	.0238						
Total	250		6,155		77		510	

POND FISH-CULTURAL STATIONS

Station	Fish		Fish meal		Low-grade flour		Beef hearts		Beef liver	
	Pounds	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*	*Pounds*	*Cost*
Cold Springs, Ga	3,780	$0.10	313	$0.085	267	$0.03				
Edenton, N. C	24½	.13								
Louisville, Ky							634	$0.10	8½	$0.10
Mammoth Spring, Ark							1,471	.0678		
Orangeburg, S. C							2,177	.10		
Tupelo, Miss							2,557	.09		
Total	3,804½		313		267		6,839		8½	

HATCHERY FISH-CULTURAL NOTES

DECISION REGULATING FISHING IN THE QUINAULT RIVER

Under date of December 15, 1924, new regulations governing salmon fishing in the Quinault River were approved and promulgated by the Bureau of Indian Affairs. With the view of regulating fishing within the reservation the regulations contain a clause providing for the collection of a royalty from Indians catching more than a specified amount of fish. The enforcement of this provision created so much dissension among the Indians occupying the most advantageous fishing grounds that they requested an injunction restraining the department from enforcing the regulations.

The case was taken up in the Federal court at Tacoma, Wash., and a decision rendered late in April was to the effect that the Indians have the right to fish within the waters of the reservation at any point and at any time. It also decreed that the entire system of fishing locations is untenable, and that one Indian has as much right to a certain location as another. Another important feature of the decision is that the department is authorized to enforce only such regulations as the tribe may see fit to adopt.

According to this decision the Government has no jurisdiction over the fishing in the Quinault reservation, and apparently there is nothing to prevent the Indians from fishing even in Quinault Lake. This means the depletion of the sockeye salmon of the Quinault River, because the Indians are permitted to fish in its lower reaches as long as the salmon runs justify it, and then to follow the runs to Quinault Lake and there resume fishing on the spawning grounds.

FISH CONSERVATION IN WEST VIRGINIA

The fisheries authorities of the State of West Virginia are thoroughly alive to the importance of restocking the streams of the State with the more valuable species of fish, and have recently passed very effective protective laws. Many of the streams have been closed to fishing, and wardens have been employed to patrol them constantly.

An effort is being made to eliminate, or at least greatly reduce, the pollution of the waters of the State, and if the present plan can be carried out successfully West Virginia will rank among the foremost States in the matter of conservation.

EXPERIMENTAL FEEDING OF YOUNG TROUT

Early in the year the bureau conducted feeding experiments at several of its stations for the purpose of determining the value of fish meal as a food for trout.

On January 26 two lots of young trout, each containing 1,000 fish and weighing 10 ounces, which had previously been fed for 30 days on beef heart exclusively, were segregated at the Wytheville (Va.) station. One lot was fed on a mixture of beef heart and fish meal in equal proportions, while the other (the control lot) continued on a beef-heart diet. At the close of the test, on February 26, the control lot numbered 869 and weighed 17.5 ounces, while the other lot had been reduced to 827 fish with a total weight of 15.25 ounces. This was typical of the results achieved at other stations, and appears to indicate the superiority of an all beef-heart food.

SUCCESSFUL STOCKING OF MONTANA'S LARGEST LAKE WITH GREAT LAKES WHITEFISH

About four years ago the Montana fish and game authorities obtained from one of the bureau's Great Lakes stations a consignment of eyed whitefish eggs with the view of determining the possibility of developing a commercial fishery in Flathead Lake. The attempt to commercialize this lake aroused so much adverse criticism and antagonism on the part of the fishermen of the State that after making one plant of fish the work was abandoned. While the State fish and game commission was engaged in net fishing in the lake in June, 1925, it was discovered that the initial plant of fry had borne results, practically every seine haul containing fine examples of whitefish (*Coregonus clupeiformis*). This demonstrated success of a single plant of the species has renewed interest in the project, and many of the sportsmen who formerly opposed it on the ground that it might prove detrimental to game fishing are now in favor of the scheme.

BROOD PIKE AT SWANTON, VT.

An interesting feature of the pike perch work at Swanton, Vt., was the unusually large number of brood fish taken in seines, 7,379 of such fish being secured, as compared with 4,319 in the preceding year. At one of the seining beaches over 1,000 large brood fish were taken in a single day.

RIPE HALIBUT EGGS

Ripe halibut eggs in large quantities were found in close proximity to the ice fields off Riggs Point, in the Strait of Belle Isle, on May 21, 1925. Captain Morrissey, of the schooner *Henry Ford*, stated that for the first time in his many years of experience in the halibut fisheries he saw large numbers of halibut with eggs running freely.

COMMERCIAL FISHERIES

The work at a majority of the bureau's stations and substations is devoted principally to the propagation or salvage of the more important commercial fishes. Some of the species referred to this classification are the salmons of the Pacific coast, the lake trout, whitefish, and cisco of the Great Lakes, the marine fishes of the Atlantic coast (including the cod, pollock, haddock, and flounder), such anadromous fishes as the shad, glut herring, and Atlantic salmon, the buffalo fishes of the Mississippi River region, and the carp. The work with the latter species is confined to certain sections of Lake Erie.

PACIFIC SALMONS

Fish-cultural operations dealing almost exclusively with the Pacific salmons are conducted at all of the bureau's stations and substations located on the Pacific coast. The results of the year's work in this region generally indicate a considerable decline in the distributions as compared with 1924, due principally to adverse climatic conditions prevailing in some sections during the spawning season.

Afognak (Alaska) Station

[Frank L. Snipes, Superintendent]

For the second successive season the number of sockeye salmon ascending to spawning grounds in the vicinity of the Afognak station was very small, in consequence of which it was deemed advisable to again defer propagation work and allow the few fish in evidence to deposit their spawn naturally. The annual run of this species into Letnik Lake lasted from May 30 to September 20, the total escapement for that period amounting to 10,317, but little in excess of last year's record.

In the fall of 1921 this station made a fair collection of sockeye-salmon eggs, but during the succeeding spring the fry were attacked by disease and suffered heavy mortality. Shortly after the surviving fish had been planted, the yearling salmon in the lake appeared to be affected by the same trouble, and they perished in large numbers. According to the 4-year cycle theory, therefore, a poor run of salmon may be expected in Letnik Lake during the 1926 season, which conditions at the close of the fiscal year 1925 would seem to confirm. Between July 31 and September 26, 1924, a large run of humpback salmon entered Letnik Lake, the count registering nearly 16,000. It is very unusual for humpback salmon to ascend this lake to any extent.

The annual ascent of large numbers of Dolly Varden trout into the lake is considered a serious obstacle to the success of salmon propagation at the Afognak station. These fish commence devouring the eggs as soon as they are deposited, and continue to prey upon the young salmon as long as there are any in the lake. The destruction of thousands of the trout every year has not seemed to make much impression upon their numbers. Quite recently a trap was installed for the purpose of intercepting the fish at the counting weir, but this device is still in the experimental stage. As an illustration of the destructiveness of Dolly Varden trout, an examination of the stomachs of large numbers of them revealed from 300 to 400 undigested salmon eggs and fry. It is not unusual to find from 100 to 200 salmon eggs and fry in the stomach of a trout 8 to 10 inches long.

Among the more important items of repair work accomplished during the year may be mentioned the completion of the wagon road leading from the station grounds to tidewater on Letnik Bay and the construction of a new bulkhead to protect the station grounds fronting on the lake.

Yes Bay (Alaska) Station

[J. L. Gardner, Superintendent]

The year's work at this station was confined to the propagation of the sockeye salmon. Shortly after completing the installation of the racks, on July 22, a few sockeye and humpback salmon appeared in the river below, but no eggs were taken until September 8. During the intervening period the seining grounds were improved by the removal of all débris between the rack and the lake, and two of the seining beaches were extended (one 20 feet and the other 40 feet) by grading the river banks and covering them with gravel. Heavy rains late in August raised the river level to a point within 2 inches of the top of the rack, and on September 3 and 4 the entire station force was constantly employed in keeping it cleared of leaves and débris. During this time water was flowing around both ends of the rack on the shores, permitting the passage of fish in small numbers. The flood began to subside on the 5th, and three days later fishing was taken up and continued to be prosecuted up to the 25th of the month, during which time 30,080,000 eggs were secured. This figure does not represent all that could be obtained, as collections were suspended as soon as a sufficient number were on hand to fill the hatchery to capacity with fry, and fish enough to yield from 15,000,000 to 20,000,000 additional eggs were released to spawn under natural conditions.

When taken, the eggs appeared to be of extra fine quality, but by the time the eye spots had developed it was apparent that a considerable number were unfertilized, undoubtedly because the eggs were taken from fish not fully matured.

The results of incubation were very good, however, the losses amounting to only about 8¼ per cent.

Early in the winter the entire water-supply pipe line froze during a protracted cold spell, and as very little water was available in the hatchery the 6,300,000 fry on hand had to be liberated and the eggs crowded into a comparatively small space. In this way they were safely carried through the succeeding 15 days, at the expiration of which time water conditions were again normal. All fry hatched from these eggs were reserved for rearing to the fingerling stage, and most of them were still on hand at the close of the fiscal year. Due probably to the occurrence of heavy rains and ususually cold water during the incubation period, there was no evidence during the season of the trouble which has occasionally been experienced in recent years from the accumulation of gas in the hatchery water supply.

During the year 3,219 predatory fish were taken in gill nets and destroyed. Very few Dolly Varden trout were seen on the spawning grounds, probably because they were intensively fished for earlier in the season.

Baker Lake (Wash.) Station and Substations

[Joseph Kemmerich, Superintendent]

Fish-cultural work in this field was conducted at only five points, the Brinnon eying plant, formerly operated, having been abandoned as a result of experiments made during the previous year which demonstrated that eggs collected in that region could be successfully transported in the green state to the Duckabush and Quilcene hatcheries. From the several species of salmon handled at this group of stations, 48,578,000 eggs were obtained; this being a reduction of approximately 2,000,000, compared with the total of the previous year. The decrease is attributed to the unfavorable weather encountered in some fields while certain species were spawning, and to the fact that it was an off year for the run of humpback salmon in Puget Sound waters. The collections were augmented by the receipt, from outside sources, of more than 16,000,000 eyed eggs of the chinook, silver, and humpback salmons. Such transfers were handled at the Birdsview, Duckabush, and Quilcene substations.

Baker Lake (Wash.) station.—Fish-cultured operations, addressed to the sockeye and silver salmons, were in progress practically throughout the year. Very gratifying work was accomplished with the sockeye salmon, the egg collections being the largest in the history of the station. Beginning July 1, the trap previously installed in Baker River was fished almost daily until the end of the run on August 21, and 14,558 captured salmon were removed therefrom to the station inclosure. All of the 22,000,000 eggs secured from these fish were of uniformly good quality, and the losses, both in the incubation and fry stages, were merely nominal.

The run of silver salmon in Baker River was the smallest in some years. This, no doubt, was occasioned in part by unsatisfatory water conditions, but the power dam in course of construction at Concrete, Wash., was a contributing factor, as it was apparent that the fish were unable to pass through the diversion tunnel. Of the brood salmon captured late in October and held for ripening, the 404 females available at spawning time yielded 1,380,000 eggs of good quality. Following the practice of recent years, the eggs were eyed at the station and then transferred to the Birdsview substation, the mode of conveyance being by pack horse as far as Concrete and by autotruck the remainder of the distance.

Birdsview (Wash.) substation.—As in recent years, salmon propagation at this point was seriously hampered by turbid water in Grandy Creek, the result of the tearing up of the banks and bed of the stream by the extensive logging operations going on near its headwaters. The water entering the hatchery was so muddy that the eggs and fry in the troughs could not be seen, and it was almost constantly necessary to remove the accumulation of sediment in the trays. During September and early October, ordinarily the spawning season for chinook salmon in this creek, the water level was so low that fish could not enter. Following several light rains later in October a few chinooks were taken in the trap and 180,000 eggs secured. At the close of the fiscal year the fingerlings resulting from these eggs were being held in ponds and fed, at which time they were 2½ inches long.

The few fingerling silver salmon carried over from the previous fiscal year were liberated early in August in the Skagit River. Eggs of this species to the number of 3,163,000 were secured between October 18 and January 24, a great many of the earlier ones being taken from fish that had been held in pens for some time to ripen. These, with the addition of the eggs furnished from the

Baker Lake station early in March, produced 4,113,000 fry and one consignment of 100,000 eyed eggs, the latter being shipped to the Lincoln Park Aquarium, Chicago, Ill. The fry were carried on trays until the yolk sac was absorbed, when most of them were planted. A few were held to be reared to the fingerling stage.

Following a slight rise in water level, a few male and female sockeye salmon entered the creek, and 35,000 eggs taken from them were hatched. The resulting fish, in the No. 1½ stage, were on hand at the end of June. One hundred and fifty thousand sockeye eggs, transferred to this point from Baker Lake station, were transported by means of truck and pack team to Illabot Creek, 11 miles distant from Birdsview, and seeded in the gravel along the shores of the lake. This is a cold, glacial body of water, and as there is a good volume of water in its tributary creek during the summer and fall months, it is believed it may be possible to establish a run of salmon in the lake. With this object in view, plants of eggs will be made here every spring until a sufficient length of time has elapsed to determine what the results will be.

The fry and fingerling steelhead salmon on hand at the opening of the year were distributed during August, various applicants being supplied, and the remainder was planted in tributaries of the Skagit River. Steelhead eggs to a total of 584,000 were taken between March 7 and May 21, this being a fair average compared with the work of recent years. However, owing to the necessity of holding the brood fish in pens for a considerable period to ripen, a large percentage of them proved infertile.

Duckabush (Wash.) substation.—The new trap site used for the first time last season having been destroyed by flood waters during the succeeding winter, permission was obtained to install a temporary trap under the State Olympic highway bridge. The first chum salmon of the season appeared here late in August, and beginning September 1 seining operations were conducted almost daily up to September 20, when a 20-foot section of the rack was carried away when a rise of several feet in the water level occurred. The fish held below were thus able to escape upstream, and during the week intervening before the river was again at its normal height the remainder of the run passed up, putting an end to the season's work. The egg collections amounted to 3,340,000.

The trap in Walcotts Slough, near the former eying station at Brinnon, Wash., was placed in condition for work late in November with the view of collecting eggs from the late run of chum salmon in that field. Brood females to the number of 3,508 were taken between December 1 and January 3, and from them 9,760,000 eggs were secured for transfer to the Duckabush hatchery. Though transported a considerable distance in the green stage, the losses on these eggs during incubation were no greater than on the local collections. On a number of occasions men were detailed from the Quilcene substation to assist in the work at Wolcotts Slough and took back with them such surplus eggs as could not be handled in the Duckabush hatchery. Operating in this manner, it is estimated that a saving of at least $1,000 was effected over the old system of eying the eggs at Brinnon. The product of the eggs was conveyed back to the slough and liberated in native waters.

A large run of silver salmon appeared in the Duckabush River in December and January, but the water level at that time was so high that practically all of the fish surmounted the rack and spawned upstream. Early in February the station received 2,000,000 eyed silver-salmon eggs from the Gold Bar hatchery of the Washington Fish Commission. These were incubated with the local collections and the fry were released in the sac-absorbed stage.

As 1924 was the alternate year for the run of humpback salmon into Puget Sound waters, no eggs of that species were available during the fall. However, the station received by transfer 4,500,000 of the humpback eggs taken in Alaskan waters by the Washington fisheries authorities, and the product was placed in the station ponds in the advanced fry stage, the pond screens being removed so that they might pass at will into the Duckabush River. In an effort to establish a run of chinook salmon in the Duckabush River 500,000 eyed eggs of that species were transferred to the station early in December from the Little White Salmon (Wash.) hatchery. When ready to take food, the fry resulting from this consignment were transferred from trays to the ponds and fed three times daily until May 28, when they were liberated. On account of the prevailing high water during the spring, most of the run of steelhead salmon was able to surmount the permanent rack and pass up the river, and only 35,000 eggs were secured. At the close of the year the fry incubated from these eggs were being cared for in troughs in the hatchery.

Quilcene (Wash.) substation.—Fish-cultural operations in this field were in progress practically throughout the year. Collections of chum, silver, and steelhead-salmon eggs were made, while eyed eggs of the humpback, chinook, and silver salmons received from other hatcheries were handled. The efforts put forth to collect eggs from the early run of chum salmon met with slight success. Owing to the prevailing low water in both the Big and Little Quilcene Rivers very few fish entered these streams, and the total number of eggs collected was only 585,000, notwithstanding the fact that both traps were fished at frequent intervals and both rivers were seined daily below the racks as long as there was any hope of securing returns. During the late run of this species, beginning about November 15, water conditions were so much improved that nearly 3,000,000 eggs were obtained. At this time some of the station employees were making frequent trips to Walcotts Slough to assist in the work there and to transfer to the home station such eggs as could not be cared for at Duckabush. As a consequence of the operations at all points and during both runs of salmon 4,010,000 eggs were secured, from which 3,741,150 fry in the advanced stage were developed and released in local tributaries of Puget Sound.

From a shipment of 5,500,000 eyed humpback-salmon eggs taken in Alaska waters by the State of Washington and turned over to this station for incubation, 5,368,500 fry were produced. Of these, 2,968,000 were released in the advanced stage in the Big Quilcene River; the remainder were returned to the State to be used in connection with a feeding experiment to be conducted in a pond located in a salt-water lagoon not far from the Quilcene hatchery.

Between October 27 and February 6 the station collected 2,120,000 silver-salmon eggs. These were incubated with 2,000,000 eyed eggs of that species furnished from the Gold Bar hatchery of the Washington fisheries department, and the resulting fry, in the sac-absorbed stage, were liberated locally. Transfers of eggs from other fields included one shipment of 500,000 of the chinook salmon furnished by the Little White Salmon hatchery with the view of attempting to establish a run of that species in Quilcene waters. During the steelhead spawning season (extending from March 17 to May 11) 375,000 eggs were collected, some being taken from brood fish held for a time in the station ponds to ripen. The resulting fry were on hand at the close of the fiscal year.

Sultan (Wash.) substation.—Elwell Creek, upon which this substation depends for its egg collections, was visited during the fall by a large run of chinook and silver salmon, enough fish of each species to yield several million eggs being in evidence. Unfortunately the station was poorly equipped to take advantage of the opportunity. The trap in use was old and partly ineffective, and dependence had to be placed on hooking and dip nets for the capture of the fish. Working under such conditions, 806,000 chinook-salmon eggs were taken; but in October, shortly after the run of silver salmon began, the trap was entirely demolished as a result of a considerable rise in the water level of the creek, putting an end to the work. The collection of silver-salmon eggs amounted to 690,000. Approximately 85,000 fry and fingerling steelhead salmon, the product of the previous fiscal year, were liberated in local waters during July. Owing to inability to conduct fishing operations, no eggs of that species were collected during the spring of 1925.

Quinault (Wash.) Station

[Philo B. Hawley, Superintendent]

The construction of a rearing-pond system at this station, undertaken during the previous fiscal year, was completed in May, 1925. The series comprises six concrete ponds of the long, narrow type, with sloping sides, each inclosure being 75 feet long and 6 feet wide and with an average depth of 30 inches. The addition of this system provides the station with a capacity for rearing 300,000 sockeye-salmon fingerlings.

As has been explained previously, the sockeye-salmon run into the lower Quinault River extends from about April 1 to the end of August, making it impossible to include in a single annual report a complete census covering an an entire season's run. The daily count maintained during the spring and summer of 1924 indicated the passage of 136,774 salmon, this number being approximately 27,000 less than the count of the previous year and about 100,000 less than that in 1922. In the spring of 1925 counting was begun on March 19, and by the end of the fiscal year the record indicated that the number of salmon passing was materially smaller than in any corresponding period since the weir was established.

The reports received from the superintendent of the Quinault Indian Reservation show that during the commercial fishing season of 1925, extending from April 1 to July 1, 54,000 salmon, in round numbers, were captured by the Indians, who received for their catch 75 cents per fish. This is the highest price ever paid for sockeye salmon in the Quinault region.

During the spring of 1925 the station's counting operations occasioned considerable ill feeling on the part of the local Indians, who charged that the weir was detrimental to a large salmon run in that many of the fish were killed by jumping against the webbing of the leads and traps. In order to gain first-hand information in the matter two trips were made to a point several miles below the weir, the first on June 30, when 30 dead fish were discovered, and the second on July 17. The latter trip was occasioned by the receipt of advice from the superintendent of the reservation that hundreds of dead salmon were to be seen along the river as a result of injuries received at the weir, but only 20 were discovered. From the investigations made it was clear that the reports spread by the Indians were greatly exaggerated and were circulated because of their antagonistic attitude toward the bureau's work.

Fish-cultural operations at this station are concerned principally with the sockeye salmon. Racks and traps were installed in Big and Merryman creeks 10 days prior to the opening of the spawning season for the purpose of collecting eggs, and the first were secured on November 1, a time extremely unfavorable for the work because of heavy freshets. Late in October and early in November the racks in both creeks were under water for the greater portions of the time, and it was impossible to operate a seine to advantage before November 10. From that time on conditions were more favorable, and collections were made daily up to the close of the season on December 12. A total of 12,350,000 eggs of fine quality was secured, of which 3,000,000 in the eyed stage were sent to the Oregon Fish Commission. The remaining eggs were hatched, and the output of fry liberated on the local spawning grounds, most of them in the fingerling stage.

Although no special effort had been made to secure them, a considerable number of silver-salmon eggs and a few chinook eggs were taken incidentally with the sockeye eggs. More than 100,000 steelhead-salmon eggs were collected in May from fish taken in the counting weir. The resulting fry were on hand at the close of the year, it being the intention to rear them to fingerling size and then plant them in Quinault Lake or its tributaries. A consignment of 25,000 eyed brook-trout eggs received from the Washington State Fish Commission was incubated practically without loss, and the resulting fry were used to stock virgin lakes in the upper Olympic Mountains.

Late in January 260,000 silver trout eggs were received from the Lake Whatcom hatchery of the Washington Fish Commission. After being reared to suitable size, the fry from these eggs will be marked and then liberated in the lower Quinault River, well on their way to the ocean, the object being to determine whether they will eventually return as fish of larger size than the ordinary silver trout which remain constantly in fresh water.

Clackamas (Oreg.) Station and Substations

Clackamas (Oreg.) station.—The installation of racks and other necessary equipment having been completed previously, the capture of adult chinook salmon was undertaken on the 1st of October and prosecuted continuously for a month, at the expiration of which time the prevailing heavy rains had brought the Clackamas River to such a high level that the racks were swept away. The brood fish secured yielded 2,223,000 eggs, which, with eggs transferred from other fields in the State, gave the hatchery a total of 8,497,600. These were incubated with a loss of only 2 per cent, and the product was liberated on suitable spawning grounds as Nos. 2, 2½, and 3 fingerlings. In the course of the year the station received small numbers of silver salmon, steelhead salmon, and brook trout eggs from various auxiliaries, which were successfully incubated. It also received 200,000 eggs of the so-called "silver trout," which were furnished by one of the Washington State hatcheries.

With the view of attempting the establishment of a run of smelt in the Clackamas River, the station force and the Oregon fish and game authorities, working in cooperation, captured approximately 13,000 live smelt during the spring run in Sandy River and transplanted them in the Clackamas River.

Upper Clackamas (Oreg.) substation.—Collections of chinook-salmon eggs in this field were conducted from August 26 to September 19, 2,291,600 being obtained, which exceeds last year's collections by approximately 400,000 eggs.

After being developed to the eyed stage, the entire lot was transferred to the Clackamas station, and the substation was closed for the season.

Little White Salmon (Wash.) substation.—Fishing for brood chinook salmon began on September 17, and by October 10 a number sufficient to meet all requirements had been secured. The racks were therefore removed and the remaining fish allowed to ascend the river to the spawning grounds. Due to the continued low stage of the stream much difficulty was experienced in maintaining a depth of water necessary for the maintenance of the fish in the live pens, and it finally became necessary to excavate a location for the pens in the bed of the river. Eggs to the number of 22,640,000 were taken, of which approximately 6,562,000 were shipped in the eyed stage to other points. The remaining eggs were incubated and the product reared to the No. 2½ fingerling stage, when they were liberated in the Little White Salmon River.

A consignment of 200,000 brook-trout eggs, received from one of the Washinton State hatcheries, was successfully incubated, and part of the resulting fry were distributed to applicants. The product of 95,000 steelhead salmon eggs, transferred from the Applegate Creek auxiliary, was still on hand at the close of June.

Big White Salmon (Wash.) substation.—There was an unusually good run of chinook salmon in the Big White Salmon River and also in Spring Creek, the latter yielding about half the season's take of eggs. An advantage in work on this creek is the entire lack of high-water stages and the fact that no expensive racks need be constructed and maintained. As they ascend the mouth of the creek, the salmon pass through a fish ladder into a pool, where they are readily accessible. They are simply dipped out, assorted, and the males and females segregated in separate inclosures prepared for them in the creek. During the period from September 20 to October 7, a total of 14,420,000 eggs was taken in both streams. On reaching the eyed stage, approximately 5,000,000 were shipped to the Oregon Fish Commission. The young fish hatched from the remaining eggs were reared to the No. 2½ fingerling stage and then released on the native spawning grounds. The food used in the rearing operations consisted of salted salmon, canned salmon, and cattle spleen.

Rogue River (Oreg.) substation.—Despite the handicap of a very low water level in the Rogue River during the summer, which necessitated the building of wing dams at each water wheel to insure its efficient operation, the yield of chinook salmon eggs at this point was about on a par with results in recent years. Immediately after the completion of the chinook-salmon run, racks were installed in Big Butte and Elk Creeks for the interception of silver and steelhead salmon, though the equipment in the former was washed out during a later period of high water, allowing most of the silver salmon held below to escape. The egg collections of this species, amounting to 1,336,000, were made between October 30 and December 11. The spring collection of steelhead eggs was somewhat above the average, the total amounting to 868,000, as compared with 506,000 in the preceding year. Small numbers of eggs of the sockeye salmon and silver trout, received by transfer from other stations, were successfully incubated, as was also a consignment of brook trout eggs donated by the State of Washington. Some of the product of this stock was still on hand when the fiscal year closed.

Applegate Creek (Oreg.) substation.—Active fish-cultural operations for the season began at this point on November 18 with the collection of the first lot of silver salmon eggs. As the best part of the run of this species occurred during high-water stages, and a majority of the fish were able to ascend to spawning grounds above the dam, the yield of eggs for propagation purposes was small, amounting to only 1,749,000. During the very favorable natural conditions existing in the early spring, a sufficient number of steelhead salmon were captured to yield at least 3,000,000 eggs, but many of the penned fish died later and only 1,771,000 eggs were obtained. On reaching the eyed stage, 500,000 of these were shipped on assignment; the fry hatched from the remainder were in process of rearing when the fiscal year closed.

Salmon (Idaho) substation.—At the opening of the fiscal year 100,000 young chinook salmon, the product of eggs shipped from the Little White Salmon substation, were on hand. On reaching the No. 3 fingerling stage they were tagged and released in local streams to determine whether it would be possible to establish an earlier run of fall-spawning salmon in the Columbia River.

In the Lemhi River field egg collections were made from the middle of August into early September, 3,658,000 eggs being taken. The racks in the Pahsimeroi River were installed about 10 miles below the site of last year's operations and eggs were taken throughout the last half of September. Owing to the very low water level in this stream, however, most of the run of fish spawned in the Snake River channel and less than 500,000 eggs were secured.

Two consignments of rainbow-trout eggs—one of 105,000 shipped by the Idaho State Fish Commission, and one of 25,000 transferred from the Meadow Creek (Mont.) field—were hatched during the season and the product liberated as fingerling fish in various waters of the region.

Sandy River (Oreg.) substation.—The principal fish-cultural work at this point consisted in the incubation of 1,000,000 chinook salmon eggs transferred from one of the Oregon State hatcheries and the rearing of the product. The young fish were released in the Sandy River in the Nos. 2 and 2½ fingerling stages. A fair run of chinook salmon made its appearance below the dam in this river, but as has occurred in previous seasons, the entire flow of water in the river channel was diverted by the Portland Electric Co. for industrial use, and all of the fish perished. During the spring traps were built in the fish ladder to intercept the run of steelheads. The take of eggs of this species was small and of inferior quality, and on the first of June it was decided to close the station for an indefinite period.

Baird (Calif.) Station and Substations

The outcome of fish-cultural operations in the California field was very discouraging, the egg collections as a whole being much smaller than in 1924 and the output of young fish correspondingly smaller. The poor results are attributed to abnormally low water stages in the streams at spawning time and unusually muddy water, the latter condition being brought about by the deposit of volcanic ash from Mount Shasta.

Baird (Calif.) station.—At this station traps for intercepting the run of chinook salmon in the McCloud River were installed early in August, 1924. Owing to the low stage of the stream this was easy of accomplishment, but as the water remained low throughout the spawning period only comparatively few salmon were secured. The work of capturing adult fish was conducted from August 28 to October 16, though the bulk of the fish was obtained in late September. Late afternoon was chosen as the time for spawning operations, experience having demonstrated that better results are obtainable then. The collections, totaling 1,200,000 eggs, produced 200,000 eggs in excess of the take of the previous year. On account of the prevailing drouth it was impossible to obtain water from the usual source of supply for incubating the eggs, and they were held in temporary troughs connected with a supply taken from a small creek until they were nearly ready to hatch, when they were transferred to the hatchery and a water supply secured by pumping.

Because of heavy rains much difficulty was experienced in the work of placing the rack for the spring run of salmon in 1925, and it was accomplished only through strenuous effort. Shortly after its completion, a 75-foot section of the structure was carried away by a heavy rainstorm, which continued unabated for 60 hours. The break was repaired as soon as possible, though it could not be made absolutely secure on account of the continued high water.

Battle Creek (Calif.) substation.—Arrangements were made early in the year for the collection of chinook-salmon eggs in the Battle Creek tributary of the Sacramento River. The work of seining the creek for adult fish was taken up on October 21 and continued until the run was over on December 1, when operations were transferred to the main river, but as no material results were obtained there the work was discontinued within a few days. As a result of the operations in the creek and river 887,500 eggs were secured. In order to supplement the stock in the hatchery, 500,000 eggs were transferred from the Mill Creek field and from the aggregate lot 1,330,000 healthy fry were incubated.

Mill Creek (Calif.) substation.—The drouth which prevailed in other parts of the California field also interfered with the work at the Mill Creek substation to the extent that the results attained were the most unsatisfactory in several years. Fish-cultural operations were undertaken as usual in late October, seining being conducted practically every day up to and including December 29. The eggs collected during the season amounted to 2,300,000, as compared with approximately 3,000,000 in 1924.

FISHES OF THE GREAT LAKES

The success of the bureau's fish-cultural operations in the Great Lakes region is dependent mainly upon the weather prevailing during the spawning season of the species handled. The range of operations extends from Rainy Lake, Minn., eastward to Lake Champlain, and the commercially valuable fishes to which particular attention is directed are the lake trout, whitefish, cisco, pike perch, and carp. Owing to unfavorable weather in practically all fields during the egg-collecting season, the output of these stations was considerably smaller than in the preceding year, the largest decline being in the case of the whitefish.

Duluth (Minn.) Station

[S. P. Wires, Superintendent]

During the early fall arrangements were made for the collection of lake-trout eggs in Lakes Superior and Michigan. Small numbers were obtained daily at Washington Harbor and at other points near Isle Royale, Mich., between September 28 and October 9, when the beginning of the closed season necessitated discontinuing the work. It was resumed on October 15 and prosecuted to the middle of November, but the results were small owing to bad weather and the light run of fish in this region. Along the south shore of Lake Superior, where spawning was most active from October 13 to the close of that month, there was a good run of fish, and egg collections were correspondingly large. The eggs secured from the 15 fields occupied aggregated 21,535,000. On reaching the eyed stage 1,550,000 were shipped to applicants; fry and fingerling fish to the number of 12,752,500 were produced from the remaining stock and distributed, a large proportion being returned to the native spawning grounds.

On account of almost constant stormy weather no nets were set for the capture of whitefish on the natural spawning grounds at Munising, Mich., hence the station's collections of eggs of that species were limited to the Isle Royale field, where 1,560,000 were secured. As a result of operations in the vicinity of the Bemidji State hatchery, conducted in conjunction with the Minnesota Game and Fish Department, the station secured approximately 27,500,000 pike perch eggs between April 17 and May 3. To avoid the heavy losses incident to handling in the green state, the eggs were eyed at the point of collection and then transferred to Duluth. Managed in this way, the losses were kept at a minimum. The resulting fry, amounting to 13,000,000, were delivered to applicants in Minnesota, Michigan, and Wisconsin. The year's work also included the incubation of 360,000 eyed brook-trout eggs received during the early winter from commercial hatcheries in Massachusetts, Rhose Island, and Wisconsin, and 45,000 steelhead eggs transferred during the early part of May from the Clackamas (Oreg.) station.

Northville (Mich.) Station and Substations

[W. W. Thayer, Superintendent]

The year's work at the Northville station consisted in the propagation of smallmouth black bass, bluegill bream, brook trout, and rainbow trout, the eggs of the two latter species being derived from outside sources. The smallmouth bass fry on hand at the beginning of the year were reared and distributed as fingerlings Nos. 2 and 3. On the last day of the following April, when the work of apportioning adult bass in the station breeding ponds was undertaken, it was discovered that some of the fish had spawned in their winter quarters, this fact being disclosed by the presence of several nests containing dead eggs. It is believed that this unusually early spawning was occasioned by the spell of unduly warm weather which prevailed in the latter part of April, and that the eggs were killed by a sudden lowering of the temperature which occurred shortly before the ponds were drawn.

In addition to the bass carried through the winter at the station, 196 adults were furnished from the Put in Bay (Ohio) station about the middle of May, this acquisition bringing the total to 325 brood fish. Spawning began in the breeding ponds on May 10 in water of 58°. After rising to 60° on the 17th, the temperature suddenly dropped to 52° on the 18th, but to all appearances the fry were unharmed. Approximately 200,000 fry of this species were hatched, of which 94,000, in the fry and fingerling stages, were distributed before the close of the year.

During the early part of the winter of 1924–25 the station received 1,100,000 eyed brook-trout eggs, 500,000 of which were transferred from the Pleasant Mount hatchery of the Pennsylvania Fish Commission. The balance consisted of commercial eggs purchased from dealers in Rhode Island and Massachusetts. All of this stock was of fine quality and from it a large percentage of healthy vigorous fry was produced. From a consignment of 129,000 rainbow-trout eggs received in May from the Paris (Mich.) State hatchery, 117,800 fry were hatched and distributed.

Alpena (Mich.) substation.—Negotiations in progress at the beginning of the fiscal year between the bureau and the city of Alpena led to the bureau's obtaining a 50-year lease on 1 acre of city land containing a 2-story brick building and a 1-story frame cottage, said property being used during the World War by the Navy Department in the operation of a radio plant. As soon as the transaction could be completed the hatchery was removed from its old location to the new site, and installed on a brick foundation in the rear of the brick building, which was fitted up as an office and an aquarial exhibit for the display of fishes common to the region.

From October 23 to December 4, 10,560,000 lake-trout eggs and 34,640,000 whitefish eggs were obtained over a territory extending from Black River to Cheboygan. Most of these were of good quality, though some of the eggs from around Cheboygan were poor. The partial failure in that field may probably be accounted for by the faulty method employed by the fishermen in taking and caring for the eggs prior to their delivery at the hatchery. In an effort to correct this condition an experienced spawn taker will be assigned to oversee the work near Cheboygan throughout the next collecting season.

The delay occasioned by the removal of the hatchery building and the installation of new piping for a water supply necessitated the retention of the eggs for a considerable time in egg cases and floating boxes. The percentage of hatch from those in the cases was very good, as they could be given daily attention, but the eggs in the boxes, held in the slip in the rear of the hatchery, were nearly a total loss. In the distribution of the fry, which work extended from March 27 to May 25, all plants intended for waters within a comparatively short distance of the hatchery were made by the local fishermen without expense to the bureau, thus materially reducing the cost of the work.

Charlevoix (Mich.) substation.—The high winds prevailing throughout the spawning season in the fields covered by the Charlevoix substation tended to reduce somewhat the collections of lake-trout eggs, though the loss was compensated for in large measure by the substitution of improved methods in the hatchery, so that the output of fry was nearly equal to the average of former years. Eggs of this species were received at the hatchery from November 3 to November 28, the season's take from the seven fields covered amounting to 34,361,000. In the course of the whitefish spawning period—from November 1 to November 30—22,960,000 eggs were taken in fields near Scotts Point, Naubinway, and St. Ignace. All of these were of good quality.

In addition to its work with the commercial species, the station received and hatched 11,000 landlocked-salmon eggs transferred from the Craig Brook (Me.) station, and 40,000 steelhead eggs shipped from the Grants Pass (Oreg.) substation. The resulting fry were delivered to applicants at Frankfort, Menominee, and Charlevoix, Mich. A filter for the improvement of the water supply was under construction during the early part of the fiscal year, and while not fully completed it was used to good advantage during the hatching season, removing practically all slime and other impurities from the water.

Put in Bay (Ohio) Station

[David Davies, Superintendent]

Shortly after November 1 the usual arrangements for obtaining whitefish eggs were effected with the commercial fishermen operating in various parts of Lake Erie, and on November 12 and 13 the field foremen visited the various fields for the purpose of distributing the necessary spawn-taking outfits. The season as a whole proved disappointing. Only a comparatively small catch of whitefish was made by the fishermen collecting eggs for the station, and in its efforts to obtain eggs in other parts of the lake the same conditions were encountered by the State. Up to the end of November it was generally believed by the fishermen that a larger run of whitefish would occur, but at about that time the weather suddenly turned cold, ice formed on the lake, and the fishermen were unable to reach their nets, many of which were frozen in the ice. Eggs were received at the station between November 18 and December 7, the total for the season amounting to 138,280,000. Of these, the Port Clinton field furnished 57,340,000, while the remaining eggs were derived from fisheries in the vicinity of Put in Bay, Toledo, Catawba, Middle Bass, and North Bass Islands. In view of the small collections, no shipments of either green or eyed eggs were made to other points, and all fry hatched were distributed on the natural spawning grounds within a radius of 10 miles from the station.

As compared with the results of former years the outcome of the pike-perch season's egg collections was fairly satisfactory, 218,200,000 eggs being secured. Of these, 177,775,000 were obtained in the Toledo field. Heretofore there has nearly always been a scarcity of large female fish, but last season such fish were captured in considerable numbers. The majority of the large fish were unripe, however, and many millions of eggs were lost because they were not in condition for propagation.

The collection of yellow-perch eggs was much larger than usual, exceeding last year's by more than 22,000,000. They were of good quality and produced a high percentage of strong, vigorous fry. One consignment of 6,000,000 green eggs was shipped by messenger to the Mammoth Spring (Ark.) station, and from the remainder 19,968,000 fry were hatched and liberated in Lake Erie.

Owing to unusually low water in the lake during June, the carp-propagation work was somewhat disappointing. Between June 2 and June 25 44,875,000 eggs were taken and from them 31,500,000 fry were hatched and distributed. All plants were made in the Portage River several miles above Port Clinton, Ohio.

Cape Vincent (N. Y.) Station and Substations

[J. P. Snyder, Superintendent]

Active fish-cultural operations began at this station on October 18, when the work of collecting lake-trout eggs at Stony Island, N. Y., was undertaken. Heretofore practically all eggs of this species collected for the station have been obtained in the Province of Ontario in the vicinity of Pigeon and Simcoe Islands. Early in the fall preparations were made for the resumption of collecting operations in those fields, but a few days before the opening of the spawning season the islands were visited by a representative of the Ontario government, who notified the local fishermen that all eggs secured by them in those fields were to be turned over to the provincial hatcheries. The closing of the fields to the bureau left only two possible sources of supply for lake-trout eggs—Stony Island and Charity Shoals—which yielded a total of 114,000. The station also received 200,000 eyed eggs from the Charlevoix (Mich.) station. The fry resulting from both lots were delivered to applicants and planted in New York State waters.

The collection of whitefish eggs was again seriously curtailed by the refusal of the provincial authorities to permit the bureau's men to enter some of the more important fields on the northern side of the lake. The station was allowed to collect any available eggs in the vicinity of Brighton, Cobourg, and Port Hope, Ontario, but the results of the work at all these points were disappointing, due to unfavorable weather. Storm after storm occurred in rapid succession, destroying the nets and discouraging the fishermen. Only 8,100,000 eggs were secured at the three points.

On the New York side of the lake eggs were collected in the open waters near Cape Vincent as well as in Chaumont Bay, where there was a fairly good run of large whitefish. One of the peculiarities of the run in this section was that only a comparatively few small fish were in evidence. The run along the open shore of the lake was the largest that has occurred in many years, but weather conditions were extremely unfavorable. During a period of nearly two weeks at the height of the spawning season there was only one day when the nets could be lifted. On that occasion approximately 17,000,000 eggs were secured. In the somewhat better protected waters of Chaumont Bay the nets were lifted oftener and a fairly good collection of eggs resulted. Of the total number secured—55,485,000—420,000 were shipped in the eyed stage to applicants. The remainder were hatched, producing 36,500,000 fry, all of which were planted in Chaumont Bay and on other spawning grounds of the species.

Operations for the collection of cisco eggs were conducted in Chaumont, Fairhaven, and Sodus Bays on the American side of the lake and in Wellers Bay on the opposite side, permission to enter this field having been obtained from the Canadian authorities. In these four fields approximately 188,000,000 eggs were taken, the collection exceeding that in the fall of 1923, though the catch of fish was the smallest in some years. This falling off in the catch appeared to be general in all sections of Lake Ontario and can not be accounted for. The vegetable growth which formed on the whitefish and cisco eggs during the previous year gave no trouble last season.

In the latter part of December 586,000 eyed brook-trout eggs were received from commercial dealers in Rhode Island and Massachusetts and 483,600 were turned over to the station by the Pennsylvania Department of Fisheries; 136,920 rainbow trout eggs were received from a hatchery of the Michigan Conservation Department in return for cisco eggs previously furnished the State, and from the Swanton (Vt.) station 11,000,000 green pike-perch eggs and 4,000,000 eyed yellow-perch eggs were received. The fry from all of this stock was utilized in supplying applicants and in making public plants in suitable waters.

In response to a general demand for fingerling fish in preference to fry, 24 troughs and 12 large rearing tanks were constructed during the winter, and in cooperation with the Jefferson County Game and Fish Association these, with 24 additional troughs belonging to the association, were set up in a field near Watertown, N. Y., and used for the rearing of brook and rainbow trout to the large fingerling size before distributing them. The water supply for this rearing project was obtained from two spring-fed brooks.

Swanton (Vt.) Substation

[J. P. Snyder, Superintendent]

During September, 1924, a considerable amount of repair and improvement work was accomplished at this substation. All pens for the holding of brood fish were enlarged and placed in good condition, power boats and skiffs were repaired and painted, a new live car for the transportation of brood pike perch from the fishing grounds to the hatchery was constructed, 200 additional jars were provided, and many minor repairs were made. Arrangements were completed early in March with the States of Pennsylvania and Vermont for the propagation of pike perch on a cooperative basis. Under the plan agreed upon the bureau furnished the services of two experienced fish-culturists, Pennsylvania supplied most of the requisite funds and the services of two men, receiving as its share of the returns 50 per cent of the eggs collected, while Vermont provided the services of one man and allowed the fishermen to sell all nongame fish taken in the nets to compensate them for the delivery of their brood pike perch for the hatchery work.

By March 23 the hatchery and its equipment were ready for active operations. Seining was undertaken as soon as the ice broke on Lake Champlain, the first brood fish being captured on April 6, and by the 13th of April 4,057 large female and 1,553 male pike perch had been assembled in the pens. In view of the very low water level in the lake it was considered unsafe to carry a larger number, hence further seining was deferred until the 17th, when an effort was made to secure additional male fish. Within a few days after the work started it became necessary to release over 1,000 of the females, as the crowded condition of the pens and the low stage of the water were causing the development of fungus. Eggs were taken between April 15 and April 29, the total for the season amounting to 170,720,000. As a result of an actual count of green and eyed eggs during the first days of the season the eggs were estimated to run 110,000 to the quart. Formerly 150,000 eggs to the quart was the measure used.

Incidental to the pike perch work, 29,300,000 yellow-perch eggs were collected from the marshes in the vicinity of the hatchery. Practically all of these produced fry, some of which were supplied to applicants. Collections of eggs of this species at the Swanton substation are limited only by the space and facilities available for their development.

Bryans Point (Md.) Substation

[L. G. Harron, Superintendent]

During the first half of March the Bryans Point station was engaged in assembling a brood stock of yellow perch as a source of egg supply for the hatchery. As the season's catch of this species by the Potomac River fishermen proved to be very small, only 6,047 could be secured, less than one-third the number handled at the station in the previous year. These fish spawned in live boxes between the 15th and the 27th of March, yielding 48,875,000 eggs. On attaining the eyed stage, 5,850,000 were shipped to central station, Washington, D. C., and 34,420,800 fry were developed from the remainder and liberated on the spawning grounds in the Potomac River.

Observation has shown that the great and growing scarcity of yellow perch in this region may justly be attributed to the present extensive use of fyke nets. Many of the fishermen are employing what is known as the sunken fyke, a device consisting of a string of from 10 to 25 nets in a line, no part of them being visible above the surface of the water. These are spread out from shore to shore, not only on the river flats but in tributary streams, and as they are in operation practically throughout the year, their destructive effects are only too apparent. For discussion of the collection of shad eggs see page 475.

RESCUE OPERATIONS

Homer (Minn.) Station and Substations

[C. F. Culler, in charge]

With the Homer (Minn.) station as a central directing base, fish-rescue operations were conducted during the summer and fall on the Mississippi River bottoms lying between Prescott, Wis., on the north and Andalusia, Ill., on the south. Owing to unusual natural conditions the results of the work were much smaller than the average returns of recent years. Activities extended from early July to the close of November, which period was marked by exceptionally cold, wet weather, the late spring and frequent rains maintaining the ponds and sloughs in a fresh state and preventing any material shrinkage of the water area. While not conducive to large collections, this situation constituted a favorable environment for young fish, the unusually wide range affording them ample feeding grounds, while large numbers were able to find their way into the main channel of the river. All rescue areas previously occupied were thoroughly worked, but, as in past years, an extensive amount of fruitful territory remained uncovered because of lack of funds, though several new fields might have been established had it been possible to foretell what the weather would be when the season opened.

On account of their more elevated location and the consequent lowering of the water at a comparatively early period, the fields in the vicinity of the Homer station and at Genoa, Wis., were the most productive, the former alone yielding nearly half the total of the season's returns. Rescue work in cooperation with the Wisconsin fisheries authorities having been contemplated in the vicinity of Lynxville, Wis., two crews were sent by the State to cover that territory in the latter part of July. However, heavy rains interfered with successful work and the field was abandoned early in August. Along the upper river 62,220,565 fish were rescued, this number being less than half the total of the preceding year. All of the rescued fish were released in the Mississippi River and its adjacent tributaries with the exception of approximately 911,000 reserved for delivery to applicants.

The season's mussel-infection work resulted in the release of 1,783,561,850 glochidia of the commercial fresh-water mussels on suitable host fishes, this number exceeding last year's total by approximately 500,000,000.

La Crosse (*Wis.*) *substation.*—A new 2-story hatchery building, 85 feet long and 50½ feet wide, was recently constructed at this point on land acquired from the city of La Crosse. In addition to the hatching room, which is equipped with a sufficient number of galvanized-iron hatching and retaining troughs to handle approximately 2,500,000 eyed trout eggs, the lower floor of the building contains an aquarium and an office. Part of the space on the upper floor is utilized for a carpenter shop and the remainder is fitted up as sleeping quarters for the station employees.

During the winter of 1924–25, 763,400 eyed brook-trout eggs were acquired, part of them from Cedar Island Lodge at Brule, Wis., and the remainder from a commercial dealer in that State. The substation also handled 371,000 rainbow-trout eggs transferred from other stations of the bureau, and approximately 96,000 eggs of the Loch Leven trout from the Madison Valley (Mont.) field. All of these were successfully incubated and the resulting fry carried to the fingerling stage with an aggregate loss of less than 25 per cent.

Bellevue (*Iowa*) *substation.*—The territory included in this field extends from Dubuque to Green Island in the State of Iowa. Due to high water, the output of rescued fish was greatly reduced as compared with that of the preceding year.

Atchafalaya (*La.*) *substation.*—The season's work at this station began on February 14, when preliminary arrangements for the propagation of buffalo fish were begun. The earliest eggs were obtained on March 7 and the latest on March 24, the total amounting to 140,400,000. Owing to the flooded condition of the Ouachita River and the consequent pollution of the local water supply, the eggs could not be developed in the Atchafalaya hatchery and most of them were planted on the spawning grounds immediately after fertilization had been accomplished. A few millions, reserved with the object of testing the water supply at a new site on the Bayou Plaquemine, were successfully incubated at that point with only a 2 per cent loss, and the resulting fry were vigorous and healthy. On account of the higher water temperature at the new site, the incubation period is materially shorter than at Atchafalaya.

Mussel Infection in Conjunction with the Rescue of Landlocked Fishes

[H. L. Canfield, in charge]

As in past years, mussel-infection operations were conducted in connection with the salvage of food fishes from overflowed lands along the Mississippi River. This work is receiving the hearty commendation of practically all who are engaged in the various branches of the mussel industry, including clammers, buyers, and pearl-button manufacturers, and many of them have expressed their approval in writing.

While weather conditions during the summer and fall of 1924 were unfavorable for the prosecution of the rescue work, they were in the main favorable to infection operations. This is explained by the fact that only strong, vigorous fish can be used to advantage in the infections, and during protracted warm periods most of the fish handled are so soft that they will not successfully endure the treatment.

The first five-year term of the mussel closure law in force along the Mississippi River and its tributaries in Wisconsin, Minnesota, Iowa, and Illinois having expired, the areas in which it was applicable are now open, while other areas will be closed for a second period of five years. No definite data as to the effects of this law will be available until the close of the second period, but judging from current reports it is believed it has proved beneficial.

The fields in which mussel-infection operations were conducted during the year and the numbers and species of mussels handled in each are shown in the following table:

Summary of infection of fishes, fiscal year 1925

Stations	Species		
	Grass mucket (*L. luteola*)	River mucket (*L. ligamentina*)	Pocketbook (*L. ventricosa*) [1]
Prescott, Wis		4, 330, 500	
Wabasha, Minn		3, 374, 000	
Winona, Minn	257, 121, 000	236, 143, 500	
Homer, Minn	159, 944, 500	431, 238, 000	
Dakota, Minn		95, 972, 500	
La Crosse, Wis	22, 127, 500		
Genoa, Wis	84, 590, 000	136, 810, 000	3, 300, 000
Ferryville, Wis	11, 500, 000		
Lynxville, Wis	38, 185, 000	36, 405, 000	
Marquette, Iowa	265, 500	4, 713, 000	
Guttenberg, Iowa	50, 245, 000	2, 633, 000	
Bellevue, Iowa	18, 358, 250	57, 128, 100	
Andulusia, Ill		129, 177, 500	
Total	642, 336, 750	1, 137, 925, 100	3, 300, 000

[1] This mussel is not of best quality and fishes are infected with it only when first-class mussels are not available.

MARINE FISHES

A very successful season was experienced in the propagation of the marine fishes of the New England coast. The eggs collected at the three stations comprising this group aggregated 4,886,182,000, as compared with 4,049,135,000 in the preceding year, while the output of eggs and fry amounted to 4,092,807,000, a gain of about 13 per cent compared with corresponding figures for 1924. The heavy increase shown is accounted for by the phenomenal abundance of cod in fields around Gloucester, Mass., and by an unusually heavy run of winter flounder along the Maine coast.

Boothbay Harbor (Me.) Station

[E. E. Hahn, Superintendent]

As in recent years, fish-cultural operations at this station were confined to the propagation of winter flounder, a careful watch maintained by the station force on all fishing grounds in the vicinity having failed to disclose any source of supply for cod, haddock, mackerel, or alewife eggs. On March 1 the work of obtaining brood winter flounder was taken up by the steamer *Gannet* and two smaller vessels, 88 fyke nets being set in numerous coves and harbors over an area extending from Penobscot Bay to Casco Bay. Of these, 46 were operated by the *Gannet* and its crew while the station force in the smaller boats tended the remaining nets. Collections were discontinued on May 11, 9,203 breeders having been secured. The number would have been much larger but for the occurrence of an accident at the height of the season. While operating nets in Casco Bay the steamer's skag was carried away in a gale, necessitating the withdrawal of the boat from the field for two weeks while a new skag was cast and installed. The captured fish provided 2,027,901,000 eggs, establishing a record far better than that of any season in the station's history. The fish were held in tanks in the hatchery pending the full development of the eggs when they were stripped and immediately liberated in the station harbor. At one time during the spawning season eggs were taken in such numbers that the hatchery was filled to overflowing and a large surplus had to be held in floating boxes installed in the harbor until the development of older lots of eggs provided hatching space for them.

On the completion of fish-cultural activities a supply of local fishes, seals, and Crustacea was collected with the view of providing the usual summer aquarial display, 25 tanks arranged in the hatching room being used for the exhibit. This feature of the work is of great interest to the many daily visitors to the hatchery.

Gloucester (Mass.) Station

[C. G. Corliss, Superintendent]

Reports having been received late in October that ripe pollock were being taken in large numbers near Plymouth, Mass., employees from the Gloucester station were sent out some days in advance of the usual time to make collections. The first eggs were taken on October 28, and between that time and the close of spawning operations on the 7th of January, 430,648,000 had been secured. Over 90 per cent of these were derived from gill nets operating around Plymouth and Duxbury, the fisheries off Cape Ann yielding only comparatively few. During the first three weeks of the season the eggs were, from some unknown cause, inferior in quality, and the losses during incubation were large. As a result of the work with this species 222,890,000 fry were hatched and planted in the coastal waters of Massachusetts.

The results of the year's work in cod propagation were the best in the history of the station. The egg-collecting season was a long one, extending from shortly after the middle of November to nearly the close of the third week in May. The first eggs were secured incidentally, in occasional small batches, with pollock spawn. As soon as the pollock work ended the energies of the station force were concentrated on the cod work. However, the results during January were poor, owing to stormy weather, but from the beginning of February to the close of the spawning season natural conditions were generally favorable and the egg receipts during that entire period were very large. Up to the first of April all eggs taken were brought to the hatchery and incubated, but subsequent to that date the low water density (resulting from spring freshets) necessitated the fertilization and immediate planting of all eggs on the spawning grounds. Of the total collections, amounting to 1,219,468,000 eggs, over one-third were incubated and the resulting fry liberated off Cape Ann and adjacent points. The Woods Hole (Mass.) station was furnished 1,750,000 green eggs for experimental work, and the remaining eggs were planted.

Haddock propagation was taken up late in March and prosecuted in connection with the cod work. The daily catch of haddock being small, the fishermen soon became discouraged and transferred their attention to the more remunerative cod, thus reducing the supply of eggs. Nearly all of the 174,603,000 secured during the season (extending from March 20 to May 16) had to be planted as soon as fertilized, owing to unsuitable water conditions in the hatchery.

During the first week in March fyke nets for the capture of a brood stock of winter flounder were set in the outer harbor near Gloucester and 336 gravid fish were taken, the catch being nearly twice as large as that of last year. These fish yielded 199,258,000 eggs for incubation.

In the conduct of the so-called "offshore" work, prosecuted under the direction of the superintendent of this station, experienced spawn takers are detailed to accompany the fishing fleet to the Georges Bank fisheries to take eggs from the ripe fish caught for the market, fertilize, and plant them on the fishing grounds. During the past season this work was in progress from February 5 to April 7, and resulted in the planting of 137,355,000 fertilized cod eggs and 42,222,000 fertilized haddock eggs.

Woods Hole (Mass.) Station

[W. H. Thomas and G. R. Hoffses, Superintendents]

Well in advance of the spawning season the customary arrangements for securing adult cod were made with trap fishermen at Newport and Narragansett Pier, R. I. It was expected that enough brood fish to serve as an egg supply for the hatchery could be obtained at these points, but inclement weather prevented the fish from entering the traps in substantial numbers. By the middle of November, however, a sufficient number had assembled and were being held in pens for transfer to the hatchery. Not having a boat fitted for carrying live fish, the station is dependent upon the charter of fishing vessels equipped with wells, and as a boat of this kind is available only at the convenience of the owner, arrangements for the immediate transfer of the fish were impossible and before the required facilities could be provided the violent storm of November 22 and 23 destroyed the inclosure and released the fish. The fishermen's equipment was so seriously damaged by the storm that the owners concluded it would not be profitable to repair it for further work, as weather conditions in that locality rarely permit trap fishing much beyond the date mentioned. With the close of cod fishing and the loss of all fish previously taken, the possibility of securing a brood stock for the station failed. The circumstances described and their practical duplication during the preceding year present a most convincing argument in support of the station's need for a boat suitably equipped for the carrying of live fish.

Quite satisfactory work in the propagation of winter flounder was made possible in the Waquoit (Mass.) field by the generally favorable weather prevailing throughout the spawning period. Operations were undertaken there on February 1 and vigorously prosecuted until April 11, during which time 584,000,000 eggs were secured, 90 per cent of which produced good fry. At one time when the entire hatching space was filled to capacity some 4,500,000 eggs were planted on the spawning grounds immediately after being fertilized. On March 20, when the collection of eggs of this species was undertaken at Newport, R. I., natural conditions appeared to be entirely favorable, the mild weather permitting regular visits to the nets, and fish of large size being plentiful. Notwithstanding these advantages, the outcome of the work was disappointing, only 42,820,000 eggs being secured. The failure to produce adequate results was due to arrested development of the eggs in the fish. Such eggs were not voided and attempts to take them by artificial means were unsuccessful. While the reason for this trouble is not understood, it is presumably due to injuries sustained by the fish during handling, and is accentuated by holding them in a restricted environment. The ovaries of the fish are unduly distended, which under normal conditions gradually become softer to the touch with the approach of maturity. A fish thus affected seems unable to extrude its eggs and eventually dies.

In the course of the season new methods were tested in an effort to devise means for the safe transportation of brood winter flounder to the Woods Hole station. Owing to the peculiar nature of this fish, experience has shown that it can not be carried to advantage in the 10-gallon transportation cans in general use by the bureau. If some method can be evolved whereby adequate numbers of the adult fish can be delivered in good condition at the hatchery it will probably go far toward eliminating the difficulty referred to and will obviate to a great extent the heavy losses that appear to be unavoidable under the present methods of conducting the work. In addition to the eggs mentioned, upward of 24,000,000 were obtained from commercial fishermen operating at Menemsha Pond and other points in Marthas Vineyard Sound. Eggs taken by incision from a few fish late in the season were readily fertilized and successfully incubated, and it is possible that this method may have to be more extensively resorted to hereafter.

During the spring mackerel appeared to be abundant in local waters and throughout the spawning season the one small boat available was in constant attendance on such traps as could be reached, with spawn takers to secure all available eggs. As a result of these efforts 3,517,000 eggs of good quality were taken and incubated. Advantage was taken of the opportunity afforded to attach tags to a considerable number of adult mackerel, in continuance of the rather extensive fish-tagging program recently inaugurated by the bureau. Scup, another highly important food fish, was also present in fair numbers, though none containing ripe eggs was found in the traps visited. If a suitable boat had been available for the prosecution of the work it seems certain that many more mackerel eggs and quite probably eggs of the scup in considerable numbers might have been salvaged.

Some 50,000 eggs of the steelhead salmon were received in May from the Applegate Creek (Oreg.) substation. The consignment arrived in rather poor condition, a considerable number of the eggs having hatched on the trays en route. The surviving eggs were successfully incubated and the resulting fish were distributed in various tributary streams of Johns Pond, Waquoit, Mass.

ANADROMOUS FISHES OF THE ATLANTIC COAST

Fish-cultural work with fishes of this class is conducted at three stations, located in Maryland, North Carolina, and Maine. The species handled are the shad, river herrings, and Atlantic salmon. The general results of the work in 1925 did not vary materially from those of the preceding year.

Shad

Bryans Point (Md.) substation.—Though weather conditions throughout the winter and early spring were favorable to a good run of shad, the fish failed to appear in any considerable numbers and the catch made by the Potomac River fishermen proved the smallest ever recorded. Overfishing and a total lack of protection are undoubtedly responsible for this falling off. In the course of the spawning period (from April 16 to May 18) small daily collections of eggs were made, aggregating 26,270,000 for the season. In accordance with the policy heretofore pursued, no eggs were measured or paid for until the second day after their receipt at the hatchery, thus obviating the possibility of paying for defective eggs and insuring a large percentage of hatch. Seven hundred thousand eggs in the eyed stage were shipped for development in the central station (Wash.) aquarium, and 16,678,671 fry were hatched from those retained. Five hundred thousand of the fry were furnished to the Connecticut State Board of Fisheries and Game, and the remainder were released on the natural spawning grounds, being divided equally between Maryland and Virginia waters.

Shad and River Herring. Edenton (N. C.) Station

[Wm. S. Vincent, Superintendent]

The two anadromous fishes of commercial importance handled at this station are shad and river herring. Though the station was established primarily for the propagation of shad, this work has gradually declined in volume and is now of minor importance, owing to the growing scarcity of shad in the Albemarle Sound region.

At the opening of the spring fishing season it was anticipated that a goodly number of shad in spawning condition might be secured at the Capehart Beach fishery, but this hope proved futile. Only 2,000 fish were taken, as compared with a catch of 12,000 the preceding year, and after endeavoring for 10 days to obtain eggs the work was finally abandoned. The total collections of eggs during this period amounted to only 502,000. A discouraging feature of the work was the difficulty of obtaining male and roe shad at the same time. The morning catch was very apt to consist almost entirely of males, while in the evening conditions were usually reversed.

Large numbers of river herring were captured during the spring, and commercial fishing for that species proved more profitable than in many years; more eggs were therefore taken for propagation than in any previous season since the Edenton station was established, the total exceeding 336,000,000. The percentage of fertilization was very low, however, owing to unusual adhesiveness of the eggs, and only about half of the collections was hatched. Every known method was employed to overcome the adhesiveness, among these being the use of muck and starch, taking the eggs at different periods of the day, feathering, etc., but all to no purpose. An apparently plausible theory was advanced by some of the fishermen to account for the faulty condition of the eggs. The almost total lack of rain during the spring caused the water in the river to drop to a very low stage at spawning time, when as a general thing very muddy, high water may be looked for during this period, and the fishermen were of the opinion that lack of sediment in the water may have been responsible for the failure of the eggs to develop as usual. In past seasons many schools of young herring have been observed near the docks and fish houses. Last season, the schools were late in appearing and their numbers were greatly reduced, seemingly justifying the assumption that the percentage of hatch under natural conditions was also below normal.

About 400 brood yellow perch, purchased early in the spring from local fishermen, were held in one of the station ponds. After the fish had spawned, the eggs were gathered up in small dip nets and developed in hatching jars. The percentage of fertilization was high and incubation was accomplished with a loss of only 5 per cent. The resulting fry were utilized to supply applicants and make plants in public waters.

Atlantic Salmon. Craig Brook (Me.) Station

[J. D. De Rocher, Superintendent]

In view of the continued antagonistic attitude of the salmon-weir fishermen as regards the collection of Atlantic-salmon eggs in Maine rivers, no effort was made to procure a brood stock of that species. The small number of Atlantic-salmon fry on hand at the beginning of the fiscal year was carried to the No. 2 fingerling stage and then liberated in Dead Brook and Dennys River. Early in March two consignments of eggs of this species were received from hatcheries operated by the Canadian Government, one of 1,000,000 eggs coming from South Esk, New Brunswick, and another of 500,000 from Gaspe, Province of Quebec. Approximately 954,000 fry were hatched from the first lot, while the second produced more than 490,000. The fish were distributed in the advanced fry stage, plants being made in the Penobscot, Piscataquis, Salmon, Pleasant, Dennys, St. Croix, and Narragaugus Rivers.

FISHES OF MINOR INTERIOR WATERS

The ever growing demands for fish and fish eggs of practically all of the game species propagated by the bureau are making it increasingly difficult to keep pace with them. Of late years the expansion in this direction has been greatly intensified by the wide use of the automobile as a means of travel, and by the building of roads into hitherto inaccessible regions, thereby opening up to public fishing and subsequent depletion many waters that formerly contained fish in abundance.

Among the fishes most frequently called for are the rainbow trout, brook trout, black basses, rock bass, sunfishes, and crappie. Thus far it has been possible to produce the rainbow trout in quantities adequate to meet the requirements, but in the case of the brook trout the dwindling supply of wild fish has necessitated reliance upon commercial trout-culturists for a large percentage of the eggs needed for stocking the bureau's hatcheries. During the past year the demands for practically all of the pondfishes have been entirely out of proportion to the available supply, and in its efforts to cope with the situation, both as regards the pondfishes and the brook trout, the bureau has endeavored to enlist the active cooperation not only of the State fisheries authorities but also of many prominent fish and game associations on a scale never previously attempted.

Aside from unpropitious weather conditions, the principal obstacle encountered in the pondfish-cultural work is lack of sufficient rearing space. In an effort to overcome this deficiency the bureau is endeavoring to secure the use of land and water facilities at the command of numerous clubs and fishing organizations for the conduct of rearing operations on an equal share basis. Its efforts in that direction have thus far met with a most encouraging response. A number of cooperative projects have been undertaken, and in some cases organizations have volunteered to construct ponds and troughs at their own expense with the view of rearing young fish, furnished by the bureau's hatcheries, to the fingerling size before liberation in open waters. The influence of such organizations has also been beneficial in securing more effective State fisheries legislation and in developing respect for fish protection on the part of the general public.

ROCKY MOUNTAIN TROUT STATIONS

The eight stations and substations comprising this group are among the more important of those whose activities are confined to the production of game fishes. The aggregate distributions of fish and eggs of the brook, rainbow, black-spotted, and Loch Leven trouts and the grayling made by these stations compare favorably with their output in previous years.

Bozeman (Mont.) Station and Substations

[W. T. Thompson, Superintendent]

The results of the year's fish-cultural work in this field (the most successful the station has ever experienced) are in a large measure attributable to the close cooperative relations that have existed between the bureau and the Montana Fish and Game Department. Since its recent reorganization, this department has rendered valuable assistance to the station in its work of stocking the numerous waters throughout the State of Montana.

Bozeman (*Mont.*) *station.*—The distribution of the large stock of fingerling trout on hand at the opening of the fiscal year was made by one of the bureau's distribution cars, the work extending from early July to the close of November. During this period 1,074,840 brook trout, 312,000 rainbow trout, 155,511 Loch Leven trout, and 9,100 lake trout of various sizes were delivered to applicants or planted in public waters. The losses sustained while the distribution was in progress aggregated 143,160 fish, or slightly less than 11 per cent of the original stock.

Of the 1,606,300 black-spotted trout eggs received early in the fiscal year from Yellowstone Park, 310,000 were turned over to the district national forester to be planted in the distant and almost inaccessible waters of the Lolo and Missoula National Forests. From the remainder 1,270,000 fry were hatched, these, in addition to the young fish on hand at the beginning of July, giving the station a total of 1,473,000 black-spotted trout. All of this stock was distributed in the advanced fry and fingerling stages by the car that was engaged in the shipment of fingerling trout of other species.

During the fall and winter the station acquired over 1,000,000 brook-trout eggs, 500,000 of which were forwarded from the Springville (Utah) station, an equal number from the Leadville (Colo.) field, and 100,000 from the establishment of the Southside Sportmen's Club of Oakdale, N. Y., the latter being a donation in recognition of the service rendered by the station in securing from the State of Montana a consignment of grayling eggs for the club's hatchery. There were also obtained 67,600 eggs from a small stock of brood brook trout carried in the station ponds. The losses on some of the eggs were above normal, notably on the consignments from the Utah and Colorado fields, which sustained a mortality in the egg and early fry stages of 152,000 and 190,500, respectively. The eggs from Leadville were unusually small in size, and the losses were largely increased by the fact that the eggs were practically at the hatching stage when received. The product of this lot was distributed during the spring, but the fry resulting from the Utah consignment were being carried at the close of the fiscal year.

In November and December several shipments of Loch Leven trout eggs, aggregating 1,393,000 eggs in round numbers, were received from the Meadow Creek (Mont.) auxiliary. Of these, 598,000 were immediately repacked and shipped on assignment. The remainder produced 509,000 fry, some of which were distributed in May and June. A small lot of landlocked-salmon eggs, received in March from the bureau's Craig Brook (Me.) station, was successfully incubated. It is the intention to plant the young fish of this species in a lake in Montana in the hope of being able eventually to develop a collecting field for eggs. The incubation of 1,391,000 rainbow-trout eggs received from the Madison Valley field was completed during May and June, the losses in hatching amounting to slightly more than 4 per cent.

Meadow Creek (Mont.) substation.—Preparations for the season's fish-cultural operations in this field began in September with the installation of traps at several points in Odell Creek for the capture of Loch Leven trout. While good weather lasted large collections of eggs were made every day between October 13 and November 15, on which date the work was brought to a sudden close by the weather turning cold. Of the 11,750,840 eggs obtained, approximately 90 per cent were shipped in the eyed stage, some for supplying applicants and some in exchange for eggs of other species.

The rainbow-trout spawning season in this field opened on March 20, fully two weeks in advance of any previous season since the station was established. Eggs were obtained daily from that time until May 21, 3,991,000 of exceedingly fine quality being secured. A considerable number of rainbow trout and numerous grayling were captured in several experimental traps installed in various channels of the Madison River near the head of Meadow Lake. Their eggs were not mature, however, and the current was too swift for the retention of the fish in pens to ripen. Approximately 50 per cent of the fry resulting from the collections were released in parent waters, the Madison Valley Anglers Club and the deputy State warden of Montana assisting in the distribution.

In pursuance of an arrangement effected with the Montana fisheries authorities, whereby the resulting fry were to be liberated in Meadow Creek and other waters in the Madison Valley, this substation incubated in excess of 5,220,000 grayling eggs and 990,000 black-spotted trout eggs and planted the product.

Glacier Park (Mont.) substation.—After carrying to the fingerling stage the 342,000 rainbow-trout fry on hand at the beginning of the fiscal year, the product was turned over to the local park authorities for distribution in the waters of Glacier Park. A consignment of 484,000 eyed black-spotted trout eggs was received in July, 1924, about half of which were planted in some of the more distant and inaccessible waters near the top of the continental divide. The remainder were incubated and the product planted as fingerling fish in park waters.

During the spring of 1925, 551,000 eyed rainbow-trout eggs were received from the Meadow Creek field. These were hatched with a small loss, leaving approximately 537,000 fry in the hatchery at the close of June. Green black-spotted trout eggs to the number of 940,380 were received early in June from the Georgetown hatchery of the Montana Fish and Game Department, with the understanding that an equal number would be returned to the State from the Yellowstone Park collections later in the season. About the same time 1,027,000 green grayling eggs were received from the State in exchange for Loch Leven eggs to be supplied later.

Leadville (Colo.) Station

[C. H. Van Atta, Superintendent]

The work at this station is concerned mainly with the production of brook trout. It differs from that at most of the other brook-trout stations in that the supply of eggs is derived almost entirely from collections made on a share basis from privately owned lakes and reservoirs. From five projects located within a radius of about 150 miles from the station over 6,000,000 brook-trout eggs

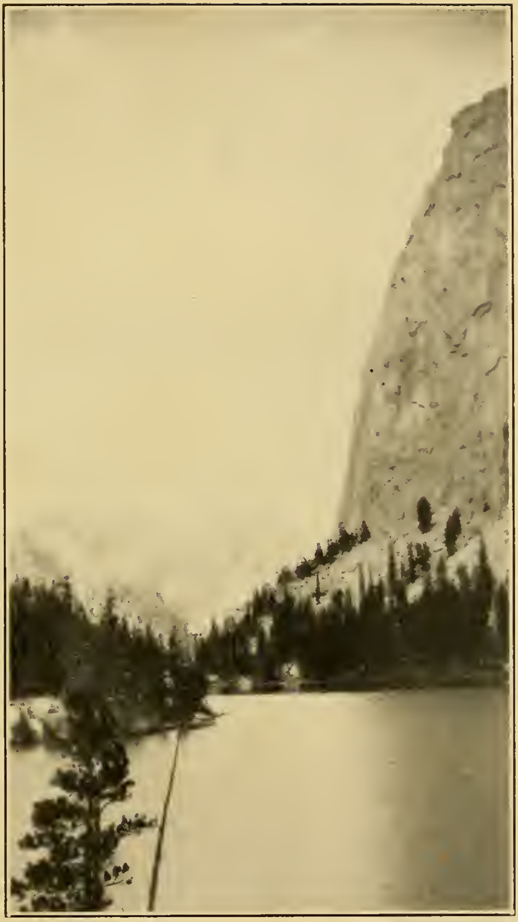

FIG. 3.—Virgin lake in the Sawtooth National Forest, Idaho. Elevation 9,000 feet

FIG. 4.—Pack outfit on the meadows of Hell Roaring Creek, Sawtooth National Forest, Idaho. Typical of the meadow streams in the region

FIG. 5.—Loading pack horses, Glacier National Park

FIG. 6.—Forest ranger planting fish, Glacier National Park

were obtained in the fall of 1924 at an average cost of 7 cents per 1,000. Among the most prolific is the property known as the Engelbrecht Lakes, consisting of two inclosures of 50 and 80 acres, fed by a small creek. While egg collecting is in progress the owner of these lakes furnishes board and lodging to the bureau's spawn takers and receives as his part of the proceeds 30 per cent of the eyed eggs and fry.

The Mount Massive Trout Club holdings comprise a group of 20 lakes, ranging in area from 1 acre to 18 acres, the series being fed by a ditch leading from a neighboring creek. The work here is conducted on an equal share basis. A third collecting point is Turquoise Lake, a reservoir of approximately 800 acres owned by the Colorado Fuel & Iron Co. Due to the fact that this lake was drawn down about 18 feet below its normal level during the fall of 1924, laying bare the usual spawning area, there was a falling off in output of more than half a million eggs as compared with the results of the preceding year. Collecting projects of smaller extent are Carroll Lakes, two inclosures having a combined area of 20 acres, controlled by the Colorado Springs Fly-Casting Club, and a series of four, known as Wurtz Lakes, ranging in size from 1 to 5 acres.

In addition to the collections mentioned the station received 1,266,000 eggs from a privately owned fish-cultural establishment at Creede, Colo. In this case the owner of the plant made the collection of eggs at his expense, and in return for 50 per cent of the developed eggs the station assumed the care of the entire lot to the eyed stage and packed the owner's share for shipment to points directed by him.

In the course of the year the station acquired 162,200 rainbow-trout eggs, collected in Baker Lake, near Jefferson, Colo., and from the Evergreen Lakes on the station grounds. Eyed eggs of this species were also received from the bureau's Springville (Utah) and Saratoga (Wyo.) stations. From a consignment of 814,000 eyed black-spotted trout eggs, received from the Yellowstone Park, 801,000 No. 1 fingerling fish were produced and distributed. The station also handled 75,000 eyed lake trout eggs transferred early in March from the Duluth (Minn.) station.

Yellowstone National Park (Wyo.) Substation

[C. F. Culler, in charge]

The collections of eggs of the black-spotted trout in this field during July, 1924, amounted to 19,522,500. These were eyed in the bureau's hatchery near Lake Hotel, together with 12,477,500 taken earlier in the season. The unusually small water supply available for incubation work making it hazardous, if not impossible, to complete the development of this large stock, it was decided to utilize eyed eggs in larger numbers than heretofore for stocking the more distant and inaccessible waters of the park, especially since close observation had disclosed encouraging results from previous plants of eggs. No available means exist for transporting fry in large numbers to such waters, and even where the waters to be stocked are accessible by boat an excessive amount of time is involved in making the plant. Taking into consideration the number of streams where eggs are collected, it is estimated that fully 20 days would have been necessary to carry out the bureau's policy of returning to parent waters 25 per cent of the fry resulting from such collections, whereas the time spent in making this return in the form of eyed eggs did not exceed 4 days. Approximately 45 per cent of the product of the eggs collected was planted in the waters of the park either in the form of eyed eggs or as advanced fry. The remainder of the output, consisting of eyed eggs, was shipped to applicants and to other stations of the bureau.

Unusually high water obtained in all the park streams in the following spring from the time the station was opened—about the middle of May—up to the close of the fiscal year. This condition and the fact that ice-cold water in large quantities was flowing into the streams from adjacent mountains made a rather discouraging outlook for egg collections.

Saratoga (Wyo.) Station

[O. N. Baldwin, Superintendent]

Brook-trout operations were conducted as usual. Part of the 318,000 fingerlings of this species carried over from the hatch of the preceding year were distributed to applicants in the course of the summer, and the remainder was turned over to Forest Service officials to be planted in streams located within the forest reserve. A somewhat smaller number of eggs than usual was realized from the adult brook trout held in the station ponds and were of a lower grade than those of the preceding year, the percentage of hatch amounting to only 67. The unusually poor quality of these eggs is attributed to the fact that it became necessary to confine the brood stock in small concrete pools for an extended period prior to the spawning season. Satisfactory terms for the collection of brook-trout eggs in Big Creek Lakes, under the control of the Big Horn Cattle & Improvement Co., having been effected with the new manager of the company, spawning operations in that field were undertaken on October 8 and continued to December 11, resulting in the collection of 663,050 eggs of excellent quality. An equitable percentage of the fry hatched from this lot will be reared to fingerlings and returned to their native waters.

By a recent decision of the courts future fishing privileges in these lakes will be vested in the Forest Service, and when the property has been turned over to that service it will doubtless be possible, through the exercise of adequate protective measures, to develop a field station that can be depended upon to yield several millions of brook-trout eggs annually.

The rainbow-trout work in the Sage Creek, Canon Creek, and Lost Creek fields extended from April 22 to May 19. When the spawning season opened Sage Creek was at its normal level, the fish appeared to be running well, and all indications pointed to a record egg collection. About the middle of May, however, the work was brought to a sudden close by a heavy rain, which lasted for about 36 hours. In the course of the storm the débris, caused by the breaking of an irrigation dam a short distance above, came down in a solid body against the upper rack, destroying the trap and liberating a brood stock of approximately 800 fish confined therein. A small stream under natural conditions, Canon Creek usually yields approximately half of the rainbow-trout eggs collected in the Wyoming field. During the past season, however, the water was so low as to hardly cover the larger fish in the stream, and the thousands of cranes that annually visit this section inflicted heavy losses on the brood stock. Under existing conditions the eggs collected numbered less than 200,000. Owing to the more favorable water stage in Lost Creek a fairly successful season was experienced, and the total egg collections for the three fields aggregated 1,038,620.

Loch Leven trout eggs to the number of 201,560 were obtained during the fall from the station brood stock, which included a number of 2-year-old fish, and at the close of the fiscal year there were 155,000 fingerling fish of this species on hand. A shipment of black-spotted trout eggs, received from the Yellowstone Park late in July, was incubated with very little loss, yielding 320,000 fry for deposit in suitable waters of the region.

Among the many more important improvements made at this station during the year was the construction of a modern 5-room cottage for the use of the foreman and the installation of a Westinghouse 32-volt electric plant for lighting the hatchery and grounds.

Spearfish (S. Dak.) Station

[D. C. Booth, Superintendent]

Fish-cultural operations were conducted as usual, though on a somewhat enlarged scale. With the recent extension of the pond system, the stock of brook trout was considerably increased by the capture of fish in neighboring streams. Eggs of this species handled during the year included 365,000 taken from the station brood stock, 295,000 obtained by purchase from a commercial dealer in Massachusetts, and 500,000 transferred from the Leadville (Colo.) field. Fry resulting from this stock, to the number of 874,600, were distributed in the Nos. 1 and 1½ fingerling stages, and a small balance was on hand at the close of June.

The station collections included 37,255 eggs of the rainbow trout and 208,250 of the Loch Leven trout. Three hundred thousand additional Loch Leven trout eggs were shipped from the Bozeman (Mont.) station and 116,000 rainbow eggs were received from the Neosho (Mo.) and Saratoga (Wyo.) stations. All of these were of excellent quality and produced a good percentage of fry.

In the way of construction the station accomplished considerable. The extension of the pond area undertaken during the previous fiscal year was completed and a concrete reservoir of 425,000 gallons capacity was built. Water from this reservoir can be successfully used from six to seven times in succession, first in the hatchery and then in each of the ponds on the lower level of the reservation.

Springville (Utah) Station

[Claudius Wallich, Superintendent]

Fish-cultural operations at this station consisted mainly in the propagation of brook, rainbow, and black-spotted trout, though they included also the capture of a limited number of catfish in Utah Lake for filling applications submitted by residents of the State of Utah.

The work of collecting brook-trout eggs in the Fish Lake field, conducted in cooperation with and under the direction of the Utah fisheries authorities, was taken up November 6, at least 12 days after spawning began, as reported by the forest ranger of that district. The delay occurred because the State officials were not prepared to enter the field at an earlier date. Over 1,000,000 eggs were taken in the first day's operations and later collections were good, though maximum results were not attained owing to the decision of the State operatives not to make daily collections. The last eggs of the season were taken December 3, the total yield being approximately 3,500,000, of which the bureau's share was 1,341,000. Of the 950,000 eggs eyed from this lot, 500,000 were shipped to the Bozeman (Mont.) station. The remainder were incubated, and most of the resulting fry were used in filling applications and making public plants in suitable waters in Utah. In this connection an equitable proportion of the output was returned to the waters of Fish Lake.

At the beginning of the fiscal year there were on hand 60,000 fingerling rainbow trout No. 2½ and 507,000 fry, the latter being the product of spring collections of eggs in Fish Lake. Excessive losses, probably due in part to the use of fertilizing medium from black-spotted trout when the stock of male rainbow trout was inadequate, reduced the output of this lot to 295,050 fingerling fish. Eggs were taken from the brood rainbow trout held in the station ponds between December 11 and February 25, the returns aggregating 988,370. Owing to imperfect fertilization only 574,000 of these were developed to the eyed stage. During April and May, 1925, collections of eggs of this species were made at Fish Lake under the direct supervision of the State authorities, and of the 21 cases of eggs secured the station received 4 cases containing 700,000. The percentage of fertilization on these was also low, only about one-fourth of them surviving to the eyed stage. The returns from cooperative black-spotted trout work along the same lines at Strawberry Reservoir, Utah, were 3,000,000 eggs, of which the station received one-tenth, or 300,000. These were of such poor quality that nearly two-thirds of them perished before the end of June.

NEW ENGLAND TROUT AND SALMON STATIONS

Included under this head are the stations located at Hartsville, Mass., Nashua, N. H., East Orland, Me., and St. Johnsbury, Vt., with their several auxiliary stations. The work of the group was concerned principally with the propagation of trout and landlocked salmon, though small numbers of other species were handled also. Their output as a whole slightly exceeded that of last year.

Berkshire (Mass.) Station

[W. H. Thomas, Superintendent]

From the stock of brook trout carried in the station ponds, consisting of 474 fish 2 years old and older, 264,700 eggs were secured at spawning time. With the consent of the proprietor, 45,000 eggs were collected from brook trout contained in a privately owned pond, and 165,300 were purchased from a commercial fish-culturist in Massachusetts. The fry from all this stock continued to develop normally up to March 11, when the loss on one lot began increasing rapidly and within four days had assumed epidemic proportions. Each lot of fry was similarly attacked on reaching a certain stage, and practically all the fish were lost eventually. Twice previously in recent years the station has undergone a like experience with its brook-trout fry, on each occasion after a heavy snow or rainfall. From the information that could be obtained it is believed that the losses were in some way connected with the entrance of surface water in large quantities into the intake pond. A noteworthy feature of the mortality is that the rainbow trout were not affected but continued to develop normally even when placed in troughs supplied with water from the troughs in which brook trout were dying in large numbers. This would seem to indicate that the disease is not infectious.

As an experiment, yeast and cod-liver oil were mixed with the ground liver fed to these fish, in the proportion of 2 parts yeast and 1½ of oil to 96½ parts liver; but it was soon discovered from the quantity of food left on the bottom of the troughs that the fish were rejecting the material, and it was observed that they were preying upon one another. Plain liver was substituted and was taken eagerly, nothing being allowed to accumulate.

Five hundred thousand pike-perch eggs were transferred during the spring from the Swanton (Vt.) station. They were of fine quality when received and the loss of 100,000 sustained during the incubation period is believed to have been due to the instability of the hatchery water supply.

During the month of May 45 adult smallmouth bass, furnished from the Cape Vincent (N. Y.) station, were apportioned among the breeding ponds. A few days afterward indications of nest building were noted, and at the close of the fiscal year 4 nests, estimated to contain 5,000 eggs, were observed.

Craig Brook (Me.) Station

[J. D. De Rocher, Superintendent]

An account of the year's work in the propagation of Atlantic salmon may be found on page 476 under the heading "Anadromous Fishes of the Atlantic Coast." The landlocked-salmon fry and fingerlings on hand at the beginning of the fiscal year—approximately 53,000—were reared to the No. 3 fingerling stage and released in suitable lakes in the region. From 70 adult landlocked salmon captured during November in trap nets set in Toddy Pond, 23,800 eggs were secured and incubated with 142,500 green eggs forwarded from the Green Lake substation. In February and March two shipments of eyed eggs of this species, aggregating 501,000, were received from the Grand Lake Stream auxiliary, and a consignment of nearly 200,000 was furnished the station by the State of Maine from its Caribou hatchery. In the course of the season the station shipped 160,200 eyed eggs, and 528,200 fry were hatched and liberated in the waters of Maine.

In January 1,149,000 eyed brook-trout eggs were purchased from commercial dealers in Massachusetts and New York, and a consignment of 53,000 was received from a Massachusetts dealer in exchange for eggs of the landlocked salmon. A good percentage of hatch was attained with both lots of the purchased eggs but the losses of fry were large, in the case of the Masachusetts consignment amounting to more than one-fifth of the original stock. All the young fish resulting from these two shipments were distributed in the advanced fry stage, while those derived from the exchange were on hand at the close of the year. The output of the station also included a few lake-trout fingerlings and fry, the product of eggs forwarded from its Grand Lake Stream auxiliary and the Charlevoix (Mich.) field.

Grand Lake Stream (Me.) substation.—At the opening of fiscal year 150,000 landlocked-salmon fry were being held in feeding ponds constructed in the canal formerly used for the passage of boats. They were fed from three to five times daily on sheep liver and beef heart, and when released, about the middle of September, they were fine active fish in the No. 3 fingerling stage.

The canal ponds are proving far superior to the trough-feeding system for the rearing of landlocked salmon. They not only require much less work but the losses are lighter, the fish are in better health, and attain a larger growth. Eggs of the landlocked salmon to the number of 1,096,700 were secured in November from 782 brood fish, which were captured by means of three crib nets and a trap installed in Grand Lake. The collection of eggs was larger than last year, when operations were conducted at both Grand and Dobsis Lakes, by approximately 112,000. On attaining the eyed stage 501,000 of the eggs were transferred to the main station. Plants of fry aggregating 273,250, part of the product of the remaining eggs, were made early in June in suitable local lakes, and the canal system was again stocked with 150,000 with the object of distributing them as fingerlings in the fall.

Owing to unfavorable weather and the difficulty of setting nets, the work of obtaining lake-trout eggs during October in the open waters of Grand Lake did not meet with much success, only 17,000 being secured. These were the yield of the four female fish captured, one of which weighed 30 pounds. The eggs were carried to the eyed stage with a loss of about 11 per cent.

Green Lake (Me.) substation.—Fish-cultural activities at this point were confined to the collection of eggs from the run of landlocked salmon in Great Brook. In the course of the spawning season (from November 9 to November 22) 249 brood fish were taken in the traps placed at the mouth of this stream, and from the 86 females contained in the lot 142,500 eggs of superior quality were secured and forwarded to the main station for development. As no hatching operations were possible, owing to the poor condition of the water-supply flume, the usual spring work in the propagation of smelt had to be omitted.

St. Johnsbury (Vt.) Station and Substations

[A. H. Dinsmore, Superintendent]

The main station at St. Johnsbury, and its two auxiliaries at Holden, Vt., and York Pond, N. H., were operated throughout the year. The principal activities at St. Johnsbury and Holden were connected with the production of brook trout for distribution in the advanced fry stage, while at York Pond the work was largely confined to the development of a project to serve as a future source of supply for trout eggs for stocking various hatcheries of the bureau.

St. Johnsbury (Vt.) station.—Owing to the high summer temperature of the water in Sleepers River, from which stream the hatchery water supply is drawn, this station is not equipped for trout rearing and its work with the Salmonidæ is limited to the production of fry for distribution just prior to the feeding stage. In the course of the year the station handled 500,000 eyed brook-trout eggs purchased from commercial fish-culturists, and, in pursuance of a cooperative arrangement with the owners of Darling Pond, Vt., approximately 742,000 brook-trout eggs collected in that body of water and transferred to the station without expense to the bureau were incubated on shares, the station receiving one-third of the resulting fry and turning back two-thirds to the owners. In addition to the above 400,000 eggs of this species, the property of two fish and game clubs of the region were incubated and the resulting fry placed at the disposal of the clubs to be planted by them in certain public waters. Small numbers of eggs of the landlocked salmon, steelhead salmon, and lake trout were also hatched and the product distributed to applicants of the bureau.

Holden (Vt.) substation.—Fish-cultural work at this point began with the collection of lake-trout eggs in Lake Dunmore in cooperation with the State of Vermont. The spawning period extended from October 24 to November 9, and 312,500 eggs were secured. On reaching the eyed stage 50 per cent of these were turned over to Vermont and about one-third of the remaining 50 per cent were forwarded to the St. Johnsbury hatchery. The remainder were incubated at Holden. Approximately 569,000 brook-trout eggs were handled during the season, including a lot of 200,000 purchased at the expense of a local fish and game association. The fry hatched from this lot were turned back to the association for liberation in public waters of the region.

York Pond (N. H.) substation.—The development work which has been in progress for several years in this field was continued as other operations would permit. The diversion ditch carrying water from Cold Brook through Sky and Bog Ponds into York Pond was enlarged so that it will now carry the entire normal flow from the brook. Work on the West Branch diversion ditch, begun in late November, was prosecuted as continuously as possible. Eventually this ditch will bring the West Branch water into York Pond through a swamp, which will form another pond about 5 acres in area. A water wheel designed by the bureau's architect and engineer was constructed and placed in position for operation, and a dynamo and transmission lines capable of furnishing sufficient power to light the station buildings and operate small machinery were installed.

During October and November 1,249 female brook trout were captured and spawned, yielding slightly more than 437,000 eggs. Approximately 69,000 of these were transferred in the eyed stage to the Holden substation, and from the remainder upward of 144,000 fry and fingerling fish were produced and distributed.

Nashua (N. H.) Station

[W. F. Hubbard, Superintendent]

There was no departure from past methods in the conduct of fish-cultural work at this station. The total output of fingerling fish, amounting to approximately 470,000, was divided as to species among the brook, rainbow, lake, and Loch Leven trouts and the landlocked salmon. The station also incubated 1,000,000 eyed pike-perch eggs transferred from the Swanton (Vt.) hatchery, and distributed the product as fry. Eggs were obtained from the small brood stock of brook trout and rainbow trout, carried in the station ponds, between November 11 and January 14, the first-named species yielding about 28,000 and the rainbows slightly in excess of 125,000. This supply was supplemented by the purchase of 694,000 brook-trout eggs from commercial dealers in New England and the transfer of 53,000 rainbow trout eggs from the White Sulphur Springs (W. Va.) hatchery. There was a very heavy loss of fry resulting from one lot of the commercial eggs, the mortality amounting to nearly 50 per cent of the original stock. From approximately 23,000 landlocked-salmon eggs, shipped during the spring from the Craig Brook (Me.) station, 20,000 fingerling fish were produced and distributed. About the middle of June the station force undertook the collection of smallmouth-bass fry from Lake Sunapee for supplying applicants, but owing to the high winds, which prevailed almost continuously during the hatching period and until the schools of fry had dispersed, the attempt was almost a failure, only 28,000 being secured.

COMBINATION TROUT AND POND STATIONS

At these stations, located in the States of Iowa, West Virginia, Virginia, Tennessee, and Missouri, the fishes propagated included not only the various trouts but also several species of warm-water pondfishes. Fish-cultural activities of some kind are in progress throughout the year, which makes these stations very attractive to the general public. As compared with last year's results, the production of both trout and pondfishes was materially increased.

Erwin (Tenn.), Station

[A. G. Keesecker, Superintendent]

The species of fish propagated at this station during the past year included rainbow, Loch Leven, and brook trout, steelhead salmon, largemouth and smallmouth black bass, rock bass, and sunfish. The total distributions of fish and fish eggs exceeded those of the previous year by approximately 165,000. Between November 2 and January 6 the brood stock of rainbow trout yielded 647,700 eggs. Though the collection was considerably smaller than that of the previous year, the quality of the eggs was far superior, over 72 per cent being successfully eyed, as compared with less than 63 per cent in 1924. This improvement in fertility is attributed to the fact that a large part of the brood stock consisted of young fish that had been reared in earth-bottom ponds containing a plentiful supply of natural food. A consignment of 25,000 eyed rainbow-trout eggs taken from wild fish was received during the spring from the Meadow Creek (Mont.) field. The fry hatched from them will be reared for increasing the station brood stock of that species.

Four hundred and fifty thousand brook-trout eggs of good quality, received early in the winter from one of the commercial hatcheries in Massachusetts, yielded 386,750 No. 2 fingerling fish for distribution. The brood steelhead salmon held in the station ponds spawned between June 13 and March 24, yielding approximately 264,000 eggs. Their fertility was poor, only about 60 per cent surviving to the eyed stage and less than 30 per cent producing fry. In view of the unsatisfactory results attained it was decided to discontinue the propagation of the species and the brood stock was distributed by one of the bureau's cars during the spring.

The output of pondfishes was somewhat larger than in the preceding year, and at the close of June from 60,000 to 70,000 of the various species were being carried in the ponds for fall distribution. All buildings on the station grounds were painted during the year, this being the only improvement for which funds were available.

Manchester (Iowa) Station

[F. E. Hare, Superintendent]

On June 15, 1925, the Manchester station had the misfortune to receive the full effects of one of the severest rainstorms that has ever visited this region. The storm broke suddenly and with unparalleled fury, washing out roadways, bridges, retaining walls, and water-supply pipes, and covering the reservation with water to a depth of several feet. The large stock of brood rainbow trout, smallmouth black bass, and rock bass on hand in the station ponds was released by the flood waters into Spring Branch, though a considerable number of the fish were recovered later with seines and will be used as the basis for a new brood stock. In the hatchery, where fingerling brook and rainbow trout aggregating 627,000 were being held in troughs awaiting distribution, the entire stock was swept away, all, with the exception of the few lost on the grounds when the waters receded, being carried into the Maquoketa River and Spring Branch.

During the previous winter rainbow-trout eggs of fine quality were obtained from the station brood stock between December 9 and March 26, the total amounting to 1,076,000, or nearly twice the number collected the preceding year. On reaching the eyed stage 690,000 were shipped to applicants in five States. The remaining eggs were incubated in the hatchery, and the resulting fry were carried away during the flood, together with the product of 25,000 eggs from wild rainbow trout received in May from the Meadow Creek (Mont.) field.

Eight hundred and twenty thousand eyed brook-trout eggs were received from commercial dealers in exchange for eggs of other species, and 500,000 were transferred from the Leadville (Colo.) field. The fry resulting from the latter were among the fish carried away by the flood, but the majority of those hatched from the commercial eggs had been distributed previous to its occurrence. The year's output also included limited numbers of fingerling smallmouth bass and rock bass, the product of the spring spawning of the previous year. Hope had been entertained that a good showing might be made in the production of pondfishes in the spring of 1925, but all efforts along that line were nullified by the storm. All brood smallmouth bass and rock bass, together with an unknown number of fry, were released, the results of the spring work proving a complete failure. In the course of the year a considerable amount of improvement work on the hatchery and other buildings was accomplished, all of it being done by the station force.

Neosho (Mo.) Station

[F. J. Foster, Superintendent]

The year at this station was one of the most successful in its history. As in former years, fish-cultural activities were confined mainly to the propagation of rainbow trout and largemouth black bass, though considerable numbers of fish of other species were incidentally produced. In the course of the rainbow-trout spawning season (from November 1 to February 28) 1,357,160 eggs were collected, of which 696,000 in the eyed stage were consigned to applicants and other stations of the bureau. An outstanding feature of the work with this species was the material increase over past years in the number of large fingerlings produced, approximately two-thirds of the fingerlings distributed being in the No. 4 stage or larger. It is believed that the present policy of discarding practically all brood trout after their first spawning season is at least partially responsible for the marked improvement in the quality and quantity of the spawn collected, the comparatively large size of the fish distributed, and the low average cost of egg production, the latter item, based on the food consumed by the parent stock, amounting to 23½ cents per thousand, a reduction of 5½ cents as compared with its cost in the preceding year.

Though the health of the adult and yearling trout was generally satisfactory throughout the year, a constant and vigilant watch had to be maintained to prevent heavy losses of fingerling fish from the ravages of parasitic enemies. Monthly and often bimonthly treatments with vinegar solution were applied for the removal of gyrodactylus, and one trough of fry, still in the sac stage, became heavily infested with ichthyophthirius. As the fish at that time were still at the bottom of the trough, remedial measures were difficult to apply and fully half of this lot succumbed before the parasite could be eliminated.

The greatest loss experienced at this station continues to be from the affection known as crystals in the kidneys, which makes its appearance in fingerling fish from 1½ to 2½ inches long. There is ground for the hope that this trouble may be overcome, one reason being that the brood fish resulting from eggs shipped from the Madison Valley (Mont.) field two years ago have never been seriously affected by it; another is that the lot of fish experimentally fed on yeast and cod-liver oil continued in good health to the end of the season. Apparently the disorder is local as it has never been known to develop in fingerlings hatched from eggs shipped by the station to other points.

Early in the spring a new and peculiar disease, apparently of nervous origin, broke out among the rainbow-trout fingerlings, not only at the main station but also at the Bourbon auxiliary and at two private hatcheries in Missouri. Strong evidence of the disease was visible in some troughs while in other adjoining troughs there was not the slightest discernible trace of it. It invariably attacked fish of the same size—about 2 inches in length. Its presence was first made evident by a marked restlessness and loss of appetite and within a day or two afterward the slightest disturbance, even the passing of a hand over the trough, would cause the affected fish to go into convulsions, the mouth opening, the gills distending, and the fish pursuing a rapid darting and frequently a turning motion. Within a few seconds thereafter the diseased fish would sink to the bottom of the trough and die. The mouth closed at death and the gills became normal but the body invariably assumed a crescent shape as if the muscles along the lateral line on one side had contracted abnormally. If allowed to run its course, the duration of the disease was from a week to 10 days, terminating fatally. The treatment adopted was to darken the troughs on the first appearance of the trouble, carefully guarding against the slightest disturbance, and discontinue feeding for a period of 36 to 48 hours. At the expiration of that time the covers were carefully lifted and the fish fed lightly on clabbered milk, this diet being continued for two days. In the troughs subjected to this treatment the losses averaged less than 10 per cent, while the rate of mortality in the troughs where nothing was done to check the disease amounted to fully 50 per cent.

In its work with the pondfishes the station was quite successful, its output of fingerlings being more than 10 per cent in excess of the record of any previous year in its history. The importance of this statement is increased by the fact that over half the production consisted of black bass, for which there is such a heavy demand. The output of bass was four times greater than last year's, and exceeded that of any previous year by a substantial margin. The improvement in results, particularly as regards the bass, is attributed to a complete renewal of the brood stock preceded by a period of nearly a year when no bass were in the ponds, the purpose being to break the life cycle of the parasites which have in the past proved such a detriment to the pond work at this station.

Bourbon (Mo.) substation.—Very gratifying results were attained during the third year of operations at this point. A total of 1,304,170 rainbow-trout eggs was collected, nearly three times the total of last year, and its entire cost amounted to only $160.44. On reaching the eyed stage, approximately 748,000 of these eggs were distributed to applicants and to other stations of the bureau, while from the remaining stock nearly 60,000 fingerling fish were produced, more than half of them being 6 inches in length when distributed.

The health of the brood stock of rainbow trout remained good throughout the year, though considerable losses were sustained among the fingerlings owing to the development of crystals in the kidneys. The few parasitic attacks encountered were easily controlled by the application of vinegar baths, but no entirely satisfactory remedy could be found for combating the kidney affection.

Langdon (Kans.) substation.—In the conduct of work at this point greater difficulty than last year was experienced, owing to the larger number of ponds in operation and the scarcity of experienced help, the services of only one trained fish-culturist and two temporary assistants being available. Despite these handicaps and the further fact that climatic conditions during the spawning season of the black bass were unfavorable, the output exceeded last year's and the results were accomplished at a cost of $2.40 less per thousand than last year's cost, which amounted to $32.68. In arriving at this cost, salaries of the statutory employees engaged in the work were not considered.

White Sulphur Springs (W. Va.) Station

[Edw. M. Haynes, Superintendent]

The methods employed in the fish-cultural work at this station did not vary in any essential respect from those of recent years. Three species of trout were handled—brook, rainbow, and Loch Leven—and of these only the rainbow trout originated from eggs produced on the reservation. Because of the heavy mortality invariably experienced in the many attempts that have been made to hold adult brook trout through the reproductive season, it has been found advisable to restrict such work to an experimental basis. During the year all brook trout eggs handled—1,741,000—were secured either by purchase or by exchange for eggs of other species. For several years the station has accomplished quite extensive brook-trout work through cooperation with the West Virginia State authorities, the State purchasing the eggs from commercial fish-culturists and distributing the fry by means of its fisheries car. The bureau's part of the work comprises the incubation of the eggs and the care of the young fish produced until they arrive at a suitable age for liberation in open waters. Such operations during the past year involved the purchase and incubation of 1,041,000 eggs and the distribution of nearly 1,000,000 fingerling fish. Seven hundred thousand brook-trout eggs, received in exchange for those of other species, produced, in round numbers, 450,000 fingerlings. These fish were distributed by the bureau's force.

From the brood stock of rainbow trout carried in the station ponds, 1,200,000 eggs were collected, the spawning season extending from November 10 to the end of January. Of these, approximately 360,000 were shipped in the eyed stage to applicants and to other stations of the bureau. From the retained eggs more than 400,000 fingerling fish were produced and distributed, 63,000 being on hand at the close of the fiscal year. The bureau recently undertook the propagation of Loch Leven trout at this station with the view of providing a substitute for the brook trout in many of the streams of West Virginia where that species was formerly abundant but no longer thrives, owing to changed conditions. With this plan in view, 150,000 Loch Leven eggs were forwarded to the station from the Madison Valley (Mont.) field during the winter. They were of fine quality and produced a large percentage of fry. Three thousand fingerling fish, part of the results of a similar shipment in the preceding year, are being reared for a future brood stock.

An interesting and conclusive feeding experiment was conducted during the spring. A lot of 15,000 rainbow-trout fingerlings was fed on beef heart and fish meal mixed in equal proportions, while another lot, similar in every respect to the first, was maintained on a diet of beef heart solely. When undertaken it was the intention to prolong the test for 60 days, but by the end of the forty-seventh day the fish in lot 1 had become so emaciated and the daily losses were so heavy that it was necessary to abandon the experiment. In the course of the 47 days the increase in the weight of the first lot was only 5.075 pounds, and 1,721 of its number had perished. The control lot had gained 12.3 pounds and the entire loss for the period was only 288 fish. Practically no loss occurred in the first lot until the end of the thirtieth day, after which time the rate of mortality increased rapidly, and when the test was discontinued it had attained the alarming total of 250 fish per day.

Another feeding experiment was made with the view of noting its effect on the quality of the eggs obtained from the brood stock. For some time prior to the spawning season a number of adult rainbow trout were maintained on a mixture of sheep liver and cod-liver oil, while another lot was fed sheep liver alone. The results were in favor of the straight liver diet, the fish thus fed yielding a considerably larger percentage of good eggs than those subsisting on the liver and oil mixture.

The work with the warm-water pondfishes was materially hampered by cold, unseasonable weather during the spring. In an effort to obviate the loss of eggs through the sudden and extreme temperature changes to which this region is peculiarly subject, the adult largemouth bass were transferred from their winter quarters early in March to a pond supplied with a heavy flow of water, the idea being to retard the development of their eggs until all danger of extreme temperature changes would be at a minimum. This measure proved partially successful, though a severe temperature fluctuation occurring as late as May 27 injuriously affected the results.

Wytheville (Va.) Station

[C. B. Grater, Superintendent]

The spawning season of the rainbow trout began on October 19 and closed February 2, the yield of eggs being 965,000. The quality of the spawn was appreciably impaired as a consequence of the very low water supply available for the brood fish during the preceding spring and summer. The condition finally became so acute that it was necessary to transfer them to a series of ponds on a lower level, where more water was available. The effect of this increased flow of water of somewhat higher temperature than customary was to noticeably advance the maturity of the fish and lower the quality of their spawn. On attaining the eyed stage 201,000 of the eggs were shipped on assignment. Less than 38 per cent of the remaining stock hatched, and subsequent losses of fry in process of rearing reduced the output of fingerling fish to 129,600. Late the following May the station received a shipment of 25,000 eggs of wild rainbow trout from the Springville (Utah) field, and the 15,000 fingerlings derived from this stock were on hand at the close of June.

In order to test the efficacy of cod-liver oil and yeast in maintaining the health of fish, 300 adult rainbow trout, equally divided as to sex, were segregated in one of the ponds for some time prior to the spawning season, and were fed a diet of beef heart mixed with these materials in the proportion of 2 parts oil and 4 parts yeast to 100 parts of the heart. That the food is beneficial was clearly shown by the improved results at spawning time, the eggs from the trout used in the experiment being superior to those from the control lot (fed exclusively on beef heart), both as to quality and quantity.

The disease known as Octomitus, prevalent at this station during the two preceding years, made its appearance again, somewhat earlier than usual, and considerable numbers of fingerling fish were lost as a result of its ravages.

With the view of ascertaining the relative value of their spawn, brood rainbow trout of various ages were segregated in different ponds and their eggs developed in separate troughs. The mortality among eggs from 3-year-old and 4-year-old fish did not vary greatly, amounting to 43.3 and 43.61 per cent, respectively. The loss among the 6-year-old fish was 40 per cent, while 57½ per cent of the eggs taken from fish 7 years of age proved worthless.

In addition to its work with the rainbow trout, the Wytheville hatchery incubated 31,000 brown-trout eggs of inferior quality, the product of 900 2-year-old fish held in the station pounds, as well as 400,000 brook-trout eggs purchased from a commercial fish-culturist in Massachusetts. The latter were of an excellent quality yielding a high percentage of fingerling fish.

The outcome of the year's work in the propagation of the warm-water pondfishes was comparatively successful. Besides an output of more than 2,000 advanced fingerling largemouth black bass in the fall of 1924, 232,000 fry and No. 1 fingerling fish of that species were distributed at the close of the year, this stock being the progeny of 250 adult bass that spawned during the spring in a single large pond. The distributions also included limited numbers of rock bass, bream, and catfish.

PONDFISH-CULTURAL STATIONS

The results of the year's work at the seven main stations and five auxiliaries included in this classification were quite satisfactory, the total output exceeding that of the previous season by approximately 343,000 fish. Owing to the impossibility of obtaining an adequate stock of brood black bass, the work with that fish was considerably curtailed at some points. Following is a statement of the aggregate output of these stations, by species, during the fiscal years 1924 and 1925:

Species	1924	1925
Largemouth black bass	1,526,355	1,927,982
Smallmouth black bass	578,385	451,025
Sunfish	292,525	376,625
Crappie	40,841	17,671
Catfish	10,745	17,488
Rock bass	21,425	21,660
Warmouth bass	3,945	5,370

Cold Spring (Ga.) Station

[Chas. A. Bullock, Superintendent]

In the work of propagating the largemouth black bass it is the practice at this station to collect all brood fish at the close of a breeding season and store them in ponds until the approach of the next spawning period in February. This makes it possible to allow all the other ponds on the reservation to remain dry for approximately six months of the year, thus tending to correct any acidity of the soil, check a too abundant plant growth, and eliminate destructive beetles and other carnivorous aquatic insect life.

In advance of the spawning season steps were taken to supplement the supply of brood bass with wild adults from local waters, and a sufficient number were secured to stock three breeding ponds. Spawning began on March 20, about 10 days later than usual, the delay being due to cool weather occurring throughout January and February. There was an absence of sudden changes in temperature and heavy electrical storms while the fish were nesting, these favorable conditions, together with the improved quality of the brood stock, making possible a marked increase in production, the output for the year consisting of 400,495 fry and fingerling bass, 20,000 of which were still on hand at the end of June. The highest record previously attained in the bass work in this field was in 1893, when 271,000 were distributed.

To facilitate the work of collecting bass fry from the ponds for distribution, a decidedly novel scheme was resorted to. Every pondfish-culturist is familiar with the fact that it is very hard to locate schools of young bass in the ponds when the weather is windy. In an effort to overcome this difficulty a small quantity of menhaden fish oil was sprinkled on the surface of the pond and proved quite effectual, the water within a short time becoming smooth and quiet and remaining in that condition for about 15 minutes.

Harris Ponds (*Ga.*) *substation.*—Work in this field is confined to the propagation of bream and catfish, and while the demands for the former are constantly increasing, thus far it has been possible to keep pace with them. The ponds are drawn late in the summer and the fingerling fish transferred to the main station for convenience in distributing them to applicants.

Edenton (N. C.) Station

[W. S. Vincent, Superintendent]

The enlarging and improving of the pond system at this station during the fall of 1924 enabled the bureau to produce the largest number of largemouth black bass in its history in the spring of 1925. The brood fish, obtained from local waters, were large, many of them weighing from 5 to 6 pounds, hence their ability to produce eggs was at its maximum. Several of the schools of fry were counted and were found to contain from 10,000 to 15,000 each. During May and the first part of June 155,450 advanced fry and fingerling fish were gathered from the ponds and supplied to applicants. Shortly before the middle of June the weather became so warm and the difficulty of tempering the water for the shipment of fish so great that the distribution work had to be postponed to await more favorable conditions. In addition to largemouth bass, sunfish, crappie, and warmouth bass were produced in small numbers.

Louisville (Ky.) Station

[C. W. Burnham, Superintendent]

The spawning season of the pondfishes handled at this station opened on April 12, about 10 days earlier than usual, eggs of the smallmouth bass being discovered on that date. In the course of the season several periods of cold weather intervened, but there was nothing to indicate that either the eggs or the fry were injured by it. The output of largemouth bass was small, as only a small brood stock of that species was available for the work. Three hundred and fifty adult fish constituted the brood stock of smallmouth bass, about one-third of which were obtained from Lake Erie with the consent of the Ohio fisheries authorities. It was originally planned to secure 300 from that source, but the demands of other stations had to be met also and the total supply was comparatively small. The season's output of young fish of this species consisted of 420,000 fry and 2,725 fingerlings.

Heretofore it has been customary, as soon as the bass were removed from the ponds, to use part of the space thus occupied for the propagation of bream. However, in view of the fact that the number of bream produced in this way exceeded the demand for them, the work with that species last season was limited to a single pond. The station also produced a small number of rock bass for distribution.

Mammoth Spring (Ark.) Station

[Dell Brown, Superintendent]

The stock of brood smallmouth black bass on hand at the opening of spring was supplemented late in April by the acquisition of 92 adults transferred from Lake Erie waters. The fish began nesting on March 26, and spawning occurred daily for some time thereafter. It was soon discovered, however, that the nests contained very few eggs and that in every instance they were being deserted by the parent fish. The reason for this unnatural action has not been determined, but it is thought to have been caused in part, at least, by blasting operations going on at the time in the vicinity of the station. At the close of the fiscal year only 28,300 fry and fingerling bass had been produced from the entire brood stock of 416 fish.

Somewhat better results were attained in the work with the largemouth bass, though it was apparent that they, too, were greatly disturbed by the heavy explosions. Many nests were seen in the ponds, but only 20 of them contained live fry. The output from these amounted to 77,135 No. 1 fingerlings. In addition to the work with the black bass, limited numbers of rock bass, bream, catfish, and crappie were produced and distributed.

Orangeburg (S. C.) Station

[G. W. N. Brown, Superintendent]

The nesting of black bass began on February 14, earlier than in any previous year in the history of the station, and was prolonged almost to the middle of June. A very unusual occurrence—at least it has never before been noted in connection with the work here—was the breaking up of several schools of young bass before they had attained the advanced fry stage. This is believed to have been due to the severely cold weather which occurred shortly after the eggs hatched, causing the parent fish to abandon the schools. The same thing was observed at other pond stations of the bureau last season. The station's output of bass for the year consisted of 107,500 fry and 265,055 fingerlings from 1 to 4 inches in length. Deliveries were made to applicants in North Carolina, South Carolina, and Georgia, and the Edisto River at Orangeburg was stocked. In addition to the above, limited numbers of sunfish, warmouth bass, crappie, and catfish were produced and distributed to applicants.

San Marcos (Tex.) Station

[Mark Riley, Superintendent]

Six species of fish were handled at this station, the most important being the black bass. Owing to an inadequate brood stock, both as to number and size, and to the occurrence of high winds during the height of the spring distributing season, making it impossible to capture many of the schools of young fish before they dispersed in the ponds, the output of black bass was below the average. The year's distribution amounted to 224,861 fingerlings ranging in size from No. 1 to No. 9. In addition to the station output of pondfishes, considerable numbers of black bass and sunfish were produced in Kerrville, Medina Lake, and New Braunfels, Tex., at which places the bureau is cooperating with the municipal authorities in the conduct of pondfish-cultural work.

A prolonged drought, the most enduring in the history of the State, caused the evaporation of the water in practically all ponds and tanks in the region, and even some of the larger streams were reduced to mere chains of isolated pools. Taking advantage of the opportunity offered by these conditions, the station seined the stagnant and rapidly disappearing waters and transferred the fish collected therein to running streams, thus accomplishing a larger amount of salvage work than has ever before been possible in the history of the station.

Within recent years the distributions of crappie from the San Marcos station have been considerably increased by drawing upon the stock of young crappie produced in privately owned ponds. These inclosures were originally stocked by the bureau with the understanding that the station would be allowed to draw upon them to a reasonable extent in supplying the public demands for crappie. Because of the drought and the consequent failure of this source of supply, there was a very limited output of this species during the year.

An assignment of rainbow-trout eggs, transferred from the Saratoga (Wyo.) station, and one of steelhead salmon, shipped from one of the Oregon substations, were received during the spring and incubated at Medina Lake. In each case considerable losses were sustained in the egg and fry stages, though enough survived to justify the experiment. Of the few thousands of these fish thus far planted locally, many are known to be doing well in the swift waters of the Medina River, just below the large dam.

Tupelo (Miss.) Station

[C. R. Wiant, Superintendent]

By means of stocks of wild fish obtained from local ponds and streams during the late summer and fall of 1924, the station's brood stock of large-mouth black bass was increased to 500 fish, ranging in weight from 1 to 5 pounds. At the approach of the spawning season the fish were apportioned in four ponds, according to size. Three hundred and forty of the larger ones were divided between two ponds covering an area of 2.38 acres; 110 fish, ranging from 1 to 2 pounds in weight, were installed in a pond slightly larger than two-thirds of an acre, while the remaining 50, averaging about 1 pound each, were placed in a shallow pond abundantly stocked with aquatic vegetation. Very few, if any, returns were expected from the latter pond. However, these fish and those in the pond next in size were the first to begin spawning. The segregation of the fish according to size proved of material advantage in the work, since thereby the fry came on in two periods, allowing time for the entire collection and distribution to be made by the station force, and as soon as the fry season was over in the ponds where spawning first occurred it was possible to seine them for fingerling fish without endangering the nests of the late spawners. The distribution of young bass from the four ponds during the fiscal year aggregated 430,000 advanced fry and 137,205 fingerlings.

A fairly successful season was experienced in the propagation of sunfish. The distribution of this fish was undertaken on September 9, and in the course of the fall 73,375 fingerlings were delivered, supplying 205 applicants in various parts of Mississippi and Alabama. Small distributions of crappie, rock bass, and catfish were also made.

Lakeland (Md.) Ponds Substation

[Supervised by Washington office of fish culture]

This pond system, located about 8 miles from the city of Washington, was leased by the Bureau of Fisheries in the spring of 1923. Early in the spring of 1924 two of the ponds—Nos. 1 and 3—were stocked with adult largemouth black bass obtained from the Potomac River, and a third pond, known as No. 2, was stocked with brood crappie transferred from the Edenton (N. C.) station. As a result of such stocking 47,376 black bass from 2 to 6 inches in length and 14,595 fingerling crappie were collected for distribution to applicants in the fall of 1924.

An interesting feature of the work was the growth attained by all of the fingerling fish, especially the black bass. On June 17, 1924, 3,000 No. 1 fingerling largemouth bass were transferred from pond No. 3 to pond No. 5, which has no connection with other ponds of the series. This pond was drained early in October and approximately 1,900 fish from 4 to 6 inches long were secured from it.

During the spring of 1925 the ponds were again stocked with largemouth bass and crappie, as well as smallmouth bass and bream.

CENTRAL STATION AND AQUARIUM, WASHINGTON, D. C.

[L. G. Harron, Superintendent]

The maintenance of the aquarial exhibit at central station was more than ordinarily successful, due to the decreased use of chlorine in the city water supply. During the year 1,980 specimens of fish and marine animals, representing 36 species, were on display, while in the small exhibit hatchery eggs of the brook trout, rainbow trout, whitefish, cisco, shad, and yellow perch, all of which were shipped from the bureau's stations, were incubated, and the resulting fry retained for a time. The supply of live fish was replenished as necessary from collections made at La Crosse, Wis., the Potomac River, and the Lakeland ponds. A fine display of adult brook trout and rainbow trout was received from the White Sulphur Springs (W. Va.) station, and the Bozeman (Mont.) station contributed a small number of adult grayl ng and black-spotted trout.

During the spring considerable trouble was experienced from the parasite *Ichthyophthirius* in the aquarium tanks, and before its ravages could be checked it occasioned a heavy loss of fish. It was finally eradicated through the use of strong solutions of lime water in the tanks, and by the end if June all surviving fish were well on their way to recovery.

Part 2.—DISTRIBUTION OF FISH AND FISH EGGS

[E. C. Fearnow, Superintendent of Fish Distribution]

The 5,301,862,583 fish and fish eggs comprising the net output of the hatcheries and rescue stations operated by the Bureau of Fisheries during the fiscal year 1925 were widely disseminated, distributions being made in practically every State in the Union, the Territory of Alaska, and the Canal Zone. Approximately 90 per cent of the output consisted of commercially important fish, such as the salmons, whitefish, pike perch, shad, yellow perch, lake trout, cod, pollock, haddock, flounder, buffalo fish, and carp. Such species are planted in waters in the vicinity of the hatcheries or near the source of egg supply, with the exception of a comparatively small number used for stocking waters where natural conditions appear to be favorable for the development of new fisheries. They are not supplied to applicants for the stocking of private waters. Under the head of commercial species are included the many food fishes annually salvaged from overflowed areas along the Mississippi River.

Among the important species propagated for stocking waters of the interior are the brook trout, rainbow trout, black-spotted trout, largemouth black bass, smallmouth black bass, rock bass, sunfish, crappie, and catfish. This branch of the bureau's work brings it into close relation with the general public, as is evidenced by the large number of applications submitted every year. In the course of the fiscal year 1925, 10,400 applications were filled and the bureau made about 1,800 plants in public waters on its own initiative, bringing the total number of assignments to 12,200, or 200 more than were made in 1924. The Izaak Walton League and various fisheries organizations during the past year submitted an unusually large number of applications, and in view of the large membership interested in the distribution of fish the allotments were liberal.

Summary, by species, of distribution of fish, fiscal year 1925

State and species	Number	State and species	Number
Alabama:		Arkansas:	
Catfish	3,400	Catfish	385
Crappie	10,600	Rainbow trout	7,751
Largemouth black bass	249,375	Crappie	5,500
Sunfish	94,800	Largemouth black bass	94,550
Yellow perch	450	Smallmouth black bass	27,300
Alaska: Sockeye salmon	7,300,000	Rock bass	14,700
Arizona:		Sunfish	22,720
Catfish	150	Yellow perch	525
Steelhead salmon	23,500	California: Chinook salmon	4,042,300
Loch Leven trout	22,500	Colorado:	
Lake trout	57,000	Rainbow trout	25,536
Brook trout	48,500	Black-spotted trout	751,517
Largemouth black bass	555	Loch Leven trout	44,000
Sunfish	700	Brook trout	4,526,536

Summary, by species, of distribution of fish, fiscal year 1925—Continued

State and species	Number
Connecticut:	
Shad	500,000
Rainbow trout	8,900
Loch Leven trout	320
Brook trout	32,700
Largemouth black bass	400
Pike perch	640,000
Yellow perch	150
Delaware:	
Crappie	300
Largemouth black bass	2,561
District of Columbia:	
Shad	600,000
Rainbow trout	1,500
Georgia:	
Catfish	4,700
Steelhead salmon	18,680
Rainbow trout	21,000
Brook trout	19,000
Crappie	50
Largemouth black bass	224,865
Rock bass	2,200
Sunfish	57,613
Idaho:	
Catfish	60
Chinook salmon	2,117,500
Rainbow trout	1,416,300
Black-spotted trout	167,000
Lake trout	1,600
Brook trout	35,850
Graylings	4,877,029
Illinois:	
Catfish	347,550
Buffalo fish	235,500
Carp	709,975
Rainbow trout	5,000
Pike and pickerel	11,745
Crappie	1,811,866
Largemouth black bass	15,721
Sunfish	540,455
Miscellaneous fishes	479,536
Indiana:	
Catfish	5,570
Carp	125
Rainbow trout	8,600
Brook trout	53,500
Crappie	8,025
Largemouth black bass	10,410
Smallmouth black bass	119,500
Rock bass	100
Sunfish	13,550
Yellow perch	3,125
Iowa:	
Catfish	4,323,042
Buffalo fish	2,498,600
Carp	2,187,750
Rainbow trout	18,804
Loch Leven trout	2,000
Brook trout	31,250
Pike and pickerel	55,193
Crappie	1,714,399
Largemouth black bass	39,305
Smallmouth black bass	500
Sunfish	1,559,652
Pike perch	299
Yellow perch	47,890
White bass	360
Miscellaneous fishes	1,417,409
Kansas:	
Catfish	600
Crappie	600
Largemouth black bass	2,200
Rock bass	200
Sunfish	11,900
Kentucky:	
Largemouth black bass	1,900
Smallmouth black bass	166,500
Rock bass	575
Sunfish	11,500
Louisiana:	
Catfish	675,000
Buffalo fish	13,142,100
Carp	651,000
Pike and pickerel	995
Crappie	227,300
Largemouth black bass	11,085
Sunfish	98,600
Yellow perch	100
White bass	100
Miscellaneous fishes	403,600
Maine:	
Atlantic salmon	1,422,500
Landlocked salmon	970,880
Rainbow trout	1,200
Loch Leven trout	480
Lake trout	30,450
Brook trout	1,172,148
Smallmouth black bass	6,095
Winter flounder	1,884,436,000
Maryland:	
Shad	8,967,602
Rainbow trout	24,800
Loch Leven trout	2,100
Brook trout	108,350
Crappie	2,268
Largemouth black bass	4,570
Rock bass	4,475
Sunfish	11,300
Yellow perch	17,212,245
Massachusetts:	
Steelhead salmon	28,080
Landlocked salmon	11,000
Rainbow trout	45,355
Brook trout	136,500
Mackerel	2,517,000
Smallmouth black bass	9,700
Cod	462,712,000
Haddock	24,511,000
Pollock	222,890,000
Winter flounder	728,500,000
Michigan:	
Catfish	6,500
Whitefish	26,850,000
Steelhead salmon	40,500
Landlocked salmon	10,000
Rainbow trout	100,800
Lake trout	28,426,500
Brook trout	1,054,720
Crappie	3,325
Largemouth black bass	11,030
Smallmouth black bass	11,925
Sunfish	10,115
Pike perch	2,600,000
Yellow perch	1,650
Minnesota:	
Catfish	2,882,560
Buffalo fish	95,245
Carp	3,438,015
Steelhead salmon	24,000
Rainbow trout	90,355
Loch Leven trout	15,500
Lake trout	2,241,500
Brook trout	182,800
Pike and pickerel	80,079
Crappie	9,208,698
Largemouth black bass	119,203
Sunfish	8,976,865
Pike perch	1,341,285
Yellow perch	167,505
White bass	1,865
Fresh-water drum	14,590
Miscellaneous fishes	93,500
Mississippi:	
Catfish	200
Crappie	11,000
Largemouth black bass	520,035
Rock bass	150
Warmouth bass	538
Sunfish	41,975

Summary, by species, of distribution of fish, fiscal year 1925—Continued

State and species	Number
Missouri:	
Catfish	9, 145
Rainbow trout	148, 852
Crappie	9, 275
Largemouth black bass	37, 720
Rock bass	2, 800
Sunfish	70, 742
Yellow perch	564
Montana:	
Catfish	360
Rainbow trout	635, 000
Black-spotted trout	1, 497, 000
Loch Leven trout	113, 711
Lake trout	7, 500
Brook trout	987, 460
Crappie	50
Largemouth black bass	2, 600
Sunfish	330
Yellow perch	600
Nebraska:	
Catfish	300
Rainbow trout	34, 850
Brook trout	81, 250
Largemouth black bass	2, 278
Nevada:	
Rainbow trout	30, 000
Brook trout	31, 500
Crappie	2, 200
Sunfish	2, 250
New Hampshire:	
Landlocked salmon	6, 400
Rainbow trout	78, 150
Loch Leven trout	800
Lake trout	9, 500
Brook trout	422, 208
Largemouth black bass	3, 780
Smallmouth black bass	9, 000
Pike perch	660, 000
New Jersey:	
Rainbow trout	3, 000
Brook trout	1, 500
Crappie	225
Largemouth black bass	4, 620
Smallmouth black bass	600
Sunfish	225
New Mexico:	
Catfish	225
Rainbow trout	400
Black-spotted trout	41, 300
Brook trout	46, 500
Crappie	870
Largemouth black bass	1, 325
Rock bass	350
Sunfish	2, 600
New York:	
Whitefish	36, 700, 000
Cisco	118, 900, 000
Landlocked salmon	17, 240
Rainbow trout	38, 345
Lake trout	277, 000
Brook trout	624, 700
Crappie	1, 400
Largemouth black bass	2, 790
Smallmouth black bass	92
Pike perch	6, 500, 000
Yellow perch	4, 400, 000
Winter flounder	24, 115, 000
North Carolina:	
Shad	480, 000
Glut herring	92, 000, 000
Steelhead salmon	8, 350
Rainbow trout	45, 800
Loch Leven trout	6, 890
Brook trout	286, 700
Crappie	2, 165
Largemouth black bass	181, 830
Smallmouth black bass	225
Rock bass	17, 250
Warmouth bass	20
Sunfish	19, 090
Yellow perch	1, 000, 331
North Dakota:	
Catfish	10, 650
Crappie	14, 900
Largemouth black bass	3, 280
Sunfish	10, 000
Ohio:	
Catfish	627
Buffalo fish	6, 870
Carp	31, 500, 000
Whitefish	109, 080, 000
Rainbow trout	150
Brook trout	4, 000
Crappie	3, 450
Largemouth black bass	9, 470
Smallmouth black bass	223, 088
Sunfish	13, 380
Pike perch	63, 140, 000
Yellow perch	19, 969, 200
Oklahoma:	
Catfish	1, 170
Crappie	3, 310
Largemouth black bass	7, 610
Rock bass	900
Sunfish	24, 150
Oregon:	
Chinook salmon	10, 828, 000
Silver salmon	2, 081, 000
Sockeye salmon	46, 700
Steelhead salmon	474, 000
Landlocked salmon	9, 100
Brook trout	65, 000
Silver trout	100, 000
Pennsylvania:	
Catfish	3, 684
Steelhead salmon	292
Rainbow trout	187, 550
Loch Leven trout	54, 900
Brook trout	753, 474
Crappie	12, 215
Largemouth black bass	12, 810
Smallmouth black bass	6, 000
Rock bass	300
Sunfish	11, 170
Yellow perch	100
Rhode Island: Largemouth black bass	2, 000
South Carolina:	
Catfish	225
Rainbow trout	32, 600
Brook trout	23, 250
Crappie	50
Largemouth black bass	340, 240
Rock bass	1, 000
Warmouth bass	110
Sunfish	11, 240
South Dakota:	
Catfish	3, 000
Steelhead salmon	54, 600
Rainbow trout	52, 850
Loch Leven trout	347, 400
Brook trout	860, 900
Crappie	4, 150
Largemouth black bass	6, 000
Sunfish	3, 200
Yellow perch	810
Tennessee:	
Steelhead salmon	462
Rainbow trout	80, 912
Loch Leven trout	1, 040
Brook trout	33, 400
Crappie	800
Largemouth black bass	81, 350
Rock bass	2, 100
Sunfish	1, 400
Texas:	
Catfish	8, 140
Steelhead salmon	2, 800
Crappie	700
Largemouth black bass	298, 613
Smallmouth black bass	1, 000
Rock bass	85

Summary, by species, of distribution of fish, fiscal year 1925—Continued

State and species	Number	State and species	Number
Texas—Continued.		Washington—Continued.	
Warmouth bass	3,425	Black-spotted trout	24,000
Sunfish	103,010	Brook trout	147,800
Utah:		West Virginia:	
Catfish	600	Rainbow trout	169,725
Rainbow trout	416,050	Loch Leven trout	74,650
Black-spotted trout	56,000	Brook trout	895,600
Brook trout	359,300	Crappie	1,425
Vermont:		Largemouth black bass	5,125
Steelhead salmon	13,200	Sunfish	950
Landlocked salmon	11,826	Wisconsin:	
Rainbow trout	500	Catfish	6,020,040
Lake trout	171,378	Buffalo fish	845,615
Brook trout	497,971	Carp	3,972,600
Smallmouth black bass	5,802	Rainbow trout	271,100
Pike perch	31,900,000	Loch Leven trout	37,800
Yellow perch	24,200,000	Lake trout	1,910,000
Virginia:		Brook trout	1,197,000
Catfish	1,282	Pike and pickerel	561,065
Shad	6,611,069	Crappie	3,820,235
Rainbow trout	142,250	Largemouth black bass	119,775
Loch Leven trout	2,450	Sunfish	2,154,380
Brook trout	175,150	Pike perch	9,460,000
Crappie	2,900	Yellow perch	330,050
Largemouth black bass	313,440	White bass	2,100
Rock bass	13,375	Fresh-water drum	5,000
Sunfish	13,165	Miscellaneous fishes	1,302,450
Yellow perch	17,208,845	Wyoming:	
Washington:		Catfish	825
Chinook salmon	28,225,200	Rainbow trout	156,000
Chum salmon	16,051,650	Black-spotted trout	3,824,100
Silver salmon	11,894,289	Loch Leven trout	57,800
Sockeye salmon	24,615,000	Brook trout	635,580
Humpback salmon	10,892,500	Largemouth black bass	5,700
Steelhead salmon	763,300	Sunfish	1,920
Rainbow trout	16,000		

METHOD OF DISTRIBUTION

Upon receipt of a request for fish, the bureau furnishes a blank form calling for a complete description of the waters to be stocked. After it has been properly filled out and returned, with the indorsement of a Member of Congress, the bureau endeavors to assign a suitable species of fish to be delivered as soon as a supply is available. As the information given on the application is used as a basis for determining what species should be assigned, applicants should endeavor to give as accurate descriptions as possible.

Applicants should confine their choice of fish to species that are indigenous to the waters of the region concerned. Many of the State fish and game authorities have requested that all applications for nonindigenous or predacious fishes be submitted to them for consideration, a policy with which the bureau is in full accord, and all such applications, including those for carp, are referred to the proper State officials before they are accepted. Even with the State's approval, the bureau reserves the right to exercise its own discretion in allotting fish.

Every species of fish reproduces at a particular season of the year. Brook trout and the domesticated rainbow trout spawn in eastern waters in the fall or early winter; the black-spotted trout, steelhead, and wild rainbow trout of western waters spawn in the spring, while all of the so-called warm-water pondfishes do so in the spring or early summer.

With the exception of a comparatively few brook and rainbow trout, which are held until they have attained the fingerling, or yearling stage, each species is distributed as soon as the fish have attained a suitable size for shipment; and after a season's supply has been exhausted no more are available for a year. In the Eastern States, trout are distributed between March and the last of June, while in the Rocky Mountain States the distribution usually begins in July and extends to about October 1.

The basses, bream, and other pondfishes are distributed within from one week to several months after they are hatched, the last lots of bass shipped usually ranging from 4 to 6 inches in length, while the sunfish range from 2 to 4 inches long. Such commercial species as the whitefish, cod, and pike perch, which are hatched in great numbers, are necessarily distributed as fry.

Immediately upon the receipt of a request, the applicant is notified concerning the species assigned him and as to the approximate date when the fish can be delivered. Just prior to the shipment a second notice is sent, usually by wire, stating the exact time the fish will arrive at the railroad station named in the application. On account of the comparatively heavy cost of shipping fish to distant points, such trips are postponed until a sufficient number of applications from a given section have accumulated to warrant the expense of making a shipment.

In making a distribution, the fish are usually sent out in the bureau's fisheries cars which are stationed at some central railroad point in a given section, while deliveries by messengers are made to applicants living at some distance off the main line. The messengers travel in the baggage cars of regular passenger trains and deliver the fish at destination as the train makes its regular stops. Delivery is made to the applicant's railroad station without expense to him, but he is required to furnish containers for transporting the fish to the waters to be stocked. The bureau's cans can not be lent for this purpose, since the cars and messengers must proceed at once to other points.

DISTRIBUTION OF FISHES OF INTERIOR WATERS

CAR NO. 3

[E. R. Widmyer, Captain]

The distribution of warm-water fishes from the La Crosse (Wis.) substation was taken up on July 12, and between that time and the close of the Mississippi River operations on the 4th of December, 266,185 fingerling fish were delivered to applicants, the work involving both car trips and messenger shipments and extending into the States of Wisconsin, Minnesota, Iowa, Ohio, Illinois, North Dakota, and South Dakota. Early in January the car was placed in the shops of the Chicago, Milwaukee & St. Paul Railway Co. at Milwaukee, Wis., and while undergoing annual repairs an electrically driven air compressor was installed.

For the purpose of relieving overcrowded conditions in the La Crosse hatchery during the latter part of March, the car transferred 153,000 rainbow trout from La Crosse to Lynxville, Wis. On April 1 it carried a load of trout from La Crosse to Homer, Minn., and after

Fig. 7.—Hauling fish on a hand car, Cedar Island Lodge, Brule, Wis.

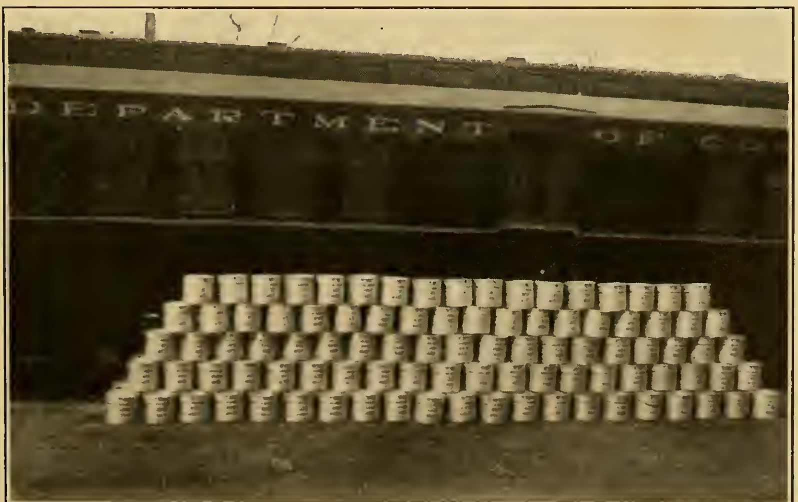

Fig. 8.—Transportation equipment of car No. 3

making a shipment of trout from that point to Eau Claire, Wis., it proceeded to Duluth to take up the season's distribution of whitefish, pike perch, and trout from the Duluth station. This work was in progress from April 26 to June 20 and included the shipment 1,100,000 whitefish, 13,000,000 pike perch, and 10,848,500 lake trout, all in the fry stage, as well as 189,000 fingerling brook trout and 29,000 steelhead-salmon fingerlings.

In moving truckloads of fish from the hatchery to the railroad station and boat wharves care was taken to avoid carrying only partial loads, and the shipment of the fish was so planned that in transporting several species to a given section the work might be accomplished without duplication of trips except in cases where very heavy consignments were to be delivered. One messenger carried 60 pails of brook trout in a single baggage-car shipment. The very successful and economical results attained in this distribution work were made possible in large measure by the close cooperation afforded by the Chicago, Milwaukee & St. Paul and the Minneapolis, St. Paul & Sault Ste.Marie Railway Cos.

During the fiscal year ended June 30, 1925, Car No. 3 traveled 11,742 miles and delivered 25,166,500 fish.

CAR NO. 4

[JAMES L. GARDNER, Acting captain]

At the opening of the fiscal year Car No. 4 was engaged in the shipment of black bass from the Lakeland (Md.) ponds, and during the first week in July it distributed from these ponds 12,200 fingerling fish. On July 7 the car was ordered to the White Sulphur Springs (W. Va.) station to make carload shipments of trout to Elkins, W. Va., and Williamsport, Pa. On the completion of this work it proceeded to La Crosse, Wis., to assist in the distribution of miscellaneous river fishes from the upper Mississippi River rescue stations. In connection with this work the car made trips to Watersmeet, Mich., Green Bay, Wis., Fort Wayne, Ind., and Harrisburg, Pa., returning from the latter point to Washington, D. C. In its work in the rescue field the car transported 87,745 fingerling and adult fish.

During October the car distributed from the Lakeland (Md.) ponds 46,420 miscellaneous pondfishes ranging in size from fingerlings to adults, and from the White Sulphur Springs (W. Va.), station it distributed 31,000 brook and Loch Leven trout. During the months of November and December it was stationed at Washington, D. C., where it was used as living quarters for the car-service employees on detail in the Washington office of the bureau.

On January 6 the car was taken to the plant of the American Car & Foundry Co. at Wilmington, Del., for annual repairs. On the completion of this work, late in January, it returned to Washington and was again used as living quarters for its crew until the middle of March, when it proceeded to Wytheville, Va., and received a load of 150,250 fingerling trout. Returning on March 26 to Washington, the car made plants of fish en route and by messenger shipments on its arrival there. Soon afterward it left for Erwin, Tenn., and took up the distribution from the hatchery at that point, making nine carload trips and a number of detached messenger shipments and carrying a total of 532,727 trout, bass, and bream for delivery to applicants in

Tennessee, Virginia, North Carolina, South Carolina, Georgia, and Pennsylvania. The shipment of fingerling black bass, rock bass, and bream in connection with the trout distribution effected a considerable saving of funds.

On May 8 the car arrived at White Sulphur Springs, W. Va., where it received 54,950 fingerling trout for distribution to applicants in central Pennsylvania. From Pennsylvania it proceeded to Bucksport, Me., via Nashua, N. H., receiving at Nashua 60,940 trout and landlocked salmon for delivery to applicants in the southwestern section of Maine. It arrived at Bucksport on May 23, and took up the distribution from the Craig Brook (Me.) station on May 27. Four carload trips and a number of detached messenger shipments with brook trout and landlocked salmon were made, also six carload trips with Atlantic salmon. In the course of the work from this station the car and its messengers covered practically all of the State of Maine and distributed a total of 3,202,145 salmon and trout.

During the year the car traveled 14,266 miles, made 32 trips, delivered or planted 4,188,801 fish, and filled 1,500 applications.

CAR NO. 7

[E. M. Lamon, Captain]

Car No. 7 was engaged in the shipment of fish from the upper Mississippi River collecting stations between September 29 and the end of November, during which time it distributed 114,100 bass and miscellaneous fishes suitable for pond culture to applicants in Wisconsin, Michigan, Iowa, Pennsylvania, Kentucky, Mississippi, Alabama, and Nevada. At the close of the rescue work the crew of the car was detailed for duty during the winter at fish-cultural stations of the bureau, and in February it was placed in the shops of the Chicago, Milwaukee & St. Paul Railway Co. for annual repairs. In the course of this work it was outfitted with an electrically driven air compressor, which has given such satisfaction that except in times of emergency the use of the steam-driven compressor can be entirely dispensed with and a considerable saving in fuel effected thereby.

About the middle of April the car took up the distribution of trout from the Manchester (Iowa) station, leaving there on April 16 with a load of fish for applicants in northern Wisconsin. After completing this trip the car obtained a load of 300,000 brook trout from the Cedar Island Lodge hatchery at Brule, Wis., and distributed them to applicants in the vicinity of Fond du Lac, Wis. It then proceeded to La Crosse, and between April 25 and May 16 distributed from the hatchery at that point 497,800 brook trout, 51,900 Loch Leven trout and 177,100 rainbow trout, delivering them to applicants in Wisconsin and Minnesota.

On completion of the La Crosse distribution the car resumed its work from the Manchester station, making carload shipments of trout to Madison and Milwaukee, Wis. It then obtained 40,500 young rainbow trout from the Lincoln Park Aquarium at Chicago, Ill., and distributed them in Wisconsin. Returning to Manchester it made a trip with trout to Minocqua, Wis., and then proceeded to Dubuque, Iowa. About this time the work at Manchester was brought to an abrupt close, the destructive flood which occurred on the night of

June 14 liberating all fish on hand at the station. On June 28 the car left Dubuque to take up the distribution of trout from the Bozeman (Mont.) station.

Car No. 7 traveled 11,335 miles in the course of the fiscal year, made 16 trips, and distributed 1,905,800 fingerling fish.

CAR NO. 8

[E. K. Burnham, Captain]

During the fiscal year 1925 this car distributed fish from stations located at Neosho, Mo., Langdon, Kans., and Leadville, Colo., and assisted in the shipments from the upper Mississippi River field. In connection with its work it entered 10 States, traveled 9,615 miles, made 18 carload trips over 8 trunk-line railroads, and distributed 2,627 cans of fish to 471 applicants. The numbers and species of fish handled in its work are shown in the following table:

	Fingerlings	Yearlings		Fingerlings	Yearlings
Brook trout	2,603,000		Crappie	6,000	
Rainbow trout		3,200	Bream	51,300	
Black-spotted trout	549,000		Yellow perch		45
Steelhead salmon	22,500		Catfish	5,098	
Lake trout	51,000		Rock bass	1,300	600
Loch Leven trout	38,500				
Black bass	11,230		Total	3,338,928	3,845

In January this car was placed in the shops of the Denver & Rio Grande Western Railroad Co., at Denver, Colo., for annual repairs, which consisted of painting the exterior surface, generally overhauling its trucks, and installing a hard-maple floor throughout. The crew made minor repairs to the interior of the car, changing its air, steam, and water pipe systems so that an even pressure might be maintained in all cans of fish. Its piping was also made self-draining to minimize the danger from freezing, and its capacity was increased to carry 20 additional fish pails, making its normal load 120 pails and seventy 10-gallon cans.

CAR NO. 9

[H. F. Johnston, Captain]

The distribution work of this car for the fiscal year 1925 began on July 22, when it left the Homer (Minn.) station with a miscellaneous load of river fishes for delivery to applicants in Nebraska, Wyoming, and Montana, en route to its destination at Bozeman, Mont. The distribution work from the Bozeman station extended from July 28 to October 13 and included the shipment of 1,609,710 trout of five species and their delivery in three States.

The annual repairs to this car were made in February by the American Car & Foundry Co. at Wilmington, Del., and included numerous changes, the more important being the rearrangement of the dining room and the construction of lockers for the storage of the aerating equipment when not in use. The covers of the lockers were upholstered, making very comfortable seats. During the month of March the crew changed the aerating apparatus to handle 250

Fearnow pails, which number was added to the carrying equipment of the car.

Between April 1 and June 25 this car was occupied in distributing trout from the Wytheville (Va.) and White Sulphur Springs (W. Va.) stations and in rendering assistance to the State of Maryland. These distributions were made in Pennsylvania, Virginia, West Virginia, Maryland, and New York.

In consequence of a 12-hour delay en route from the White Sulphur Springs station with a full load of trout, and later on for a period of 8 hours with half a load, the electrically driven air compressor of this car was in continuous operation without weakening the batteries to any appreciable extent. This practical test demonstrates that it will seldom be necessary to use the steam-controlled air compressors.

In the course of the year car No. 9 traveled 22,825 miles, making 31 trips and supplying 1,173 applicants. It entered 11 States and carried a total of 2,933,568 trout and 29,588 miscellaneous river fishes.

NUTRITIVE VALUE OF FISH AND SHELLFISH[1]

CONTENTS

[1] Appendix X to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 1000. Technological contribution No. 27.

INTRODUCTION

During recent years knowledge of the nutritive value of foods has been widely expanded. The great importance of proper diet in promoting the right kind of growth and in maintaining life and health at their best is now realized. It is generally believed that the food supply as a whole should furnish (*a*) enough digestible organic foodstuffs to meet the body's needs for energy, (*b*) enough protein of suitable sorts to supply all needs for essential amino acids, (*c*) sufficient mineral constituents in the right proportions, and (*d*) enough of the various kinds of vitamins.

The main bulk of most of the staple foods consists of the following groups of substances: Carbohydrates, fats, proteins, minerals, and vitamins. With the exception of carbohydrates, which are practically lacking, all of these substances are known to be abundantly present in fish and shellfish.

It was for the purpose of summarizing present knowledge regarding the nutritive value of these substances and the general subject of the composition of fish and shellfish that this document was prepared. The various chapters comprising it were prepared by scientists well qualified to write upon the subject. These papers show that fish and shellfish furnish an excellent supply of very valuable proteins and fats and, as a source of certain vitamins and minerals, they are of great importance.

HARRY R. BEARD,
Chief Technologist.

I.—CHEMICAL COMPOSITION OF FISH AND SHELLFISH

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HARVESTS FROM THE SEA, LAKES, AND RIVERS

Not only the land but the sea, lakes, and rivers as well provide mankind with crops of food. In some ways—for example, in the matter of the dependence of animal life upon green plants—land and water are alike. On the other hand, there is a fundamental difference between gathering crops on land and gathering them from the water. Plant and animal products derived from agriculture are produced under the control of man and are still capable of being increased by the use of more land whenever the demand warrants such a course. Aquatic harvests, however, are neither planted by man nor cultivated by him, nor does he exercise much, if any, control over them.

The sea is not merely an expanse of blue water, but may be likened to productive green fields on land—it is alive. The sea, too, has its cycles of life, in which inorganic matter, under the influence of green plants, microscopic or otherwise, is built up into organic matter in the form of vegetable materials. These in turn are eaten by the lower forms of animal life, and then they, too, succumb to still higher orders of animal life, until finally man may utilize for his own food some of the links in the chain, such as seaweeds, mollusks, crustaceans, and fishes. Ultimately, however, all animal life in the sea is dependent for its store of energy upon sunlight, which is fixed first by green plants.

At some stage in the development of man he found that little effort was required to secure essential foods by domesticating animals and allowing them to gather and eat the grass, grain, etc. They transformed these raw materials into meat, milk, dairy products, and eggs. It is clear that the food fishes are doing likewise in the sea, lakes, and rivers.

It is not the purpose of this chapter to discuss anything more than the general composition of fish and shellfish from the nutrition standpoint. Other fascinating subjects, such as the rôle of iodine in fish, the wonderful power of certain fishes to store vitamins, as in the case of the liver oil of certain fishes, and the occurrence of unusual elements and metallic derivatives in these foods will be discussed in separate chapters. The storing of certain essential amino acids in the protein of the muscles of fishes will also be discussed later.

THE HUMAN BODY—A PERFECT TRANSFORMER OF ENERGY

Like every other engine or motor that depends upon heat for its power, our bodies can only transform as much energy as is made available to them. In other words, the human body can not create energy; it can only change the stored energy existing in the foods that we eat into heat to keep the body always at its temperature of 98.6° F. and to supply it with the energy necessary for the work which it performs. In addition, our foods must replace the materials utilized and destroyed in the body cells during their life activities.

This time-worn figure of speech—comparing the human body to an engine or motor—is only a very crude simile. As a matter of fact, the efficiency of the human body in converting food (fuel) into heat and work is almost 100 per cent, while that of the most highly developed internal-combustion engine or mercury-vapor power plant is very much less. Furthermore, the human body is a self-sustaining and regulating mechanism unlike any machine ever devised by man. It builds itself up out of the foods which we eat; it maintains itself in the same way and makes good its losses; it provides its own lubrication, eliminates all of its waste products, and regulates its own body processes to suit the needs of the occasion. In other words, it is a most wonderful transformer of energy.

As has been stated, the real source of energy in our foods is ultimately the sun; so our bodies are at all times actually utilizing for various purposes the stored-up energy of the sun, just as our steam-power generating plants and internal-combustion engines are transforming into useful work the solar energy fixed ages ago in the form of coal and petroleum.

Just as the engineer can estimate the amount of energy available in different kinds of fuel for purposes of producing power, so can we determine, by proper apparatus, the fuel value of foods. A common unit for these energy measurements is the "calorie." Speaking in terms of the everyday units of measurement, a calorie is the amount of heat necessary to raise the temperature of 1 pound of water 4° F.; or, stating it another way, 1 pound of starch, if completely burned to produce heat and energy either outside the human body or within it, will develop enough heat to raise 1,900 pounds of water 4° F. in temperature or to raise about 5 gallons of water from the freezing point just to the boiling point.

This example, showing the amount of energy or heat units in starch, is not the whole story. It happens that many foods, and particularly fish, contain larger amounts of the so-called protein and fat types of food material than they do of the carbohydrate type (starches or sugars), which is so characteristic of vegetable foodstuffs. Fats or oils have the highest food value and are commonly recognized to be the most concentrated form of energy. They supply the quickly-burned fuels for the body, while the proteins play a particularly important rôle in replacing losses from wear and tear in the body cells themselves.

TABLE 1.—*Analyses of the ash of fish flesh*

Fish	Lime (CaO)	Phosphorus (P_2O_5)	Magnesium (MgO)	Potassium (K_2O)	Sodium (Na_2O)	Sulphur (SO_3)	Chlorine (Cl)
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Anchovies (salted)	4.22	18.11	1.88	2.17	38.80	0.93	33.25
Eel	45.83	43.18	----------	.18	9.48	----------	.17
Haddock (salted)	3.39	13.70	1.90	13.84	36.51	.31	38.11
Pike	7.38	38.16	3.81	23.92	20.45	2.50	4.74
Salmon (fresh)	8.60	20.32	9.49	24.40	13.66	----------	21.44

Both the proteins or nitrogenous constituents of foods and the carbohydrate or starchy constituents of foods have the same fuel value; namely, 1,860 calories per pound. On the other hand, the fats or oils have a fuel value of 4,220 calories per pound. The proteins do not give up all their energy in the body as fats and carbohydrates do. The reason for this is simple; namely, the fats and carbohydrates in the body (as well as when burned outside) are completely consumed to form carbon dioxide and water, while the proteins are only partially consumed and are excreted in the form of creatinin, urea, ammonia, and so on.

In addition to the proteins, fats, and carbohydrates (which constitute by far the greater proportion of our foods) there is another highly important food essential, namely, the inorganic matter more commonly given in food-value tables as ash. All living matter contains inorganic or ash constituents, and in the case of bones and teeth the percentage of these is high. Because our body can neither be built nor function without these inorganic substances, our foods must contain them. Deficiencies in the diet of calcium (lime) or iodine, for instance, give rise to serious ailments and physical deformities. Fortunately, fish and shellfish are characterized by containing an unusually wide range of the necessary mineral elements. Goiter is extremely rare among the Japanese, and this may probably be attributed to their extensive use of both animal and vegetable sea foods. Table 1 shows the percentage of various types of mineral matter in several species of fish.

GENERAL COMPOSITION OF FISH AND SHELLFISH

FRESH FISH

The pioneer work on the composition of American fish was done by Prof. W. O. Atwater (1888) for the United States Bureau of Fisheries during the period 1880–1887. This is a classical piece of research on the composition of a certain class of food materials, and in completeness and thoroughness has never been surpassed by any investigations on American fishery products. Table 2 gives a highly condensed summary of the composition of the edible portions of the more common American fishes which Atwater analyzed in the fresh condition.

TABLE 2.—*Chemical composition and food value of some typical American fishes, etc.*

Species	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Alewife	25.6	4.9	19.4	1.5	570
Bass, black	23.3	1.7	20.6	1.2	455
Bass, red	18.4	.5	16.9	1.2	335
Bass, sea	20.7	.5	19.8	1.4	390
Bass, striped	22.3	2.8	18.6	1.2	465
Bluefish	21.5	1.2	19.4	1.3	410
Buffalo fish	21.4	2.3	18.0	1.2	430
Butterfish	30.0	11.0	18.0	1.2	800
Catfish	35.9	20.6	14.4	.9	1,135
Ciscoe	26.0	6.8	18.5	1.1	630
Cod	17.4	.4	16.5	1.2	325
Cusk	18.0	.2	17.0	.9	325
Eels, salt water	28.4	9.1	18.6	1.0	730
Eulachon (Columbia River smelt)	25.3	11.2	13.2	1.4	718
Flounder	15.8	.6	14.2	1.3	290
Haddock	18.3	.3	17.2	1.2	335
Hake	16.9	.7	15.4	1.0	315
Halibut	24.6	5.2	18.6	1.0	565
Herring	27.5	7.1	19.5	1.5	660
Kingfish	20.8	.9	18.9	1.2	390
Mackerel	26.6	7.1	18.7	1.2	645
Mullet	25.1	4.6	19.5	1.2	555
Perch, white	24.3	4.0	19.3	1.2	530
Perch, yellow	20.7	.8	18.7	1.2	380
Pickerel, pike	20.2	.5	18.7	1.1	370
Pollock	24.0	.8	21.6	1.5	435
Pompano	27.2	7.5	18.8	1.0	665
Porgy	25.0	5.1	18.6	1.4	560
Red grouper	20.5	.6	19.3	1.1	385
Red snapper	21.5	1.0	19.7	1.3	410
Salmon, Atlantic	35.4	12.8	22.0	1.4	950
Salmon (Atlantic), landlocked, spent	22.3	3.3	17.8	1.2	470
Salmon, chinook, California	36.4	17.8	17.8	1.1	1,080
Shad	29.4	9.5	18.8	1.3	750
Sheepshead	24.4	3.7	20.1	1.2	530
Smelt	20.8	1.8	17.6	1.7	405
Spanish mackerel	31.9	9.4	21.5	1.5	795
Sturgeon	21.3	1.9	18.1	1.4	415
Trout, brook	22.2	2.1	19.2	1.2	445
Trout, salmon, Atlantic	29.2	10.3	17.8	1.2	765
Weakfish	21.0	2.4	17.8	1.2	430
Whitefish	30.2	6.5	22.9	1.6	700
Whale meat (mammal)	28.8	4.2	23.1	1.2	607

In glancing over Table 2 it is evident that there is a considerable variation in the composition and food value of the different species of fish. For instance, a typical lean fish like the cod may run as low in fat content as two to four-tenths of 1 per cent, the percentage of protein not running particularly high in this case and the fuel value being only 325 calories. At the other extreme we may take a popular fresh-water fish in the Middle West, like the catfish, and find that the percentage of fat in this case is 20.6, while the percentage of protein is 14.4 and the total fuel value 1,135 calories per pound. Most of the other common fresh and salt-water fishes will fall in between these extreme limits of variation.

There are two considerations that should be mentioned in connection with the composition of fish, as they will run through all tables presented in this chapter. In the first place, the main fluctuations in the composition of fish flesh are in the percentage of moisture and the percentage of fat. The percentage of protein does not fluctuate widely. The other consideration to be borne in mind is that there is very slight variation in the percentage of ash or inorganic matter in the different types of fish. This might appear surprising at first glance, but it is not. Just as the protein or cell substance does not vary much in composition, neither does the amount of inorganic matter associated with it. As already pointed out, a certain minimum amount of inorganic matter of certain types must be present for the normal life of the cells of the body, which select from the food materials offered to them those inorganic constituents which they need for their growth and functioning. The rest is eliminated, as inorganic substances are not stored in the body to any great extent.

There is one difficulty in drawing general conclusions from Atwater's analyses as to the average composition of the various types of fish. It is this. Professor Atwater usually analyzed but one or two samples of the different species of fish, and it became apparent to other investigators in the years that passed after this pioneer work had been done that there was a great variation in the composition of the same kind of food fishes, due to several factors. In the first place, individual fish of the same school caught at the same time often differ widely in composition. This is not due to different stages of development, age, or sex, but must be ascribed to what is called "individual variation," or, more likely, to the greater success of some fish in securing their food in the struggle for existence. Then, there is another factor, namely, the proximity to the time of spawning. This is a very important factor and one which will be shown quite clearly in the tables to appear later on. Third, there is considerable evidence that the locality where fish are caught may cause its own type of variation in composition. Whether such variation, apparently due to locality, is caused primarily by differences in food supply or to some more fundamental consideration we do not know as yet.

TABLE 3.—*Variation in composition of some important food fishes analyzed at different seasons of the year*

[Analyses of the edible portion on the fresh basis]

Common names	When caught	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
Atlantic coast:		*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Blackfish	June 16	20.0	0.15	18.31	1.40	347
Bonito	June 12	26.66	1.46	23.87	1.71	506
Cod	Nov. 24	18.65	.09	18.42	1.23	346
Herring	June 12	22.90	2.41	18.92	1.66	454
Kingfish	May 4	24.60	5.24	17.69	1.39	550
Ling	Nov. 18	18.30	.12	16.81	1.15	318
Porgy	May 14	23.39	2.59	18.87	1.37	460
Tilefish	Dec. 17	19.66	.51	17.50	1.35	347
Silver hake	May 26	18.86	1.41	16.25	1.22	362
Bluefish	May 7	23.83	1.54	21.00	1.16	456
Do	Sept. 28	29.04	8.10	20.38	1.11	721
Butterfish	May 19	25.66	5.96	18.06	1.49	587
Do	Oct. 12	30.01	13.52	18.25	1.40	910
Carp sucker	May 29	22.80	2.10	18.63	1.20	435
Do	Oct. 20	24.79	4.17	19.94	1.20	547
Croaker	Apr. 10	20.77	1.25	17.81	1.18	384
Do	Sept. 8	24.26	3.23	----------	1.37	----------
Flounder	Apr. 19	17.54	.20	16.00	1.17	306
Do	Sept. 22	21.59	.37	15.87	1.34	311

TABLE 3.—*Variation in composition of some important food fishes analyzed at different seasons of the year*—Continued

Common names	When caught	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Haddock	Apr. 2	18.32	.15	14.56	1.11	277
Do	Aug. 31	20.83	.09	16.19	1.01	305
Striped bass	Apr. 16	25.70	3.58	20.06	1.26	524
Do	Oct. 16	19.83	2.98	19.19	1.26	483
Sea bass	May 12	22.02	1.61	18.62	1.23	414
Do	Sept. 14	19.44	1.60		1.09	
Spanish mackerel	June 4	33.01	12.59	19.56	1.20	895
Do	Oct. 26	35.70	16.24	19.32	1.11	1,045
Weakfish	May 1	21.41	2.34	17.70	1.25	428
Do	Sept. 25	19.35	.52		1.20	
Shad (male)	Apr. 2	35.32	14.43	19.87	1.34	978
Shad (female)	Apr. 13	34.17	13.93	18.74	1.40	936
Do	May 22	26.00	5.87	18.19	1.29	586
Shad (female) spent	June 19	23.38	2.95	18.62	1.53	471
Pacific coast:						
Albacore	(1)	35.76	10.51	24.00	1.36	890
Atkafish	(1)	21.00	3.1	14.88	1.2	408
Barracuda	June 11	25.28	2.72	21.69	1.10	518
Do	Dec. 15	25.14	1.85	22.31	1.26	493
Do	do	28.10	6.45	20.69	1.26	657
Do	Jan. 7	21.74	1.51	20.25	1.53	440
California halibut	May 16	20.14	2.01	17.25	1.10	406
Do	Feb. 7	24.45	.85	22.31	1.41	451
Cultus cod	May 25	18.67	1.34	17.19	1.08	376
Hake	June 13	19.27	1.30	16.25	1.21	357
Herring	Mar. 25	20.15	.78	17.63	1.66	361
Do	Feb. 3	20.67	4.39	15.69	.96	477
Horse mackerel	June 22	28.57	5.62	21.56	1.24	638
Jack smelt	June 27	22.70	1.60	19.69	1.11	434
Do	Jan. 6	23.88	1.34	21.50	1.34	457
King Salmon	May 27	32.55	11.82	19.13	1.18	855
Kingfish	June 22	20.41	.76	18.13	1.23	369
Do	Nov. 15	20.24	.89	17.75	1.32	368
Little smelt	Apr. 10	22.61	.74	19.81		400
Rock cod ("Chili pepper")	May 25	20.35	.45	19.00	1.17	372
Rock cod ("bullhead")	June 25	20.81	1.46	17.94	1.12	395
Rock cod	Feb. 7	19.71	1.20	17.88	1.20	383
Sablefish, small	Apr. 3	18.05	.07	16.69	1.57	313
Sablefish, large	June 11	29.34	14.87	13.31	.95	875
Sand dab	May 29	18.05	.28	16.75	.87	323
Do	Jan. 4	17.77	.16	16.69	1.09	317
Sea bass	June 3	23.72	.50	21.44	1.40	420
Shad (male)	Mar. 20	35.14	15.90	18.38	1.35	1,013
Shad (female)	Apr. 10	27.40	7.86	18.25	1.46	672
Sole	Apr. 3	19.62	.69	17.38	1.70	352
Striped bass	May 27	21.68	.78	19.38	1.32	393
Skipjack	(1)	41.08	19.21	20.44	1.34	1,191
Yellowfin croaker	May 12	20.97	.76	19.19	1.17	389
Yellowtail	Aug. 20	24.31	3.21	19.75	1.34	502
Do	Oct. 23	30.27	7.51	22.13	1.32	729

[1] Summer.

In order to avoid the pitfall of analyzing but one sample of fish caught in one place at one time of the year, Clark and Almy (1918) made a study of the common food fishes of the Middle Atlantic coast, and Dill (1921) did the same with important Pacific coast fishes (Table 3), with the idea of checking the question of seasonal variation. Even a casual inspection of this table makes it clear that in the case of many of the fish studied there is a seasonal variation in their composition and food value, which is generally in the direction of a tendency toward increase in the fat content from spring to fall. For instance, the percentage of fat in a group of bluefish caught May 7 was 1.54, while that of another group caught September 28 was 8.10. In the case of butterfish, a group caught on May 19 averaged 5.96 per cent and another group caught in the fall (on October 12) averaged 13.52 per cent.

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Another tendency, however, is plain in the case of the shad, which run in the spring and spawn at that time of the year. Three female shad analyzed April 13, May 22, and June 19 show percentages of fat running from 13.93 to 5.87 and down to 2.95. This is a case where the fat of the tissue of the fish was being rapidly transferred from the flesh into the roe (eggs), the variation being due not so much to seasonal factors as to the approaching maturity of the fish. In all of these cases, whether bluefish, butterfish, or shad, changes in the percentage of fat are reflected by great changes in the fuel value per pound. In other words, a person who bought a female shad on June 19 got considerably less than one-half the same number of calories as the person who bought one two months earlier.

It does not seem worth while to present any more general tables giving the food value of fish flesh in this connection, but under the section entitled "Variation in composition" some very interesting and important tables are shown to illustrate the different kinds of variation already mentioned. However, it may be of interest to many people who enjoy eating the roe of shad and other fishes to know that the food value is usually quite high, particularly from the standpoint of the percentage of protein, which is the most essential and valuable constituent in fish and shellfish. Table 4 gives an idea of the food value of the roe of some typical food fishes.

TABLE 4.—*Composition of the roe of various fishes*

Source	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Shad	28.75	3.78	23.44	1.53	595
Sturgeon	43.03	12.85	27.87	2.31	1,060
Salmon (chinook)	42.32	13.60	26.66	.66	1,070
Herring	23.12	2.41	17.53	2.18	428

TABLE 5.—*Composition of various canned fish*

Name	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Mackerel	31.82	8.68	19.63	1.30	731
Salmon, chinook (Atwater, 1888)	38.12	15.70	20.18	1.32	1,037
Salmon (Shostrom, Clough, and Clark, 1924):					
Sockeye	35.22	11.22	20.80	1.23	860
Chinook	36.83	15.72	17.67	1.21	991
Coho	32.51	8.49	21.08	1.24	750
Pink	30.20	6.99	21.40	.76	696
Chum	29.96	6.69	20.67	1.02	524
Steelhead trout	33.16	8.95	21.32	1.21	792
Atlantic salmon	35.70	12.49	21.14	1.22	920
Sardines in oil (French)	43.63	12.71	24.87	[1] 5.61	909
Sardines in oil (American)	47.85	25.52	19.17	[1] 3.84	1,433
Sardines in tomato sauce (American)	32.33	5.55	18.08	[1] 3.94	570
Tuna in oil	46.40	19.60	25.40	1.40	1,298

[1] Includes salt.

PRESERVED FISH

As canning is the most important, economically, of all the methods of preserving fish, we give Table 5, which shows the composition and food value of the more important types of canned fish. As the individual items in this table were assembled from a great variety of sources, it will not be possible to give credit to the individual investigators.

In the case of salmon—which is the most important sea food canned, amounting in value (to the packer) to some $50,000,000 a year—there are few changes in the manufacturing process except that due to the addition of salt. On the other hand, in the case of sardines, tuna, and products of that sort, the fish are usually precooked, fried, steamed, or dried before being packed, and then olive oil, cottonseed oil, or tomato sauce may be added just before the can is sealed. In the case of canned salmon the food value is quite high for most species because of their fat content. All species of canned fish have a considerable percentage of protein, and that, of course, is the main constituent that makes them valuable. Where additional oil is added, as in the case of sardines and tuna, the food value is naturally very high, in terms of calories, because of the added oil. As salt is always used in canning, it will appear in analyses under the heading of "ash," except in those cases where particular pains were taken to determine the salt separately from the rest of the ash constituents.

In regard to the percentage of solids or moisture in canned fish it should be noted that those products that are put into the can in the raw state, like canned salmon, undergo shrinkage and elimination of water during the high temperatures of sterilization, so that the composition of canned salmon is more like that of cooked fresh fish unless all the liquids in the can, which were cooked out, are mixed with the fish when prepared for the table. In the analytical work reported above, Shostrom, Clough, and Clark (1924) analyzed the edible contents of the can, including the liquid, so the food values of the drained salmon as usually eaten would be considerably higher than those given in the table.

The most complete data we have on any canned fishery product is that of Shostrom, Clough, and Clark (1924) on the Pacific coast salmon, given in the above table. In connection with this work some 786 separate cans of salmon were analyzed. Many of these cans consisted of identical cuts of individual salmon so as to eliminate variation in composition due to different parts of the same fish being canned. The average number of calories per pound for all species and grades of salmon from all districts was 738 in the special packs just described and 768 for the commercial packs that were analyzed and in which no special pains were taken to secure uniformity of the section of the fish analyzed. The steelhead trout, while not a salmon, is a fish of considerable economic importance on the Pacific coast, and its food value when canned was found to average about 972 calories per pound. A few samples of Atlantic coast salmon were analyzed and were found to have an average fuel value of 920 calories per pound. This agrees very closely with the fuel value of the Pacific coast chinook salmon, which is 928 calories, although the Atlantic and Pacific species are entirely distinct.

Of all the ways of preserving fish there is none more important than canning. The great development of the salmon-canning industry on the Pacific coast shows that canned fish is a staple article in the United States and certain other countries like Great Britain, Canada, Australia, etc. When properly handled before canning and thoroughly sterilized, canned fish become available for shipment into any part of the world and can be enjoyed by people where fresh fish are not available. The loss in using canned fish is very slight, and as the cooking has already been done the product can be eaten cold, as a salad, if so desired.

There is a growing popularity in the Orient and South Sea Islands for canned fish, not only among the white residents but also among the natives. The coolies and workers on rubber and sugar plantations find canned salmon and canned sardines very valuable foods, and the same is true in many parts of the United States where canned fish are the only kind of fish available. It is hard to see how great industrial developments such as the building of railroads, lumber camps, mining, oil drilling, etc., in difficultly accessible places could be carried on without the use of canned products like fish, meat, fruits, vegetables, and milk. Not only has the conquest of the Tropics been made possible by the discovery of the connection between the mosquito and yellow fever, but also by the great development and utilization of canned and sterilized foods, among which fish and shellfish are always popular and, as we have seen, provide the essential foodstuff—protein—at a reasonable cost.

Next in economic importance to the canning of sea foods comes the freezing of fish. This is a very important industry both in the United States and abroad. While freezing fish has some disadvantages, compared with canning, it has certain advantages—namely, the flavor and appearance of the fish are practically unchanged by the freezing process. At times the public has shown an unjustifiable suspicion of frozen fish. The assumption has been that fish that can not be sold fresh are frozen, and that, furthermore, during the freezing process and storage there is considerable deterioration which affects the food value and palatability of the product. It was in order to study this question most carefully that Clark and Almy (1920) undertook a long series of experiments and investigations on the behavior of Atlantic coast weakfish and bluefish during freezing and after storage. They analyzed groups of fish to determine the normal composition when fresh (before freezing) and then analyzed other individuals of the same lots of fish which had been frozen and stored for periods of time up to and over 27 months. As a matter of fact, frozen fish are not kept any longer than eight months or a year at the most, because the normal cycle—first, of scarcity and then of plenty—usually requires a year to be completed. There is no economic reason whatever for carrying frozen fish over into the season when the fresh fish are being obtained and frozen for a coming period of scarcity. In Table 6, taken from a publication of Clark and Almy (1920), the composition of weakfish and bluefish before and after freezing and storing is given.

TABLE 6.—*Effect of freezing and storage on the composition of food fishes*

[Analyses of the edible portion on the moist basis]

Name	Storage period, in months	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Fresh, eviscerated weakfish		24.41	5.15	18.75	1.18	566
Do		21.30	1.76	18.50	1.24	418
Frozen, eviscerated weakfish (glazed, not wrapped in paper)	2	22.39	1.91	18.69	.96	428
Do	4	23.35	2.47	19.56	1.10	468
Do	8	23.08	1.99	19.50	1.18	446
Do	13	24.86	2.82	20.00	1.16	491
Do	25	24.84	2.87	19.80	1.10	489
Fresh, eviscerated bluefish		23.98	1.13	21.50	1.34	447
Do		24.36	1.82	20.68	1.32	461
Frozen, eviscerated bluefish (glazed, not wrapped in paper)	4	25.80	3.33	20.87	.99	529
Do	5	26.02	3.19	20.31	1.14	512
Do	8	25.68	2.02	22.30	1.27	500
Do	12	25.26	1.85	21.06	1.22	470
Do	16	25.71	1.81	21.06	1.23	468
Do	16	24.33	.63	22.30	1.26	442
Do	27.5	26.22	1.33	22.69	1.23	478

During storage the fish were kept glazed; that is, dipped into water immediately after freezing and thus covered with a thin coating of ice. The object of this glaze is to prevent mechanical damage to the skin of the fish and at the same time prevent evaporation or loss of water. If fish were not glazed, their skins would rapidly dry out and take on a most unattractive appearance. It may seem strange that moisture will evaporate from frozen fish at a temperature of only 5° above zero; but this has to be guarded against constantly in the storage of frozen products. The same thing happens to a cake of ice standing in the open air. Even when the temperatures are far below freezing it will soon be noticed that the edges of the cake become rounded, and that it gradually shrinks in size and finally disappears. The water in the form of ice has evaporated directly from the solid state into the state of vapor without any apparent sign of becoming a liquid. This is exactly what happens to frozen fish when stored without glazing.

While the storage period which these experimental fish passed through was probably about three times as long as that commonly used in commercial practice, it is evident that there was no detectable change in chemical composition or food value during that period. The glaze on the fish apparently prevented the evaporation of any considerable amount of water, and, as could be expected, there was no change in the fat, protein, or ash content, except such variations as are always found when individual fish are being analyzed. In addition to the work reported in the table given above, Clark and Almy (1920) found no significant changes in the more refined analyses which they made on the individual nitrogenous substances found in fresh fish. These substances are supposed to be quickly influenced by any signs of decomposition, but such changes were not detected. In conclusion, we may say that the process of freezing and storing of fish in cold rooms is one in which there is no appreciable change in the quality or food value of the fish.

SALTED, SMOKED, AND DEHYDRATED FISH

The earliest way, probably, in which foods were preserved for future use by man was through the process of smoking. Later on the use of salt was combined with the smoke as an added preservative. Being essentially perishable and yet worthy of special effort in the matter of preserving them for future use, prehistoric man gradually learned to provide himself with fish for the winter season of scarcity by means of smoking, drying, or a combination of smoking and salting. We know that the Indians in the United States and Alaska used to go long distances in order to capture and preserve fish for their winter supply at a time when the fish were running in the rivers. Even to-day the Indians in Alaska smoke and dry large quantities of salmon to be used as food for themselves and their dogs during the winter, when no other food is available.

In our colonial times the people consumed considerable quantities of salt codfish, salt salmon, herring, etc., which they sometimes prepared themselves when the fish happened to run in their rivers, or which were prepared at some central salting and drying place like Gloucester, Mass. It was not a strange fancy that led the early colonists to adopt the tradition of keeping the "sacred codfish" in the Massachusetts capitol building in Boston. In those days of hardships, had it not been for the salt cod it would have been practically impossible for the colonists to have maintained themselves on the edge of a rather inhospitable country that they were beginning to subdue to the purposes of civilization.

Unfortunately there is not very much data available on the composition and food value of salted and smoked fish. In Table 7 are given data on some of the more common forms of salted and dehydrated fish.

TABLE 7.—*Composition of salted, smoked, pickled, and dehydrated fish*

Name	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Boneless salt cod	45.6	0.3	26.3	[1] 23.2	502
Desiccated cod	88.4	4.9	72.0	5.2	1,546
Smoked haddock	27.4	.2	23.3	1.5	442
Smoked halibut	50.6	15.0	20.8	2.1	1,020
Pickled herring	[2] 57.7	19.7	25.0	4.0	1,297
Smoked herring	65.5	15.8	36.9	1.5	1,353
Salt mackerel	56.1	25.1	18.6	2.6	1,405

[1] Salt included. [2] Contains 4.04 per cent of undetermined acids, sugar, etc.

Of course, one of the outstanding features in the composition of salted and smoked fish is naturally the elimination of water. Fundamentally the salting of fish or meat products results in the withdrawal of water. In other words, whether the fish are dried naturally or salted, the effect is the same; namely, to reduce the percentage of water to the point where bacteria and molds can not grow and destroy these food products. Of course, smoking adds a slight amount of creosote and similar materials to the surface of these products, which act as a sort of preservative and at the same time give them their characteristic flavor. Because a considerable proportion of the water existing in the flesh of the fish is removed by salting and drying operations, salt fish like cod and smoked herring are quite highly concentrated forms of protein. In the case of smoked herring there is the additional advantage of a rather high percentage of fat. Similarly, salt mackerel owes its chief fuel value to its very high content of oil; namely, 25.1 per cent. This, together with its protein content, gives it the unusually high fuel value of 1,405 calories per pound. However, probably the most commonly used form of salted fish is the salt cod. This does not gain much in food value from its fat content, which is very low, but does have a considerable percentage of protein—namely, 26.3 per cent—and a total fuel value of 502 calories per pound. Pickled herring and mild-cured salmon are prepared in large quantities and used in many countries.

MOLLUSKS, CRUSTACEANS, ETC.

Up to the present point we have been considering only fish in the narrow meaning of the word. However, it was probably quite early in the development of mankind that they learned to utilize oysters and clams as well as crabs, shrimp, etc., which they could gather along the seashore. Just as pointed out in the case of the early native tribes flocking to the rivers at certain seasons in order to catch fish and preserve them for the winter, it is also true that in Europe and North America the natives frequented certain favorite places along the shores in order to enjoy oysters and clams. Judging by the enormous size of some shell mounds in Europe and on both our coasts, large quantities of these mollusks must have been consumed over long periods of time. The fragments of pottery, arrowheads, and other prehistoric traces show that these mounds were built up slowly, sometimes one over another, where the remains of one civilization would be buried along with the shells, only to be followed by later deposits. Modern man has not lost his taste for mollusks and crustaceans, and the consumption of oysters, clams, scallops, mussels, lobsters, crabs, and shrimp is quite large.

The most important of the mollusks, industrially, is the oyster. Great quantities are eaten raw on the seaboard and also shipped long distances inland in refrigerator cars. The flavor of the oyster seems to be one that is particularly attractive to many people. From the standpoint of composition the oyster is very interesting for the reason that a quart of oysters and a quart of milk have very nearly the same composition and about the same food value. Oysters are also peculiar from a scientific standpoint in that they contain some unusual inorganic constituents like copper and zinc. Of course, not enough of these metals is present to affect injuriously their value for human food.

Generally speaking the food value of the edible part of mollusks and crustaceans is not as high as in fish flesh. This is made plain in Table 8. The reason for this is that mollusks do not contain very much fat, while the flesh of many fishes does. On the other hand, there is one characteristic of this class of sea foods which is interesting and important; that is, they contain some carbohydrate or starchy type of nutrients, which is quite unusual in sea foods. As a matter of fact, carbohydrates are not determined in ordinary analyses of fish flesh because they exist in quantities of considerably less than one-half of 1 per cent. In the present class of sea foods, however, the percentage of carbohydrates ranges from 1 to 5.2. The carbohydrates usually exist in the form of glycogen, sometimes called animal starch, which is a form of sugar storage in the muscles of the mollusks and crustaceans as well as in the liver of human beings and mammals. The muscles that hold the parts of the shells together are quite powerful, and it seems that the glycogen storage takes place in these muscles.

TABLE 8.—*Composition of the edible portion of mollusks, crustaceans, etc.*

Name	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Carbohydrates	Fuel value per pound
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Fresh:						
Abalone	27.2	0.1	21.7	1.3	3.3	469
Long clams	20.6	1.7	13.6	2.5	2.8	377
Round clams	19.2	1.1	10.6	2.3	5.2	340
Crab (eastern, hard)	22.9	2.0	16.6	3.3	1.2	415
Crawfish (eastern)	18.8	.5	16.0	1.3	1.0	337
Frog's legs	16.3	.2	15.5	1.0		315
Lobster	20.8	1.8	16.4	2.2	.4	388
Mussels	15.8	1.1	8.7	1.9	4.1	285
Oysters (eastern)	13.1	1.2	6.2	2.0	3.7	235
Scallops	19.7	.1	14.8	1.4	3.4	343
Shrimps	22.7	.4	19.3	1.5	1.7	407
Terrapin	25.5	3.5	21.2	1.0		542
Turtle (green)	20.2	.5	19.8	1.2		390
Boiled:						
Dungeness crab (Puget Sound)	22.8	.3	21.0	2.1	.3	409
Spiny lobster (southern California)	27.4	.3	24.6	1.7	.1	472
Shrimp (Alaska)	30.9	1.0	24.6	5.3		500
Preserved:						
Abalone (canned)	26.8	.1	21.7	1.3	3.7	478
Abalone (dried)	60.3	.5	36.0	2.9	20.9	1,079
Long clams (canned)	15.5	1.3	9.0	2.3	2.9	276
Round clams (canned)	17.1	.8	10.5	1.0	3.0	285
Crab (eastern, hard, canned)	20.0	1.5	15.8	1.9	.8	372
Lobster (canned)	22.2	1.1	18.1	2.5	.5	392
Oysters (canned)	16.6	2.4	8.8	1.5	3.9	337
Shrimp (canned, dry pack)	32.3	.8	25.5	2.9	(1)	508
Shrimp (canned, wet pack)	24.3	.5	20.0	1.9	(1)	393
Dried shrimp	87.5	5.0	71.4	6.8	(1)	1,540

[1] Carbohydrates present but undetermined.

While it is true that the food value of mollusks and crustaceans as a class is not as great on the average as that of fish flesh, still these products play an important part in the diet, because they contain considerable quantities of protein (essential for muscle-building purposes) and are particularly noted for their delicate and unusual flavors, which add variety to the diet and whet the appetite. It is probably not purely by accident that in most civilized countries dinners often begin with a course in which oysters, clams, crabs, or lobsters figure as the appetizer.

Owing to the almost universal popularity of mollusks and crustaceans people wish to eat them in seasons when they are not available in the fresh state. This has led to the development of several important industries, such as the canning of clams, crabs, lobsters, oysters, and shrimp. In Table 8 will be found some interesting data on canned and dried sea foods of this type. Some of the canned products, such as oysters, shrimp, and clams, are packed in their own liquor or in a light brine, and this appears to reduce their food value, as a certain percentage of the nutrients dissolve in the liquid during the sterilizing process. This is of no great importance, however, as in most cases the consumer realizes that much of the flavor has passed into the liquor and he uses this along with the product itself.

Dried abalone is rather striking on account of its high percentage of protein and carbohydrate, which is about 36 and 21 per cent, respectively, giving it a fuel value of 1,079 calories per pound. Dried shrimp is even more surprising in this regard, as the total solids are increased by drying to 87.5 per cent, the protein being 71.4 per cent, with a considerable percentage of glycogen, which was not determined in these analyses. Leaving out, of course, the undetermined glycogen, the fuel value of dried shrimp is 1,540 calories per pound. For some reason this product is not as popular with American consumers as it ought to be. It can be prepared, shipped, and stored at rather small expense, and soaks up in water to give a product very similar to the original fresh substance in flavor and appearance. The Chinese on the Atlantic coast consume considerable quantities of this article, which is prepared in the South Atlantic and Gulf States. In the San Francisco Bay region large quantities of shrimp are dried and exported to China, where it is quite popular.

TABLE 9.—*Percentage of edible portions of fish and meat as commonly purchased*

Product	Percentage edible	Product	Percentage edible
Whole fish:		Fully dressed fish—Continued.	
Butterfish	55.9	Sablefish (black cod)	72.2
Brook trout	47.0	Salmon, chinook	88.7
Herring	51.1	Sea bass	74.0
Mackerel	45.8	Skipjack	90.1
Pickerel	53.1	Sturgeon	84.7
Pompano	56.2	Striped bass	73.9
Shad	52.4	Yellowtail	80.8
Smelt	61.8	Meat:	
Striped bass	49.6	Beef—	
Whitefish	45.7	Side	80.3
Fish with entrails removed:		Round	90.0
Flounder	41.3	Neck	80.1
Lake trout	63.6	Sirloin	75.0
Mackerel	57.4	Flank	88.3
Pickerel	55.7	Mutton—	
Red snapper	54.3	Side	80.0
Fully dressed fish:		Leg	81.6
Albacore	91.3	Shoulder	83.2
Barracuda	75.0	Loin chops	83.7
Cod	64.6	Ham, smoked	86.0
Eel	76.1	Pork, very fat	89.6
Halibut	75.9	Chicken	58.4
Mackerel, California	64.9	Turkey	64.6
Rock cod ("chili pepper")	71.7		

PERCENTAGE OF WASTE IN FISH

Some consideration must now be given to the subject of the losses that occur in preparing fish for the table. These losses are generally greater than in the case of meat, which, of course, is the food to which fish bears the closest similarity.

The housewife may buy fish whole, and this is usually the case with the smaller ones like herring, smelt, butterfish, etc. More commonly the fish are dressed—that is, the entrails and very often the head are removed. On the average, dressing the fish in this way causes a loss of some 25 to 30 per cent, varying with the species. Of course, there are certain types of the larger fish, such as swordfish,

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halibut, salmon, cod, striped bass, etc., that are sold by having slices cut off to suit the convenience of the purchaser. In such cases the edible portion comprises most of the part purchased, the only loss being a section of the backbone and attached smaller bones.

To give an idea of the percentage of the edible portion that may be obtained from the whole fish as originally caught or the dressed fish as bought in the market as compared with similar meat products, Table 9 is given.

It is apparent that there is usually more loss in preparing fish for the table than is the case with meat. Of course, the reason is obvious—namely, that a quarter of beef or leg of mutton, for instance, consists of relatively large pieces from which portions for individual families can be removed with minimum loss. Furthermore, most animal food products as placed on the market represent but a fraction of the original live weight of the animal. Fish have a good deal of waste in the form of head, entrails, tail, fins, etc., removed before they can be cooked and put on the table.

Referring now to preserved fish products, naturally the waste is very much less than in fresh fish, as they have already been treated in much the same way as when being prepared for the table. This is true in the case of boneless codfish, in which there is no waste whatever, and to a slightly less extent with canned salmon, where the only waste would be the skin and bone, which two items constitute a small percentage of the total contents of the can. In the case of canned shrimp, oysters, sardines, tuna, etc., there is no waste.

EFFECT OF COOKING ON THE COMPOSITION OF FISH

Naturally, it makes a great deal of difference whether the fish are cooked by baking or frying, where the main loss is moisture, or by boiling, where another element comes in—namely, the dissolving of soluble substances from the fish flesh by the hot water. Table 10 is based upon some work done in Europe and some done by Atwater. (Atwater and Bryant, 1899.)

TABLE 10.—*Analyses of fresh and cooked fish, edible portion*

Name	Fat	Protein (N×6.25)	Nitrogen free extractive matter	Ash (inorganic matter)	Pure ash	Salt	Fuel value per pound
On dry basis: [1]							
Salmon—	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Fresh	24.03	69.94	1.42	4.61	4.27	0.34	2,314
Boiled	23.92	68.63	3.25	4.20	3.33	.87	2,285
Baked	20.59	69.38	1.69	8.34	4.62	3.72	2,159
Smoked	24.32	51.06	3.87	20.77	3.50	17.27	1,974
Herring—							
Fresh	29.14	63.94	3.04	3.88	3.65	.23	2,418
Smoked	29.79	56.50	1.47	12.24	6.64	5.60	2,307
On moist basis:			*Total solids*				
Bluefish, cooked	4.50	25.90	31.80	1.20			670
Spanish mackerel, broiled	6.50	23.70	31.10	1.40			715

[1] These results are calculated on the dry basis and are approximately three times as high as they would be if calculated on the moist basis.

As one might expect, it is evident that the changes which occur in the composition of fish during cooking are not very noticeable, consisting mainly in the slight loss of moisture where the cooking takes place under dry conditions and, on the other hand, a loss in nitrogenous or protein material where the fish are boiled. The main object in cooking fish is to make them palatable in accordance with the tastes of civilized man. It should be noted, however, that many of the native tribes and many of the people in civilized countries do eat fish raw. In Japan it is quite customary to eat fish flesh without cooking, but in Europe and America it is usually only pickled herring, smoked salmon, etc., that are eaten without any real cooking by heat.

VARIATIONS IN THE COMPOSITION OF FISH

SEASONAL AND MATURITY VARIATIONS

It has already been mentioned in connection with the discussion of Tables 2 and 3, giving the general composition of food fishes, that very marked variations occur in the composition of fish. These changes may be roughly classified as due to (*a*) season or maturity, (*b*) locality, (*c*) variations in individuals, and (*d*) variations in the different parts of the body of the same fish. In this section the seasonal and maturity variations only will be discussed.

In Table 11 Dill (1921) presents the analyses at different times of the year of some important economic fishes of the mackerel family caught off the coast of California.

TABLE 11.—*Analyses of various fishes of the mackerel family caught off the coast of California*

[Analyses of the edible portion on the fresh basis]

Species	Number analyzed	Date	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
			Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Albacore	5	June 19	32.05	5.22	25.69	1.34	698
	5	July 22	31.80	4.35	26.69	1.30	680
	5	Sept. 8	38.49	12.76	24.06	1.35	986
	5	Oct. 20	31.71	5.50	25.94	1.33	715
	5	Nov. 20	33.21	6.92	25.56	1.30	767
Bluefin tuna	5	Sept. 21	34.45	9.37	24.44	1.32	850
	5	July 22	27.43	1.08	25.13	1.43	513
Yellowfin tuna	10	May 14	27.17	1.00	25.31	1.47	513
	5	Sept. 8	30.83	6.54	24.00	1.32	722
	3	Sept. 15	29.27	3.29	25.19	----------	608
	6	Sept. 22	29.23	3.52	24.56	----------	606
	6	Oct. 25	26.05	.90	24.31	----------	490
Striped tuna	5	Aug. 18	33.48	6.62	25.50	1.28	753
	5	Oct. 23	34.64	8.11	25.31	1.32	813
Bonito	1	Sept. 21	41.08	19.21	20.44	1.34	1,191
	6	May 19	26.26	1.21	24.81	1.47	512

In the case of the albacore, for instance, which is so important for canning purposes, it will be seen that the percentage of fat, which so largely influences the fuel value, seems to reach its peak about the first week in September and then falls off again during October and November. Expressed in terms of fuel value, the albacore caught early in the season averaged about 690 calories per pound, while those caught the first week in September averaged 986 calories per pound. Later on in the fall the fuel value dropped down to an average of 750 calories. We find the same thing illustrated in the analysis of the yellowfin tuna, where the fat content seems to reach the maximum about the first week in September and drops off again like the albacore.

In Table 12 Dill (1921a) presents a special study of the variation of the average monthly composition of the larger-sized California sardines which are used in packing pound oval cans. We have in this table data running through two years, based upon analyses of a considerable number of fish caught at monthly periods during the seasons when the sardines are present in considerable numbers off the southern California coast.

TABLE 12.—*Monthly average composition of "large oval" size sardines caught off the coast of California*

[Analyses of the edible portion on the fresh basis]

Month	Number of analyses	Total solids	Fat	Protein (N×6.25)	Fuel value per pound
1919		*Per cent*	*Per cent*	*Per cent*	*Calories*
January	4	37.71	19.20	17.44	1,135
February	2	33.34	14.02	18.00	927
March	3	35.41	15.83	18.06	1,004
April	2	21.08	.75	18.93	669
May	5	23.27	2.74	19.07	470
December	4	40.30	21.38	18.00	1,237
1920					
January	4	37.91	17.89	19.00	1,108
February	17	38.34	18.88	18.06	1,133
March	20	36.53	17.04	18.06	1,055
April	20	27.52	6.67	19.25	639
May	10	25.78	4.00	20.75	555
June	4	25.22	2.75	21.13	509

Again, using the percentage of fat as an index of the variation (and that is fair because, as we have already pointed out, the percentages of ash and protein do not vary greatly for one reason, and for another it is the changes in fat content that cause the greatest variation in fuel value per pound), we see that there is a marked cycle of variation in each year. During January, February, and March these sardines are at their maximum degree of richness—namely, have an average fat content of about 17 per cent. However, in April, May, and June, the cycle swings downward and the percentage of fat decreases to an average of only 3 or 4 per cent. This is a very great change in composition and has considerable economic significance because the large oval sardines are packed in tomato sauce and not oil and for that reason must be packed at a time of the year when the fish are at the maximum degree of fatness. This has been found by experience to be during the winter and early spring.

In Alaska there is a somewhat similar variation in the composition of herring, on which a large industry has been founded in preserving the fish by the Scotch-cure method. It is during the season of the year when the fish are in the stage of maximum fatness that most of the Scotch-curing operations are carried on. We see, therefore, that the question of seasonal variation of fish is one not only of importance to the consumer from the standpoint of calories obtained for a given unit of expenditure, but also that large industries with many millions of dollars involved and many people employed must shape their operations in accordance with variations in the composition of the fish.

TABLE 13.—*Composition of the muscle tissue of the chinook salmon during the spawning migration*

Collecting station	Date	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Organic extractives
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Ilwaco, Wash., tidewater	Aug. 15–20	36.83	16.43	16.97	0.90	2.48
Warrendale, Oreg., 100 miles from sea	Aug. 5–7	37.32	17.17	16.88	.89	2.49
Seuferts, Oreg., 210 miles from sea	July 11–31	36.64	16.33	17.01	.95	2.49
Ontario, Oreg., 700 miles from sea	Sept. 6–11	31.02	10.73	16.31	1.00	2.94
Cazadero, Oreg., spawning grounds	Aug. 25–28	20.32	2.63	13.71	.94	2.99

The chinook salmon of the Pacific coast is very important from the standpoint of the large amount that is eaten fresh, because it is the basis of the large mild-cure salmon industry, and finally because of the large amount of it that is canned. A typical salmon river is the Columbia River. From time immemorial the Indians have come there to catch their salmon at certain seasons, and it was one of the earliest salmon-canning districts to be developed by the white man. From the standpoint of fuel value as well as economic value in connection with canning operations the variation in the fatness of the chinook salmon as it enters the Columbia River from salt water and proceeds upstream to spawn has always been important. It is also particularly interesting from a scientific standpoint, because by taking fish at different points on the river, from tidewater to the spawning beds, it is possible to study the changes in composition and fuel value of the flesh as the fish approach the time of spawning.

Greene (1919) has studied this problem in a most painstaking way, and in Table 13 it is easily seen that as the fish progress up the Columbia River on their way to the spawning areas many hundreds of miles from salt water their flesh suffers a deterioration, particularly as regards the fat content and to a less extent in the matter of protein. It is evident that the flesh of the chinook salmon is gradually depleted of its most valuable constituents—namely, its fat and protein—in order to provide for the coming generation. This is also very interesting for the reason that as the parents die soon after spawning it would be a waste in the scheme of nature for large amounts of valuable nutrients to remain in the flesh. (As a matter of fact the bodies of the parents disintegrate after death and provide the young fish with one of their first foods when they emerge from the gravel after being hatched.) From the standpoint of the use as food of spawning or spawned-out fish, it only needs to be pointed out that the fuel value of such fish is relatively low and their flesh is always watery and more or less unpalatable and lacking in the characteristic firmness, flavor, and richness of the flesh of salmon taken in salt water or very early in the spawning migration up the rivers.

VARIATIONS DUE TO LOCALITY

From the earliest days it has been known that the fish in certain localities are unusually fat as compared with those taken from other places, and fishing operations have often been conducted with this in view. The variations in composition of the herring in European waters have been studied very carefully by various investigators but need not be discussed in this chapter on the composition of American food fishes.

In our own country, for example, it has been known for many years that the salmon that run in certain streams are unusually rich and desirable from the market standpoint. This is true, for instance, in the case of chinooks from the Columbia River and sockeye salmon from the Fraser River. In Alaska it is also true, as the fish in the Copper and Yukon Rivers, for instance, are famous for their high fat content. There has been a tradition in connection with this to the effect that the fish that run in the longer rivers are considerably richer than those that spawn in the shorter rivers of the coast. Unfortunately for this theory, however, which seems to be true in a general way, there are some notable exceptions. For instance, the chinook salmon that run in the Rogue River on the Oregon coast, the Klamath River on the California coast, and the red salmon in the Quinault River on the Washington coast are unusually rich, yet these rivers are small and can not be classed with majestic streams like the Columbia and Yukon.

In connection with the detailed study made by Shostrom, Clough, and Clark (1924) on the composition of salmon used for canning on the Pacific coast, sections from 216 individual chinook salmon taken from practically all of the canning districts under the American flag on the Pacific coast were considered in great detail. Table 14 gives a highly condensed summary of this work, referring only to chinook salmon.

TABLE 14.—*Variations in composition of the canned chinook salmon caught in various localities*

Locality	Number of fish analyzed	Solids	Fat	Protein (N× 6.25)	Salt-free ash	Fuel value per pound
ALASKA						
Western Alaska:		*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Bristol Bay—						
Nushagak River	9	31.47	9.33	19.60	1.19	758
Kvichak River	9	32.38	10.30	19.77	1.31	802
Naknek River	9	32.88	11.12	19.01	1.24	822
Central Alaska:						
Alaska Peninsula, Chignik River	9	35.94	14.24	18.29	1.19	940
Kodiak Island, Karluk River	9	32.23	8.59	20.92	1.32	751
Average for Alaska fish		32.98	10.71	19.51	1.25	814
UNITED STATES						
Puget Sound:						
Blaine, Wash.—						
A. Red-fleshed fish	9	37.94	12.19	20.75	1.15	900
B. White-fleshed fish	9	38.02	13.24	19.15	1.17	915
Average for Puget Sound		37.98	12.71	19.95	1.16	908
Columbia River:						
Near mouth—						
A. Grade 1	29	39.31	17.27	19.26	1.20	1,086
B. Grade 2	40	35.86	13.59	19.31	1.17	932
C. Grade 3	20	32.06	9.58	19.98	1.20	776
D. White-fleshed fish	9	31.90	10.26	19.53	1.21	796
200 miles from mouth—						
A. Grade 1	11	39.65	16.83	19.16	1.18	1,066
B. Grade 2	11	38.61	17.18	18.80	1.12	1,074
Average for Columbia River		36.57	14.12	19.34	1.18	955
Oregon coast:						
Coquille River, Grade 1	11	37.00	12.94	20.68	1.26	931
Rogue River, Grade 1	11	38.30	15.40	19.76	1.23	1,017
Northern California coast: Klamath River, Grade 1	11	38.71	16.36	19.94	1.20	1,061
Average for Oregon and California coastal rivers		38.00	14.90	20.13	1.23	1,003
Average of all chinook salmon		36.02	13.41	19.51	1.21	928

This table shows that in addition to the variations of fish in different streams there are certain general changes that are obvious. In the first place the chinook or king salmon in Alaska, with the exception of the Chignik River, is not as rich in oil and consequently in fuel value as the salmon from the canning districts in the United States. The chinooks caught on Puget Sound average about the same in food value as those caught in the Columbia River. However, there is no careful grading system in effect in the Puget Sound district such as on the Columbia River, and so we have no class of selected No. 2 grade, for instance, that compares with No. 2 chinooks on the Columbia River.

A detailed study was made of the composition of chinooks caught at Astoria, near the mouth of the Columbia River, with those caught 200 miles from the mouth, and it was found in a general way that there was little, if any, variation in fuel value in this 200-mile stretch of river. A further study of the composition of the three different grades on the river showed that in a general way the grading that was done for color seemed also to show a certain correlation in the matter of the percentage of oil, as the fuel value seemed to run in proportion to the grading, the primary object of which was to select the brightest-colored fish for the higher grades. On the one hand, analyses of white-fleshed fish on Puget Sound, as compared with red-fleshed fish taken at the same time and at the same place, showed that there was little, if any, difference in the fat content between the red and the white varieties, at least in that particular locality; on the other hand, the white-fleshed chinooks on the Columbia River seemed to run about the same as a No. 3 grade chinook—namely, relatively low in oil as well as poor in color. However, more work will have to be done along this line to prove conclusively that color and food value have any necessary relationship.

TABLE 15.—*Variation in the composition of individual California mackerel (Scomber japonicus), based upon analysis of the edible portion on the fresh basis*

Number analyzed	Description	Average weight, grams	Date	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
			1918	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
1		496	Oct. 25	25.92	1.27	23.50	1.27	491
1		526	do	26.20	.85	24.31	1.52	488
1		546	do	31.71	7.88	22.88	1.34	758
6	Males	511	Nov. 17	24.35	.41	23.06	1.41	446
6	Females	511	do	24.89	.85	23.37	1.37	471
			1919					
1	Male, spent	582	Aug. 7	28.16	3.50	23.56	1.45	586
1	Female, spent	596	do	26.83	2.91	22.81	1.47	547
1	do	596	do	28.03	3.87	23.06	1.47	592
1	do	624	do	28.18	4.48	21.81	1.44	595
1	Female, full	823	do	32.65	9.81	21.44	1.32	813
1	do	1,135	Aug. 11	30.36	6.35	23.06	1.40	697
9	Males, full	1,220	do	30.69	7.50	21.87	1.31	722
1	Female	538	Nov. 18	28.57	5.25	22.38	1.56	638
1	do	568	do	32.57	9.78	21.88	1.43	820
1	do	568	do	32.31	9.34	22.19	1.23	807
1	do	625	do	34.21	11.68	22.88	1.35	919
1	do	682	do	32.96	10.69	22.06	1.37	861
1	Male	1,022	do	29.33	6.86	21.68	1.33	695
1	do	1,079	do	37.67	15.45	20.81	1.28	1,039
1	Female	1,193	do	37.25	15.84	20.44	1.20	1,048
1	do	1,332	do	39.84	18.93	20.31	1.04	1,177
1	Male	1,333	do	41.05	20.32	20.44	1.04	1,237
1		538	Dec. 10	30.65	8.41	22.00	1.23	764
1		625	do	33.00	10.32	21.56	1.31	836
1		681	do	33.99	12.35	21.56	1.35	922
1		838	do	37.48	17.78	21.25	1.34	1,145
1		938	do	30.31	7.77	21.56	1.52	729

INDIVIDUAL VARIATIONS

It has already become evident that the composition of fish flesh is greatly influenced by such factors as the time of year when caught, relation to maturity, and locality. Of course, the variation due to locality is somewhat complicated by the fact that this may be due rather to the unusual prevalence of food in or off the mouths of certain rivers like the Rogue, Columbia, and Yukon.

There is another type of variation which should be considered, and that is what we may call "individual" variation, for which we can find no other explanation than that it is due to the individuality of different fish. It is a well-known fact that no two biological individuals, whether of plant or of animal origin, are exactly alike. The amount of food they eat, the amount of energy they transform, and other conditions often seem to vary greatly for no apparent reason. This may be the cause of the so-called "individual" variation in fish that may be caught in the same school, where the conditions of time, place, school, and sex are apparently identical. Dill (1921) has analyzed a large number of individual California mackerel by groups caught at the same time, often of the same sex, and approximately the same size.

It takes only a very brief glance at Table 15, where Dill's results are tabulated, to bring out how great this factor of individual variation may be. For instance, in three individual mackerel caught on October 25 there was a variation in fat content from a minimum figure of 0.85 per cent to a maximum of 7.88 per cent. Again, at a later date—namely, December 10—five of the California mackerel varied individually in the percentage of fat from a minimum of 7.77 to a maximum of 17.78, or, when expressed in calories, from a minimum fuel value of 729 calories to a maximum of 1,145 calories per pound. The variation in the percentage of protein and ash is not very great, the main difference being in the percentage of fat, with a corresponding inverse change in the percentage of moisture.

VARIATION IN THE COMPOSITION OF DIFFERENT PARTS OF THE FLESH OF THE SAME FISH

Everyone who eats fish habitually has probably noticed that slices taken from different parts of the same fish will show a different degree of richness. This is also very well known to canners or preservers of fish. Many people, for instance, are very fond of the so-called "cheeks" of salmon and halibut. These portions of flesh on each side of the head are unusually rich and have a flavor of their own. Other parts of the body vary, also, as is well shown in Table 16, in which the results of Shostrom, Clough, and Clark (1924) on the analyses of different parts of the same salmon and Dill's work on the yellowtail and skipjack are presented.

TABLE 16.—*Variation in composition of different parts of the same fish*

[Analyses of the edible portion on the fresh basis]

Name	Cross section analyzed	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Fuel value per pound
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Calories*
Salmon (red chinook)	Near head	39.47	20.15	17.62	1.19	1,178
Do	Near tail	31.87	11.11	17.92	1.12	802
Salmon (white chinook)	Near head	35.71	15.10	19.00	1.40	990
Do	Near tail	29.80	8.10	19.93	1.31	712
Yellowtail	Middle	24.31	3.21	19.76	1.35	503
Do	Near tail	23.68	1.38	20.95	1.35	448
Skipjack	Belly only	45.45	25.80	18.31	1.35	1,430
Do	White meat only	38.68	15.39	21.87	1.39	1,056
Do	Dark meat only	41.57	22.38	18.16	1.03	1,282

In the case of the white and red chinook salmon there was a variation of almost 100 per cent in the fat content of the flesh taken from a slice near the tail as compared with a slice taken near the head. In the case of the yellowtail there was some variation, but less, between slices taken from the tail and the middle of the fish. The analyses of different parts of the skipjack are rather surprising in that the fat content in the belly pieces is larger than that of the dark meat. It is one of the characteristics of the mackerel and herringlike fishes, which include in the two groups mackerel, tuna, herring, sardines, shad, etc., all fishes of great economic importance, that they have a considerable lateral strip of dark meat which is known to be very rich in fat. In the white meat of the skipjack only 15.39 per cent of fat was present as compared with 22.38 per cent in the dark meat. In the case of the small fishes this variation in the individual part of the fish makes very little difference to the consumer because practically the whole edible part of the fish is consumed. On the other hand, where larger fish are canned or sold fresh in the form of slices this variation assumes greater proportions.

FOOD VALUE OF FISH AND SHELLFISH COMPARED WITH THAT OF OTHER FOOD PRODUCTS

In order to appreciate the real significance of fish in the diet it is necessary to make some comparisons in highly condensed form between the composition of fish and that of common animal and vegetable foods. We have already seen that the great value of fish is their content of protein, in the first place, and, in the second place, that the proteins of fish, like those of meat, contain essential nitrogenous substances like the amino acids tryptophane, cystine, and histidine, without which the body can not replace its wear and tear and either develop or function normally.

There is a great lack of carbohydrates in fish when compared with vegetable products. On the other hand, it is not at all necessary for fish or meat to compete with vegetable products in the matter either of fat or of carbohydrates, as it is commonly known that foods of vegetable origin are primarily of the carbohydrate or starchy type; furthermore, vegetable fats are relatively cheap. Some fish contain as much or more fat than meat, but generally speaking they do not. Fish can compete with meat in the dietary on the basis of the cost of the protein involved, and that will become clear in a table to be used later on. In Table 17, which is taken from Atwater's (1888) original publication, these considerations are presented in rather striking form.

TABLE 17.—*Comparison of the composition and food value of various types of food materials*

[Analyses of the edible portion on the fresh basis]

Food materials	Total solids	Fat	Protein (N×6.25)	Ash (inorganic matter)	Carbohydrates	Potential energy in 1 pound of each material
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Calories*
Fish and animal foods:						
Beef, side	45.3	27.1	17.2	1.0	----------	1,465
Beef, round	33.3	9.0	23.0	1.3	----------	805
Beef, sirloin	40.0	19.0	20.0	1.0	----------	1,175
Mutton, side	54.1	38.7	14.7	.7	----------	1,905
Mutton, leg	38.2	19.0	18.3	.9	----------	1,140
Mutton, loin (chops)	50.7	35.0	15.0	.7	----------	1,755
Flounder	15.8	.7	13.8	1.3	----------	285
Codfish	17.4	.4	15.8	1.2	----------	310
Mackerel, fat	36.0	16.3	18.2	1.5	----------	1,025
Mackerel, lean	21.3	2.2	18.1	1.0	----------	430
Mackerel, average	28.4	8.2	18.8	1.4	----------	695
Salmon	36.4	13.4	21.6	1.4	----------	965
Oysters, fat	18.3	1.7	8.0	1.9	6.7	345
Oysters, lean	9.1	.6	4.2	2.5	1.8	135
Oysters, average	12.9	1.2	6.0	2.0	3.7	230
Hens' eggs	26.9	11.7	13.7	1.0	.5	760
Cows' milk	12.6	3.7	3.4	.7	4.8	310
Cheese, whole milk	68.8	35.5	27.1	3.9	2.3	2,045
Cheese, skimmed milk	58.7	6.8	38.4	4.6	8.9	1,165
Butter	90.0	85.0	1.0	3.5	.5	3,615
Oleomargarine	90.0	84.5	.6	4.5	.4	3,585
Lard	99.0	99.0	----------	----------	----------	4,180
Vegetable foods:						
Wheat bread	67.3	1.9	8.9	1.0	55.5	1,280
Wheat flour	88.4	1.1	11.1	.6	75.6	1,660
Graham flour	87.0	1.7	11.7	1.8	71.8	1,625
Rye flour	86.9	6.7	6.7	.7	78.7	1,620
Buckwheat flour	86.5	1.3	6.5	1.1	77.6	1,620
Beans	86.3	2.1	23.2	3.6	57.4	1,585
Oatmeal	92.3	7.1	15.1	2.0	68.1	1,845
Corn (maize) meal	85.5	3.8	9.1	1.6	71.0	1,650
Rice	87.6	.4	7.4	.4	79.4	1,630
Sugar	97.8	----------	.3	.8	96.7	1,800
Potatoes	24.5	.2	2.0	1.0	21.3	440
Sweet potatoes	24.2	.4	1.5	1.2	21.1	435
Turnips	8.8	.2	1.0	.7	6.9	155
Carrots	12.1	.2	1.0	.8	10.1	215
Cabbage	10.0	.2	1.9	1.2	6.2	170
Melons	4.8	.6	1.1	.6	2.5	90
Apples	15.2	----------	.4	.5	14.3	275
Pears	17.0	----------	.4	.3	16.3	310
Bananas	26.9	.6	1.9	1.1	23.3	495

In order to appreciate better the real significance of fish in the dietary and the relative cost of obtaining protein (which is the essential part of both fish and meat) Table 18 is given. This table is taken from a bulletin by Langworthy (1907), entitled "Fish as food," and is well worth careful study by anyone interested in matters of diet and the preparation of menus, particularly where the cost of food is a factor.

TABLE 18.—*Comparative cost of protein and energy, as furnished by a number of food materials, at certain prices* [1]

Kind of food material	Price per pound	Cost of 1 pound protein	Cost of 1,000 calories energy	Amounts for 10 cents: Total weight of food material	Amounts for 10 cents: Protein	Amounts for 10 cents: Energy
	Cents	*Dollars*	*Cents*	*Pounds*	*Pounds*	*Calories*
Codfish, whole, fresh	10	0.90	48	1.000	0.111	209
Codfish, steaks	12	.71	36	.833	.142	274
Bluefish	12	1.20	58	.833	.083	172
Halibut	18	1.18	40	.556	.085	253
Codfish, salt	7	.44	23	1.429	.229	437
Mackerel, salt	10	.61	10	1.000	.163	998
Salmon, canned	12	.62	18	.833	.162	547
Oysters (solids, 30 cents quart)	15	2.50	68	.667	.040	147
Oysters (solids, 60 cents quart)	30	5.00	136	.333	.020	74
Lobster	18	3.05	129	.556	.033	77
Beef, sirloin steak	25	1.52	26	.400	.066	380
Do	20	1.21	21	.500	.083	475
Beef, round	14	.74	16	.714	.136	615
Beef, stew meat	5	.38	5	2.000	.266	1,862
Beef, dried, chipped	25	.95	33	.400	.106	303
Mutton, chops, loin	20	1.48	14	.500	.068	694
Mutton, leg	22	1.46	25	.454	.069	394
Pork, roast, loin	12	.90	10	.833	.112	1,016
Pork, smoked ham	22	1.55	14	.454	.064	729
Milk (7 cents quart)	3½	1.06	11	2.857	.094	891
Milk (6 cents quart)	3	.91	10	3.333	.110	1,040
Wheat flour	3	.26	2	3.333	.380	5,363
Corn meal	2	.22	1	5.000	.460	8,055
Potatoes (90 cents bushel)	1½	.83	5	6.667	.120	2,020
Potatoes (45 cents bushel)	¾	.42	2	13.333	.240	4,040
Cabbage	2½	1.79	21	4.000	.056	484
Corn, canned	10	3.57	23	1.000	.028	444
Apples	1½	5.00	7	6.667	.020	1,420
Bananas	7	8.75	24	1.429	.011	414
Strawberries	7	7.78	42	1.429	.013	240

[1] Data taken from Farmers' Bulletin No. 85, U. S. Department of Agriculture, "Fish as food," by Langworthy. The prices are therefore based on pre-war conditions.

Of course, the relative cost of the different foods in this table is based on prices that were in effect several years ago. In using this scale of prices it will be necessary to make an addition of some 50 or 60 per cent to the figures to make them accord with the increased cost of living at present, as determined by the various indexes of commodity prices, most of which are based on prices current in the year 1913 as 100 units. Furthermore, it would not be possible to give any exact figures on the cost of foods that actually represent conditions all over the country, as there is considerable variation between different localities. However, this table serves a very good purpose because it makes the comparisons between the different food products on the basis of the cost of protein, the essential ingredient, and also on the cost of total calories, which is not quite as important. It is evident that fish compare quite well with meat products in the matter of protein. It is also striking that the cost, where calories only are a consideration, is lowest in the case of vegetable products like wheat, flour, corn meal, potatoes, etc. It has been pointed out by an eminent physiologist that a man could probably keep body and soul together at a cost of 10 cents per day on the basis of calories only. However, as civilization advances and the standard of living reaches a high point as it has in the United States, the consumer is not interested so much in stoking his human furnace with the required number of calories in the form of bread or potatoes, for instance, as he is in getting a varied diet consisting of palatable foods with attractive flavors.

There is no question that flavor is the thing that makes foods attractive, and it has a great deal to do with establishing their price in competition with other foods. It is just in this matter of flavor that fish and shellfish stand out most conspicuously. It is a well-know fact that one of the first things people do when they travel from the interior to any of the coasts is to indulge in oysters, clams, and fish products. It is, first, the flavor that they are anxious to get, and, secondly, the change in diet; at the same time they usually are securing an unaccustomed source of nitrogenous nutrients. It is surprising how popular "shore dinners" are in some places on the New England coast and "sea-food dinners," so-called, served in other places. From beginning to end such meals may consist of various fishery products and yet not give one the impression of overdoing the matter. It is not the purpose of this chapter to go into the matter of dietaries or the discussion of various attractive ways in which fish can be prepared.

There is one popular misconception regarding fish and shellfish, particularly fish, that should be corrected. The early investigators on the composition of fish reported that considerable phosphorus was present, and the idea that fish must be brain food on account of its phosphorus content immediately gained popularity. As a matter of fact, there is absolutely no foundation for this belief. The analyses made do not show that there is an unusual amount of phosphorus in fish, and even if this were the case it does not follow that the phosphorus in them would be absorbed and transferred especially to the brain for the maintenance of that organ and thus enable brain workers to excel in their particular line of activity. It is true that the brain does contain considerable amounts of substances in which phosphorus and nitrogen play an important part. However, all the cells of the body, as well as of the brain, obtain the necessary ingredients for their life activities from the blood stream, selecting the materials necessary for their life processes. There is no indication whatever that the brain could function any better without water or without nitrogen or sulphur or potassium than it could without phosphorus. The truth of the matter is the brain must have all of these elements. It has already been pointed out that the only safe course for an individual to follow is to eat a varied diet consisting of the proper proportion of fats, carbohydrates, and proteins, derived from fish, meat, eggs, dairy products, cereals, fruit, and vegetables. When this is done, and if pains are taken that the vitamins are not neglected in the diet, the body can grow, maintain itself, and function in a normal way.

II.—FISH AND SHELLFISH AS A SOURCE OF PROTEIN

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INTRODUCTION

Protein is one of the most important components of our diet. Fats and carbohydrates are primarily energy-yielding foods, whereas proteins are not only sources of energy but are tissue-builders as well. Our bodies form the proteins characteristic of our own tissues; they can not build them up from simple inorganic substances but must depend upon the digestion products obtained from the food. Neither the growth of the young nor the satisfactory nutrition of adults can take place without an adequate source of proteins in the diet. Further, recent studies in nutrition have pointed out the danger of attempting to live over the entire span of adult life on a diet containing just sufficient proteins of good quality to support growth at approximately the maximum rate to the full adult size. A generous protein ingestion during our entire lives is required to maintain optimal vigor for the longest possible period.

An examination of the tables given in the preceding section indicates that fish resemble meats in containing a high percentage of protein. Live crabs, lobsters, shrimp, scallops, mussels, clams, and oysters contain much calcareous matter in their shells and also contain much water; for these reasons their protein content is apparently much lower, but when the analyses of water-free substance of the edible portion of these shellfishes is considered it is seen that its protein content is also high.

Near the seashore and in the markets of the large cities where fish may be purchased cheaply in season they constitute a low-priced source of protein. Well-cooked fish are delicious and offer a welcome change from a steady diet of meat. Protein purchased in the form of crabs, lobsters, scallops, clams, and oysters at the usual prices of these shellfish is more expensive. However, these mollusks and crustaceans have other nutritive values and should not be omitted from well-planned diets.

Inasmuch as proteinaceous foods are so essential for the well-being of man, and as fish and shellfish contain much protein, a consideration of the nutritive value of their proteins should be made if these foods are to be given their proper place in the diet.

CHARACTERISTICS OF PROTEIN REQUIRED FOR THE NUTRITION OF MAN

Proteins, whether found in plants or animals, are complex compounds of high molecular weight built up of a number of relatively simple substances called amino acids, which are combined in various proportions. The amino acids of common proteins include the following: Glycine, alanine, valine, leucine, phenylalanine, tyrosine, serine, cystine, aspartic acid, glutamic acid, ornithine, arginine, lysine, histidine, proline, tryptophane, and oxyproline.

During the digestion of a protein it is split up into these amino acids or into combinations of a few of them called peptids. The amino acids and peptids are absorbed by the blood stream; those required for the building of tissues are so utilized, and those left over are used for their energy. Their waste products—urea, etc.—are removed by the kidneys and excreted in the urine.

The proteins of the human tissues are definite chemical compounds. Various proportions of the common amino acids are required for their synthesis. In other words, the amino acids constitute the building stones or units out of which the great protein structure is put together.

Formerly the nutritive value of proteins was discussed in terms of digestibility, physical properties, and their content of carbon, hydrogen, oxygen, nitrogen, and sulphur. Osborne and Mendel (1911 to 1924) have done much to establish the modern conception that the nutritive value of proteins is largely determined by the amounts of each of the amino acids which they yield. Many, if not all, of these amino acids are essential for the construction and maintenance of tissues. The efficiency of any individual protein in nutrition depends upon the minimum of any indispensable amino acid that it yields on digestion, for it is known that several of the amino acids can not be synthesized in the human body. For example, if a protein or mixture of proteins, comparatively deficient in the amino acid tryptophane, be supplied in the diet as the sole source of combined nitrogen, the synthesis of protein molecules containing this amino acid would be limited by the amount available in the diet. Thus, maintenance and growth would be limited by the minimum of the essential unit.

As yet we do not know how many of the amino acids are essential in the diet, but nutrition experts have shown that the following amino acids are absolutely essential for growth and maintenance: Tyrosine, tryptophane, lysine, cystine, and either histidine or arginine. Further, many believe that valine, leucine, and phenylalanine are also essential units. On the other hand, it has been demonstrated that neither glycine nor proline need be provided ready-made in the food.

Since the proteins of the protoplasm of our bodies are built up from the amino acids in the digestion products of the proteins of our foods, it is probable that the more nearly the amino acid composition of the proteins of the food resembles that of the body the greater is their nutritive value.

DIGESTIBILITY

Several scientists (Milner, 1905; White and Crozier, 1911; and Holmes, 1918) have shown that the proteins of fish are as easily digested as those of beef and other meats. The digestibility of the proteins of salmon, mackerel, butterfish, and dogfish have been determined both by the use of the enzyme, trypsin, and by experiments with human subjects. These proteins were in all cases easily and nearly completely digested. On the average, about 92 per cent of the proteins were digested.

The proteins of oysters, clams, scallops, and mussels also are readily digested. Whale meat has been found to be as easily and as completely digested as beef. Very few experiments have been carried out to determine the digestibility of crabs, lobsters, shrimp, and other crustaceans, but by analogy we may conclude that the proteins of these shellfish are readily digested.

ANALYSES OF THE PROTEINS

FORM OF NITROGEN

Upon extraction of fresh fish muscle with water the following substances are obtained: Histidine, hypoxanthine, carnosine, tyrosine, creatine, and creatinine. Of these, histidine and tyrosine are especially valuable in nutrition.

A study of the proteins of fish by the Hausmann method of analysis gives some information concerning their nutritive value. According to this procedure the amounts of ammonia nitrogen, monoamino nitrogen, diamino nitrogen, and humin nitrogen are determined. Since humin nitrogen is found chiefly by the decomposition of the amino acid tryptophane, which is essential for proper nutrition, the percentage of humin nitrogen found may be taken as an index of the quantity of tryptophane in the protein. The diamino nitrogen includes the nitrogen in the form of the diamino acids, arginine, histidine, and lysine. Since any diet must contain an ample amount of lysine and either arginine or histidine, or both, it is interesting to note whether or not the fish that have been analyzed are deficient in diamino nitrogen. From the data given in Table 19 it is seen that the proteins of halibut, cod, herring and scallops compare very favorably with those of beef and chicken in their content of diamino and humin nitrogen.

TABLE 19.—*Analyses showing form of nitrogen in certain fish, meats, etc.*[1]

[Total nitrogen=100]

Source of protein	Ammonia	Humin	Monoamino	Diamino
Halibut	6.70	2.37	60.80	30.20
Cod	5.82	2.30	61.20	30.00
Herring	6.05	2.64	61.40	29.70
Scallops	6.33	2.34	64.81	26.51
Beef	5.51	2.66	64.40	27.30
Chicken	6.63	1.76	61.55	30.27
Glutenin from wheat	18.86	1.09	68.32	11.72
Globulin from wheat	7.72	1.52	53.39	37.14
Zein from corn	18.41	.99	77.56	3.03
Legumin from pea	9.40	.94	60.27	28.82

[1] Compiled from papers published by Drummond (1918-1919), and Osborne and Heyl (1908).

The Hausmann method does not give much information concerning proteins that is of value from a nutrition viewpoint, but as it is comparatively rapid and does not require a high degree of skill it has been used in the examination of a very large number of proteins. Physiological experimentation and the determination of the individual amino acids are required to obtain much information concerning the nutritive value of protiens. No two physiological chemists agree entirely as to the procedure that should be followed in feeding experiments in determining the nutritive value of a given protein. On this account there is some disagreement between chemists as to the exact value of many proteins in the diet. The increase in our knowledge concerning the amino acid content of proteins is aiding in the proper evaluation of proteins from a nutritive standpoint.

AMINO ACID ANALYSES

The methods of determining the several amino acids obtained by the hydrolysis of proteins while not especially accurate are fairly well standardized, and on this account different workers can check each other with a fair degree of accuracy. Unfortunately, comparatively few fish have been analyzed for their amino acid content. In Table 20 are given the amounts of amino acids obtained upon the hydrolysis of 100 grams of ash and moisture-free muscle protein of those that have been analyzed, viz, porgy, halibut, bonito, cod, whale, and scallops. The analyses of the proteins of chicken and beef are given for comparision.

TABLE 20.—*Cleavage products of proteins of various fish and shellfish and some meats*

[Expressed in grams obtained from 100 grams of ash and moisture-free muscle protein]

Product	Porgy (Pagrus major)	Halibut (Hippoglossus hippoglossus)	Bonito (Katsuwonus pelamis)		Cod (Gadus callaorias)	Carp (Cyprinus carpio)	Whale	Scallop	Chicken	Beef
			Light flesh	Dark flesh						
Glycine	[1] 0.0	0.0	0.0	0.0	[1] 0.0	2.0	0.0	0.0	0.68	2.06
Alanine	1.04	(2)	2.3	1.1	3.53	5.7	4.66	(2)	2.28	3.72
Valine	2.77	.79	2.8	1.8	3.88	5.7	6.25	(2)	(2)	.81
Leucine	8.82	10.33	10.4	9.4	2.46	8.0	3.54	8.78	11.19	11.65
Proline	1.22	3.17	3.1	3.0	1.68	10.5	1.51	2.28	4.74	5.82
Phenylalanine	4.72	3.04	4.1	1.6	2.31	3.9	2.59	4.90	3.53	3.15
Aspartic acid	1.66	2.73	3.3	3.2	.61	.9	1.47	4.37	3.21	4.51
Glutamic acid	1.63	10.13	8.1	12.1	5.24	12.9	3.28	14.88	16.48	15.49
Serine	(2)	(2)	(2)	(2)	.51	(3)	.49	(2)	(2)	(2)
Tyrosine	2.64	2.39	2.1	2.9	2.46	3.5	2.40	1.95	2.16	2.20
Arginine	5.15	6.34	7.8	7.08	6.68	14.0	6.48	7.38	6.50	7.47
Histidine	2.07	2.55	3.04	3.16	2.29	12.3	3.44	2.02	2.47	1.76
Lysine	6.28	7.45	7.41	6.78	8.35	11.3	9.48	5.77	7.94	7.59
Ammonia	1.32	1.33	.64	.78	.75	1.4	.91	1.08	1.67	1.07
Tryptophane	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Guanine	(2)	(2)	.09	.12	(2)	(2)	(2)	(2)	(2)	(2)
Adenine	(2)	(2)	.04	.1	(2)	(2)	(2)	(2)	(2)	(2)
Hypoxanthine	(2)	(2)	.08	.03	(2)	(2)	(2)	(2)	(2)	(2)

[1] Or trace.
[2] Present but not determined.
[3] Not determined.

NOTE.—Compiled from data published by Osborne and Heyl (1908), Okuda (1919), Okuda and Oyama (1912-1916), Okuda, Okimoto, and Yada (1919), and Okuda and Matsuda (1923).

These data indicate that the tyrosine, arginine, histidine, and lysine content of various fishes is about the same, whereas the content of the various monoamino acids varies considerably. In general, it may be said that the proportions of amino acids found in fish proteins are approximately the same as those found in chicken muscle, except that the proteins of fishes are curiously low in glycine, an amino acid not essential in the diet. If the analysis of the proteins of halibut muscle is compared with that of chicken proteins, it is seen that the halibut proteins are much lower in the nonessential amino acids, glycine, and valine and somewhat lower in proline, phenylalanine, and glutamic acid, but that these proteins are almost identical in their content of the essential amino acids, tyrosine, arginine, histidine, and lysine.

The analysis of the proteins of the porgy is curiously low in glutamic acid, probably on account of an error in technique on the part of the analyst. The analysis of cod proteins is very low in leucine, and this perhaps may be explained in the same way.

The data given in the table indicate that the proteins of whale and beef resemble each other closely. The proteins of whale meat are low in glycine, glutamic, and aspartic acids, and in proline and leucine; the other amino acids exist in both whale and beef proteins in practically identical proportions.

One would hardly expect the proteins of scallop muscle to resemble in composition those of chicken and beef, yet the analysis given in Table 20 shows that this is the case. Except for a lower content of leucine and proline and a deficiency in the nonessential amino acid glycine, scallop muscle proteins are similar in composition to meat proteins.

INTERPRETATION OF ANALYSES

Thus, it is seen that fish, scallop, and whale proteins are valuable sources of nitrogenous substances for the nutrition of man and other animals, for they are complete proteins, lacking only in the simple amino acid glycine, which can be formed in the body by the splitting of other amino acids.

The presence of considerable amounts of tyrosine, tryptophane, lysine, histidine, and arginine is noteworthy, as these amino acids are essential for proper nutrition. Fishes and whale meat also have been shown to contain adequate amounts of valine, leucine, and phenylalanine, which are valuable constituents of proteins and are also considered essential by many nutrition experts.

Cereal proteins are, for the most part, deficient in arginine, histidine, and lysine. The amounts of these three amino acids contained in many restricted vegetarian diets are the limiting factors that determine their value for maintenance and growth. The ability of many Japanese to subsist on a vegetarian diet supplemented by fish is due to the fat-soluble vitamins found in the fish fats and the amino acids arginine, histidine, and lysine found in fish proteins. The Japanese also eat considerable quantities of whale meat. Whale proteins are especially high in lysine and are also high in histidine and arginine, and on these accounts they are valuable in supplementing vegetable proteins.

Scallops also contain relatively large amounts of lysine, arginine, and histidine, and for this reason furnish the amino acids deficient in a vegetarian diet. Although no analyses are available to prove the point, it may be assumed that the proteins of oysters, clams, mussels, and other mollusks also contain adequate amounts of these amino acids, which are so valuable in supplementing restricted vegetarian diets.

SUMMARY AND CONCLUSIONS

Fishes, mollusks, and crustaceans are rich sources of proteins. Many of them are available to the wealthy and the poor alike on account of their low cost. For these reasons the nutritive value of the proteins of fish and shellfish is of much importance in determining the proper place of these foods in the diet.

The proteins of fish, mollusks, and whale meat have been shown to be easily and completely digested. The digestion products consist of a number of amino acids and peptids (groups of amino acids). The nutritive value of any protein depends upon the quantity and quality of these amino acids which it yields on digestion.

Only a few of the proteins of fish and shellfish have been analyzed for their content of the individual amino acids. From the available data the following conclusions may be drawn:

1. The proteins of fishes, scallops, and whales are complete, viz, they contain all of the amino acids required for the growth and maintenance of the human body. They are lacking in only one amino acid—glycine—which can be obtained by the body by the splitting of other amino acids; many investigators have demonstrated that its presence in food is nonessential for proper nutrition.
2. The amino acid composition of the proteins of other shellfish has not been determined.
3. The proteins of the fishes, scallops, and whales, which have been analyzed for their amino acid content, have been shown to be high in tyrosine, lysine, tryptophane, arginine, and histidine, the amino acids which have been demonstrated as being required in considerable quantities by the human body for growth and maintenance.
4. The presence of a high percentage of lysine, histidine, and arginine is particularly noteworthy, as these amino acids are deficient in most vegetable proteins. Because of this fish and shellfish may be served as the principal dish of a meal consisting largely of fruits and vegetables with the assurance that the fish proteins will completely supplement the vegetable proteins.
5. The proteins of fish and shellfish are superior to most vegetable proteins and equal to most meat proteins in nutritive qualities.

III. OILS AND FATS FROM FISH AND SHELLFISH

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The dietary value of fish oils, like that of fats and oils obtained from land animals and plants, depends on a number of factors, the principal ones being their composition or nature, digestibility, and vitamin content.

COMPOSITION

Considered from a chemical standpoint, the edible fats and oils consists chiefly of glycerides of fatty acids; or, in other words, they are compounds of glycerin and fatty acids, and, as every one knows, when fats are saponified (made into soaps) one obtains soap (which is a mineral salt of fatty acid) and glycerin as a by-product.

The fatty acids most commonly occurring in the edible fats and oils are oleic, linolic, palmitic, and stearic. These fatty acids differ from one another principally as regards chemical composition and the temperature at which they melt. The difference in the physical condition of fats is largely due to this fact.

Referring briefly to the above four fatty acids, the chemist would say that the degree of saturation and the melting point increase as one progresses in the series. In practical terms this means that fats such as olive, peanut, and cottonseed oils, which contain a high percentage of the glyceride of oleic acid, would become rancid more quickly and would melt at a lower temperature than such fats as beef or mutton tallow, which contain a high percentage of the glyceride of stearic acid.

The fats from land sources consist largely of the glycerides of oleic, palmitic, and stearic acids. In addition to these, fish oils contain others to a greater or less extent. Various investigators have submitted experimental evidence to show that from fish fats one may obtain jecoric acid, jecoleic acid, therapic acid, and culpanodonic acid. The discovery of the presence of the glycerides of culpanodonic acid in marine animal fats was of more than scientific interest, for Tsujimoto, a Japanese investigator, has apparently shown that the characteristic fishy odor of these fats is due very largely to this substance. When the glyceride of culpanodonic acid was removed from marine fats, or by hydrogenation was transformed into a glyceride of some other fatty acids, the characteristic odor of fish fats disappeared.

The edible fats obtained from land animals and plants are naturally divided into two groups—those that are solid and those that are liquid at ordinary temperature. In general, the fats of animal origin, such as lard, butter, and beef and mutton suet, are solid at ordinary temperature. With a few exceptions, such as cocoa butter and coconut fat, those from the vegetable kingdom are liquid at ordinary temperatures. In addition, there are, to be sure, a few border-line fats, such as chicken fat, that are semisolid at ordinary temperature.

In comparing the nature of fish fats with those obtained from land plants and animals it will be found that a much larger proportion of the former are liquid at ordinary temperature than is the case with fats of land origin. In fact, with the exception of that obtained from the Pacific coast eulachon, all fats obtained from fish are liquid at ordinary temperature.

Crude fish-liver oils, such as cod-liver oil, are very nearly on the border line between liquid and solid fats, for if the temperature is lowered stearin begins to solidify and separate from crude cod-liver oil.

In considering the nature of fish fats there is one factor that should be given attention—their tendency to oxidize and become rancid. Considered chemically, fats may be divided into three groups—drying, semidrying, and nondrying oils. This classification of oils is based on the power of oils to take up oxygen. Oils that can absorb relatively large amounts of oxygen are called drying oils and are in demand for use in paints. The best-known member of this group is linseed oil. Next comes the semidrying oils, or those which can take up some oxygen but not enough to make them good paint oils. The nondrying oils are characterized by a low iodine number and do not absorb oxygen readily.

While fish and marine animal oils differ from the terrestrial animal oils to some extent as regards color, odor, and viscosity, they are quite different chemically. The terrestrial animal oils resemble closely the nondrying oils in that they do not easily absorb oxygen. The fish and marine animal oils resemble the drying oils and have the power to absorb oxygen. Due to this chemical difference a cook would have relatively little difficulty in keeping beef or mutton fat, lard, chicken fat, or butter without oxidizing and becoming rancid, but more care would be necessary for the storage of fats from fish and marine animals.

In using fish fats for culinary purposes attention should be given to the possible necessity for modifying somewhat the procedure involved in the culinary use of common fats such as lard and butter. Studies with regard to the scorching temperature of common culinary fats show that in frying (particularly deep frying) there is a definite temperature for each fat at which food is most satisfactorily cooked and with the absorption of a minimum of fat. In a previous publication [1] it was noted that this temperature is about 260° F. for beef fat, 350° F. for lard, and 390° F. for cottonseed, coconut, and peanut oils. It was noted further that if these temperatures were lowered 20° for the animal fats and 40° for the vegetable fats the amount of fat absorbed by the cooked foods increased 25 per cent. Accordingly, when using fish fats for culinary purposes one should be prepared to modify culinary practices in accordance with the nature of the particular fat under consideration.

DIGESTIBILITY

Hundreds of digestion experiments with human subjects have been conducted to determine the extent to which the edible fats from land plants and animals are utilized by the human body. These show that the liquid fats as a class are more completely utilized by the body than are the solid fats. While in some instances there is little difference between the digestibility of solid fats with a relatively high melting point and that of the liquid fats, there may be a difference of 10 or 12 per cent between the digestibility of the more completely digested liquid fats and that of the less completely digested solid fats.

Applying this generalization concerning the digestibility of fats obtained from land plants and animals to the digestibility of fatty substances obtainable from fish, one would conclude that the digestibility of edible fish fats would be quite similar to that of vegetable fats.

As regards actual data concerning the digestibility of fish fats, one finds very little information recorded. The digestibility of fish fats has been studied to a limited extent by a number of investigators, who conducted digestion experiments with human subjects. Milner (1905) studied the digestibility of fat contained in canned salmon and in fresh cod steaks when they were eaten as constituents of a simple mixed diet. He found that the fat of both the salmon and cod was 97 per cent digested. Oshima (1905) reports the digestibility of the fat contained in the edible portion of fresh fish to be as follows: Porgy, 73 per cent; salmon, 94 per cent; poulpe, 60 per cent; shellfish (*Tapes Philippinarum*), 85 per cent; and dried herring, 80 per cent.

The results of digestion experiments conducted by the writer [2] while employed at the United States Department of Agriculture show that fish fats are well utilized by the human body. In studies with fresh mackerel and butterfish and canned salmon and dogfish the digestibility of the fat was found to be 95 per cent for Boston

[1] Holmes, A. D., and H. L. Lang: Fats and their economical use in the home. United States Department of Agriculture Bulletin No. 469, Dec. 15, 1916, 26 pp. 2 figs. Washington. (See p. 19.)

[2] Holmes, A. D.: Experiments on the digestibility of fish. United States Department of Agriculture Bulletin No. 649, Apr. 13, 1918, 14 pp. Washington. (See p. 14.)

mackerel, 86 per cent for butterfish, 94 per cent for dogfish, and 94 per cent for salmon.

From this limited data concerning the digestibility of fish fats one is inclined to conclude that they are quite satisfactorily utilized by the human body.

PALATABILITY

The palatability of fish oils is influenced by many factors. When the oils are separated from the fish and prepared for consumption, careful attention should be given to the source of the oil and manufacturing conditions. It is essential that the body or liver of fish from which the oils are extracted should be strictly fresh. Manufacturing processes, also, should be developed so that only the highest possible grade product is produced.

At the present time the greater portion of fish oils is consumed in conjunction with the tissues in which they naturally occur. Many people are very fond of fat-rich fish, such as butterfish, mackerel, and salmon, and as a result add fish oils to their dietary. Persons who desire to increase the fat content of their diet do not consider eating lard for that purpose. However, they often find crisp bacon very appetizing. In the same manner one may not wish to include separated fish oils in the dietary but would find well-cooked, fat-rich fish a welcome addition to their daily fare. In fact, those who are accustomed to eating fish often become very enthusiastic concerning the unusual palatability of broiled mackerel or broiled fresh salmon when done to a turn and well garnished with a little parsley and plenty of fresh lemon juice.

PRESENT CONSUMPTION

It is difficult to accurately estimate the quantity of fish fats used for food. Relatively speaking, very little fish fat is included in the human dietary as such, but large amounts are eaten in conjunction with the flesh of some of the well-known fat fish. For instance, the 1923 pack of salmon amounted to 6,500,000 cases, or 312,000,000 pounds. Since canned salmon contains nearly 11 per cent of oil, this amount contributed something like 33,900,000 pounds of salmon body oil to the human dietary.

The amount of oil which may be contributed by other fish can be estimated if one remembers that 16,000,000 pounds of mackerel have been taken by the New England fisheries in one season; that a single year's catch of butterfish off the New York-New Jersey coast amounted to 5,000,000 pounds; and that the edible portions of these fish at some seasons may contain as much as 12 per cent fat. Perhaps a better conception of the amount of fish oil which finds its way into the human dietary can be gained if it is noted that of the many millions of pounds of fish caught the general average percentage of fat is about 10 per cent of the edible portion.

A consideration of fish and marine animal oils would not be complete without mention of whale oil. Many romances of the sea have centered about expeditions of whaling vessels. In earlier times whale oil was used largely for illumination, but with the advent of kerosene, gas, and electricity relatively little whale oil is now used for that purpose.

Under ordinary conditions of preparation whale oil is not very satisfactory for food. It is difficult to obtain accurate figures concerning the use of whale oil, but probably the larger portion is hydrogenated. It is reported that in Europe considerable quantities of hydrogenated whale fat are used in the manufacture of margarines.

ENERGY VALUE

As is well known, the energy value of fats is greater than that of any other substance included in the human dietary. Protein and carbohydrates, such as starches and sugars, produce approximately 4 calories per gram when burned in the body. Fats, on the other hand, supply about 9 calories per gram when oxidized under the same conditions. Accordingly, fats have an energy value roughly 2¼ times that of protein and carbohydrates.

Fats that have been separated from extraneous substances, such as water, tissues, and cellular material, have an energy value of about 4,080 calories per pound. On the other hand, products like butter and margarines contain water, casein, and salt, and therefore possess a lower energy value. Since the legal standard for butter and oleomargarine requires that they contain 80 per cent fat, we might assume that the energy value of butter and margarines is something like 3,300 calories per pound. Considered from a dietary standpoint, the energy value of fish fats would be approximately 4,080 calories per pound, which is the same as that for vegetable fats, and roughly one-fourth greater than that of butter and margarine.

A further conception of the dietary value of some fat-rich fish and fish products may be obtained by comparing these with some common articles of the diet. It is generally considered that such foods as veal, whole milk, baked beans, and sirloin steak are very hearty and are well suited to the needs of those engaged in strenuous labor. On the other hand, one commonly thinks of mackerel and smoked herring as valuable only for the Friday dinner; of canned sardines as a constituent of the picnic lunch, to be eaten when one is carefully avoiding strenuous labor; and of shad roe as a delicacy consumed for palatability rather than for energy value. As a matter of fact, we find[3] that smoked herring supplies 755 calories per pound as compared with 745 calories per pound of breast of veal; mackerel supplies 370 calories per pound as compared with 310 calories for whole milk; canned sardines furnish 950 calories per pound as compared with 975 calories per pound supplied by sirloin steak; and shad roe furnishes 600 calories per pound, as compared with 555 calories per pound of baked beans.

Obviously, a portion of the energy value of these foods is derived from their protein content, but the above comparisons have been included with the hope of correcting the misconception concerning the inferiority as a source of energy of canned sardines, mackerel, shad roe, and smoked herring to such food materials as veal, milk, sirloin steak, and baked beans.

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[3] Atwater, W. O.: Principles of nutrition and nutritive value of food. United States Department of Agriculture Farmers' Bulletin No. 142, 1902, 48 pp., 1 chart. Washington. (See pp. 16 and 17.)

LIVER OILS, RICHEST NATURAL SOURCE OF FAT-SOLUBLE VITAMINS

In considering the dietary value of fish fats and oils one should consider their value as a source of vitamins as well as of energy. Considered from the standpoint of vitamin content, the liver oils of the family Gadidæ (which includes cod, hake, haddock, and pollock) are generally acknowledged to be the richest known source of the antiophthalmic and antirachitic vitamins. The antiophthalmic vitamin is also known as vitamin A, and the antirachitic vitamin is sometimes referred to as vitamin D.

It has been shown by the writer (Holmes, 1925) that the vitamin A content of cod-liver oil is more than 100 times as potent as that of dairy butter, which is believed to be one of the substances richest in fat-soluble vitamins. The writer has also found that the liver oils of pollock, hake, haddock, halibut, and dogfish have a high content of vitamin A (Holmes, 1922 and 1924; Holmes and Pigott, 1925). Other studies (Holmes, 1924a) show that the vitamin content of cod-liver oil varies over wide limits, and that its extent is influenced to a great degree by the condition of the fish from which the livers are taken, as well as by manufacturing processes and storage conditions. To prepare a wholesome, palatable cod-liver oil having a high vitamin content it is necessary to use only strictly fresh livers, and these should be cooked within a short time after the fish are caught.

The process of manufacturing cod-liver oil is much like that of making a cake. If the cook is provided with strictly fresh eggs she should be able to prepare a tasty cake, at least in so far as the eggs are concerned; but if stale, musty, or bad eggs are used it is difficult if not impossible to make a satisfactory cake. In the same way if cod livers have begun to decompose the oil obtained from them can be used only for industrial purposes unless it is chemically processed. By chemically treating industrial or even "rotted" cod-liver oil it is possible to so improve the color, odor, and other characteristics that such renovated oils will pass for medicinal cod-liver oil. In this connection it is important to remember that such refining does not increase the vitamin potency of these low-grade oils, which ordinarily have little if any value as a source of vitamins.

As noted above, large quantities of fish body fats that are intimately associated with muscular tissues are eaten annually. The question, therefore, naturally arises as to whether the fish body fats also contain large amounts of the fat-soluble vitamins. Vitamin tests were conducted by the author (Holmes, 1925a; Holmes and Pigott, 1925a) to secure information concerning the vitamin potency of shad and salmon body fats, and it was found that these fats were not as rich in vitamin A as were cod and other fish liver fats.

Since in evaluating an edible fat one must consider both the energy value and the vitamin content, it is of interest to note here the recent work by Fridericia (1924) regarding the vitamin content of whale fat. He reports that additions of 20 per cent hydrogenated whale fat to the diet of experimental animals did not contribute sufficient vitamin A to enable the animals to make scarcely any growth. Furthermore, he shows that the hydrogenated whale fat actually had destructive action on the vitamin A content of butterfat when the two fats were mixed after they had been melted. He very properly points out the results that this undesirable property of hydrogenated whale fat might have in the manufacture of margarines if it or other fats possessing this destructive power were included as components of margarine or lard compounds.

The foregoing remarks concerning the fat-soluble vitamins in fish fats have been included here because of the close relation of fat-soluble vitamins and fish fats. The general subject of the distribution, availability, and value of vitamins in fish and shellfish is more fully covered in another chapter.

INCREASING THE CONSUMPTION OF FISH FATS

In the foregoing reference has been made to the amount of fish fats that are eaten as a part of fish flesh. The amount of fish fats ingested in conjunction with the consumption of fresh fish far exceeds the estimate of anyone who has not examined market records. This amount of fish fat is greatly exceeded by the amount eaten as a part of fish preserved by drying, salting, pickling, smoking, and canning. The total of the fats eaten as a part of both fresh and preserved fish is many times exceeded by the quantity of separated fish fats prepared annually.

To indicate briefly the extent to which such fish fats are available, it may be noted that as much as 6,260,478 gallons of menhaden, 170,977 gallons of sardine, 450,362 gallons of herring, and 25,989 gallons of salmon oils have been prepared during a year. At the present time these are used largely for industrial purposes. In selecting fats for food the purchaser ordinarily considers such factors as price, quality, palatability, and individual preference. The question of the third factor—palatability—has to a very great extent been the deciding factor against the use of fish fats. To be sure, individual preference plays an important part in the decision against the use of fish fats in cooking, but this objection would not be of long standing if their quality and palatability were improved. In support of this assumption attention may be called to the status of cottonseed oil, which is now used on its own merits. Years ago it was in decided ill repute as a salad oil, for it was considered a substitute for olive oil. At the present time cottonseed oil (which has an energy value as high as that of any fat) is freely used for salads and cooking purposes with no thought of comparing it with olive oil. Similarly, if fish fats could be offered to the average consumer in an attractive and palatable form at a price not in excess of that of commonly used fats they would be used for cooking in constantly increasing quantities in spite of any present personal prejudices.

To be sure, it would be necessary to refine such fats in order to make them attractive to the average consumer. This is also the case with cottonseed oil, for when it is first obtained from the hot, pressed seed it is a heavy ruby or dark red oil that is far from attractive as a food, but when refined by treating it with various decolorizing, deodorizing, neutralizing, and bleaching agents it is transformed into an attractive, light yellow oil that may be used for salads or in cooking, and it may be further transformed by hydrogenation into a white, bland, solid fat of any desired consistency.

The results of numerous investigations show that the hydrogenation process is most suitable for improving the quality of fish fats. It is largely used for hardening liquid fats and consists of heating under proper pressure an intimate mixture of finely divided nickel or other catalyst, hydrogen, and the oil to be hardened. The hydrogenation of fish fats is doubly successful. First, as pointed out above, it deodorizes the fat, and, second, by this process it is possible to harden the liquid fats to the consistency of lard.

From the foregoing it is evident that when economic conditions demand it chemists will be able to transform fish fats into products suited to the consumer's taste. Furthermore, it is evident that there must be an ever-increasing supply of edible fats, for the present-day dietitian feels that the human diet to be satisfactory should contain a certain percentage of fats. It therefore appears to be only a question of time until fish fats will be more extensively used in the human dietary.

SUMMARY

Fish and marine animal fats have somewhat the same composition as the terrestrial fats. Due to their greater power to absorb oxygen, they should be protected from the air during storage.

From the data at present available it appears that fish fats are as completely digested as terrestrial fats of like melting point.

The use of fat-rich fish increases the fat content of the diet by adding fish fats in a very palatable form.

The energy value of the separated fish fats is equal to that of the common salad and culinary fats.

Some of the fat-rich sea foods, such as canned sardines, salmon, and shad roe, have an energy value equal to that of popular hearty foods such as veal, milk, sirloin steak, and baked beans.

Fish fats such as the liver oils are the richest known natural source of the essential fat-soluble vitamins.

Fish fats are available in large quantities and may be modified to suit requirements by various refining processes whenever economic conditions warrant.

IV.—MINERAL CONSTITUENTS OF FISH AND SHELLFISH

By Harden F. Taylor, *Vice President for Investigation and Research, Atlantic Coast Fisheries Co. Formerly chief technologist, United States Bureau of Fisheries*

INTRODUCTION

Perhaps every student taking his first course in chemistry has wondered what would happen if some of all the chemicals were dumped in a big jar and allowed to react as they would. The ocean is such a reaction jar on a world scale. Into it the rivers have for geologic ages been unceasingly delivering the washings of the land, containing the soluble compounds of the earth, and leaving them there, the water being distilled as rain to return and percolate through the earth again and again. Volcanoes have thrown their ashes and dusts high into the air to settle down in the ocean or be carried down by the rains. Springs issuing from the earth bring out large quantities of dissolved matter from below the surface, and the cosmic dust and meteors coming from distant space add another part to the constituents of the sea. Furthermore, these chemical compounds that find their way into the sea that we think of as insoluble in water are only relatively so; it is the view of chemists that all substances are soluble in some degree, however slight, in water.

In view of these facts, the reader need not be surprised to find in the ocean very many if not all the elements known to exist on the earth—eighty-odd in number. Thirty-two of them have been definitely detected by chemical methods, and most of the 32 have been quantitatively determined. The animals and plants that live in the sea live all their lives in a medium that contains every chemical element that can be needed, and the food on which each animal lives has also grown in this universal solution. It is difficult to imagine a lack in their environment of any substance useful or necessary to life.

This can not be said of land animals and plants that derive their mineral constituents from the soil. The science of soil fertility and fertilizers is based on widespread deficiency of important substances in the soil, such as nitrogen, phosphorus, potassium, calcium, and magnesium. In man and other land animals disorders and diseases are known to be caused or influenced by deficiencies of calcium, phosphorus, iodine, iron, etc., and research continues to bring out facts of this kind. It has been shown that even the minutest traces of certain mineral substances may have a profound effect on life processes.

For example, it was discovered several years ago (Bayliss, 1924) that zinc in infinitesimal quantity has an extraordinary effect in stimulating the growth of the mold fungus Aspergillus, one part of zinc in 25,000,000 parts of water increasing growth 50 per cent. It was revealed by further research that manganese in extreme dilution had a similar effect; and that zinc and manganese had a stronger effect than either alone. In the presence of zinc and iron in traces the fungus grew freely but bore its fruit (conidia) only if traces of manganese were present. These metals, though required in only infinitesimal quantities, are considered absolutely indispensable to the normal functional capacity of protoplasm.

Copper has a similar but opposite effect, being destructive to algæ and other lower plants. A copper coin allowed to remain in a liter of distilled water four days gave up only 1 part of copper to 77,000,000 parts of the water, yet the water killed the alga Spirogyra in one minute. It may or may not be significant that copper is found habitually, zinc often, and manganese occasionally in human bile (Hammarsten and Hedin, 1915), and that the human intestine is the normal habitat of a diversity of fungi to which these metals may bear an important relation.

Manganese has been found to occur in fairly constant quantity in the blood and various organs of man and seems to be a normal constituent (Reiman and Minot, 1920). The results of analysis of four adult brains and one fetal brain indicate that copper and zinc are normal constituents of the human brain (Bodansky, 1921). From analysis of one fetal brain it appears that during intrauterine life there is a more rapid storage of zinc and copper in the brain than there is after birth. In this respect the behavior of these elements is similar to that of iodine and other inorganic constituents. Other investigators (Bertrand and Medigreceanu, 1912) found, by 250 determinations on about 60 different species of animals, the constant presence of manganese in all of them excepting only the white of eggs of birds. They regard this constant occurrence of manganese in animals as evidence of a physiological significance. Future research may be expected to bring forth other results dealing with what have been regarded as unimportant or insignificant substances in the animal organism, perhaps having a bearing on the problems of health under conditions of civilization.

Meanwhile there is some satisfaction to be found in the fact that fish as a class contain the elements necessary for life, whether or not we know at the present time which ones are necessary or important or in what way. If we subsist on foods derived from the land, deficiencies may and do occur; they seem much less likely in fish, especially those from the sea.

CONSTITUENTS OF SEA WATER

The following are the more important elements present in solution in sea water (Clarke, 1920):

Element or radical	Per cent	Element or radical	Per cent
Chlorine	1.935	Sodium	1.0171
Bromine	.0066	Potassium	.0387
Sulphate (SO_4)	.269	Calcium	.0419
Carbonate (CO_3)	.0072	Magnesium	.1304

Besides these, the following elements exist in smaller quantities. Figures, where given, are milligrams per liter of water:

Iodine	2.38. Found in considerable quantities in ashes of seaweeds.
Fluorine	0.822. Found in the shells of mollusks.
Phosphorus	Present as phosphate.
Arsenic	0.01 to 0.08.
Silicon	0.2 to 1.4.
Boron	Present in sea water and in ashes of marine plants.
Lithium	Present in sea water.
Rubidium	14.
Cæsium	Present in sea water.
Barium	Can be detected by ordinary methods. Present in ashes of seaweeds and marine boiler scale.
Strontium	Can be detected by ordinary methods. Present in ashes of seaweeds and marine boiler scale.
Aluminum	Easily detected by direct methods.
Iron	Easily detected by direct methods.
Manganese	Easily detected. Abundant in mud of ocean bottom; present in ashes of seaweeds, and in shells and tissues of mollusks.
Nickel	Present in ashes of certain marine plants.
Cobalt	Present in ashes of certain marine plants.
Copper	Present in sea water and in ashes of some seaweeds and corals.
Zinc	0.002.
Lead	Present in certain corals and conchs.
Silver	0.01 to 0.169.
Gold	0.005 to 0.016. Also present in kelp and bottom dredgings.
Radium	0.000000000017.

ASSIMILATION AND CONCENTRATION OF MINERAL SUBSTANCES BY MARINE PLANTS AND ANIMALS

Some of the elements are present in sea water in merest traces, yet plants and animals living in the sea have the ability to extract them as needed and concentrate them. For example, iodine exists in sea water to the extent of about 2.38 milligrams per liter, yet dried seaweed contains 900 and bath sponge 3,870 milligrams per kilogram. In fact, man depends on the concentrated supply of iodine in the seaweed for an important part of his supply of that element. Mussels in fresh water that contains only 0.0000066 per cent manganese may contain as much as 2.1 per cent of the metal in the liver (Bradley, 1910). Copper, as will be seen below, may be present in considerable quantity in oysters, though its quantity in sea water is very slight. Silicon is dissolved in sea water to the extent of only 0.2 to 1.4 parts per million, yet it makes up the shells or skeletons of billions of diatoms, the most important ultimate source of food in the sea for larger organisms. Calcium, occurring in relatively small quantity in sea water, constitutes the greater part of the shells and skeletons of nearly all animals in the ocean. Iron is the principal source of red color in the shells of mollusks and is of vital importance in the blood of all red-blooded animals such as fish. It is also stored in considerable quantity in the hepato-pancreas or liver of oysters and clams, yet it exists in only a small quantity dissolved in sea water. Phosphorus is not in great concentration in sea water, but it is essential to life and is concentrated as calcium phosphate in bones and in organic compounds of fundamental importance in the life processes of marine animals.

The organisms thus perform a most important function in collecting the needed elements of the ocean in acceptable form for human food.

ANALYTICAL DATA CONCERNING MINERAL SUBSTANCES IN FISH AND SHELLFISH

It must be admitted that chemists have neglected the inorganic in favor of the organic constituents of fish. The analyses usually made give data concerning fat, protein, etc., but the ash has not often been completely analyzed. This neglect seems the more noteworthy in that one of the most important distinctions of fish in comparison with other foods exists in the inorganic constituents.

ASH

Most of the analytical data relating to the mineral matters in fish are for total ash, from which, in some cases, individual elements have been separated and determined. Table 21 gives data relating to total ash, phosphorus, and sulphur of some common sea foods that are fairly representative of fish and shellfish in general.

TABLE 21.—*Total ash, phosphorus, and sulphur in the edible portion of some common American fish and shellfish*

Product	Total ash	Phosphorus calculated as P_2O_5	Sulphur calculated as SO_3	Product	Total ash	Phosphorus calculated as P_2O_5	Sulphur calculated as SO_3
	Per cent	*Per cent*	*Per cent*		*Per cent*	*Per cent*	*Per cent*
Herring, sea	1.50	0.55	0.66	Oysters, Atlantic	2.76	.30	.82
Shad	1.35	.60		Flesh	2.21	.30	.82
Shad roe	1.53			Liquid	2.00		
Smelt	1.68	.81	.66	Canned salmon	1.20	.80	
Salmon:				Canned tuna	1.70		
Chinook	1.06	.57	.52	Canned Sardines	5.30		
Atlantic	1.14	.59		Smoked halibut	1.90	.62	.53
Eel	1.01	.51		Smoked herring	.90	.84	1.49
Mackerel	1.28	.56	.56	Salt mackerel	1.70	.35	.73
Spanish mackerel	1.50	.60	.70	Salt cod	1.20	.25	.89
Bluefish	1.27	.63		Clams, quohaug:			
Butterfish	1.14			Flesh	2.22	.40	1.07
Striped bass (rock)	1.16	.48		Liquid	3.17		
Sea bass	1.44			Mussels, sea:			
Red snapper	1.31	.47	.56	Flesh	1.73		
Haddock	1.27	.47		Liquid	2.23		
Cod	.99	.45		Scallops	1.38	.48	.60
Halibut	1.06	.44		Lobster	1.71	.38	.50
Flounder	1.28	.40	.55	Lobster, canned	2.47	.23	.58
Sardines, California	1.60			Crab, blue	3.13		
				Shrimp, canned	2.58		

The figures in Table 21 representing ash show that fish, as a rule, contains on the average somewhat more than 1 per cent of ash and about one-half of 1 per cent each of phosphorus and sulphur calculated as oxides. Shellfish contain nearly twice as much ash as true fishes. This is in part due to the iron stored in the liver and in part to the calcium in the mantle (of mollusks), which, being the tissue from which the shell is secreted, is heavily charged with mineral salts. The figures in this table were taken from Atwater (1892) and Dill (1921).

TABLE 22.—*Percentage of mineral elements in flesh of various animals*

	Potassium	Sodium	Iron	Calcium	Magnesium	Phosphorus	Chlorine	Sulphur	Water
Man	1.1659	0.2906	0.0535	0.0273	0.0771	0.7406	0.2552	0.7576	72.53
Pig	.9363	.5752	.0218	.0298	.1042	.7848	.1787	.7536	72.89
Ox	1.5200	.2695	.1019	.0088	.1006	.7090	.2342	.7719	75.80
Calf	1.5444	.3492	.0356	.0587	.1237	.8928	.2733	.9178	75.39
Rabbit	1.7179	.1974	.0233	.0790	.1240	1.0922	.2206	.8500	76.83
Hen	1.4700	.3008	.0295	.0333	.1174	.8164	.1904	.9234	68.38
Frog	1.6756	.3005	.0339	.0852	.1280	1.0130	.2190	.8835	81.62
Haddock	1.7281	.5118	.0300	.1138	.0863	.7067	1.2447	1.1514	80.64
Eel	.6519	.0812	.0148	.1061	.0483	.4796	.0935	.3657	63.10
Pike	2.0176	.1426	.0209	.1929	.1505	1.0285	.1548	1.0576	79.38

It will be noticed in Table 22 (taken from Katz, 1896) that fish, with respect to mineral constituents, is richer in calcium than other flesh foods. It is relatively low in iron because it does not retain hemoglobin of the blood in the muscle, for example, as the flesh of the ox does.

Although iodine probably exists in the living fish only in organic combination, it remains in the ash upon combustion and in this sense may be classified with the mineral substances present. In Table

23 are given data (from Tressler and Wells, 1924) concerning the iodine content of various food materials, including fish.

TABLE 23.—*Iodine content of various foods*

Product	Source	Iodine, parts per billion	Product	Source	Iodine, parts per billion
Lettuce, leaf	Signau	27	Bluefish	Atlantic Ocean	260
	Bern	6	Cod	do	240
Oranges		15	Haddock	do	290
Lemons, whole		106	Pollock	do	120
Wheat	Canada	3	Pompano	do	80
	Australia	19	Scup	do	300
Milk	Bern	5	Spot	do	590
Butter		106	Spotted squeteague	do	20
Eggs	Bulgaria	27	Squeteague (weakfish)	do	230
Veal	Bern	22	Winter flounder	do	180
Beef	do	5	Albacore, canned	Pacific Ocean	320
Dried seaweed	Atlantic Ocean	900,000	Salmon, canned	do	250
Clams	do	1,370	Sardines, canned	California	430
Oysters	do	1,160		Maine	570
Crabs, meat flakes	do	180	Cod, salted	Atlantic Ocean	660
Lobster	do	1,380	Mackerel, salted	do	400
Shrimp	do	450	Herring, smoked	do	530

Iodine is necessary for the proper functioning of the thyroid gland. Deficiency of iodine is believed to be the cause of goiter and other serious disorders. In inland regions, where natural land foods contain little iodine, goiter is common. In Table 23 it will be seen that the same food material from different sources may vary in iodine content, but fish as a group contain far more iodine than land foods. For this reason fish, especially salt-water fish and shellfish, have been proposed as a valuable preventive of thyroid disorders.

HEAVY METALS

It was pointed out above that copper and zinc may have some function in the body. Zinc is present in most of our foods, both meat and vegetable. Both zinc and copper have been found in all marine invertebrates that have been examined for them, except one species of clam. Table 24 gives data (taken from Bodansky, 1920; Rose and Bodansky, 1920; and Severy, 1922) concerning the prevalence of these elements in Atlantic and Pacific coast marine animals. (See also Willard (1908).)

TABLE 24.—*Copper and zinc in marine animals*

Product	Number of samples	Copper, parts per billion	Zinc, parts per billion	Product	Number of samples	Copper, parts per billion	Zinc, parts per billion
Oysters:				Crabs:			
Eastern	5	43.85	259.88	Eastern	2	5.750	20.65
Western	8	3.925	64.97	Western	9	2.500	30.97
Clams:				Salmon, chinook	2	4.000	8.00
Eastern	1	.000	77.00	Abalone	5	.796	24.12
Western	3	.000	11.63	Whale	6	.000	40.00
Shrimp:							
Eastern	3	13.000	17.05				
Western	6	13.070	18.65				

Copper is a normal and necessary constituent of shellfish as oxygen-carrying pigment of the blood, like iron in the vertebrates. It is also taken up in quantity by oysters growing in the presence of copper. That zinc and manganese are also probably normal and physiological in some way in the lower marine animals and not derived from accidental contamination is shown by data obtained from 22 species of marine invertebrates around Tortugas, Fla., which is in pure ocean water far removed from land. The metals occur in these animals in greater concentration than they do in sea water. These data are given in Table 25 (taken from Phillips, 1917).

TABLE 25.—*Copper, zinc, iron, and manganese in 22 species of marine invertebrates around Tortugas*

[Quantities in grams per 20-gram sample]

	Copper	Zinc, as ZnO	Iron	Manganese, as MnO
Maximum	0.0745	0.0133	0.0397	0.0043
Minimum	.0002	.0006	.0054	.000016

In another work on Pacific coast mollusks (Albrecht, 1923) further data are given on the inorganic constituents of the livers of shellfish. These are shown in Table 26.

TABLE 26.—*Inorganic constituents of the livers of Pacific coast mollusks, based on 100-gram samples*

Constituents	Abalone	Pismo clam	Crypto-chiton	Ischno-chiton
	Per cent	*Per cent*	*Per cent*	*Per cent*
Silica (SiO_2)	3.00	1.77	0.15	0.20
Iron (Fe_2O_3)	3.00	.96	6.76	4.23
Calcium (CaO)	.65	.63	1.44	1.36
Magnesium (MgO)	.83	.15	.26	.30
Total ash	5.79	5.93	3.38	9.12
Iron, per cent of total ash	31.90	21.70	27.00	29.20

In Table 26 the high percentage of minerals in the livers, as represented by total ash, is significant, especially the iron, which amounts to nearly one-third of the total ash. The liver seems to serve as an iron-storage body in these animals.

Traces of arsenic have been found in oysters (Hiltner and Wichmann, 1919). In 15 samples the minimum was 0, the maximum 1.47, and the average 0.99 milligrams per kilogram or parts per billion. Arsenic is found normally in human hair and nails.

IMPORTANCE OF MINERAL SUBSTANCES IN THE DIET

The chemical elements that occur regularly in the human body are oxygen, hydrogen, nitrogen, carbon, phosphorus, sulphur, chlorine, fluorine, iodine, iron, calcium, magnesium, sodium, and potassium. Besides these, arsenic, copper, zinc, and manganese occur in small quantities and are of unknown significance. All of these elements occur in sea water and sea foods. As they are absolutely necessary for normal human life (with the possible exception of the last four), it would be idle to discuss their relative importance. Such fundamental processes of life as respiration, digestion, muscle contraction, nerve impulse, regulation of heart beat, coagulation of the blood, reproduction, gland secretion, cell permeability, and other vital processes depend on proper amounts of these elements that remain in the ash on ignition. The important question concerning them for the general reader is, Do they occur in sufficient quantities and proper proportions in our daily diet?

There is believed to be a danger of deficiency and disproportion in some of them. We demand our food highly cleaned and selected, and parts containing valuable mineral substances such as husks, peelings, bones, and skins are frequently discarded. If, for example, in our meat foods we should grind up the entire animal and eat equal proportions of it all we would get about the proper amounts of mineral; but we discard bones and often glands, and prefer muscle tissue, which contains more potassium than do the other tissues and is deficient in calcium. Deficiency of iodine is at the danger point in many localities.

Table 22 shows that that part of fish which we usually eat contains relatively more calcium than other meat foods do. This applies particularly to such canned fish as salmon and sardines, where the bones are softened and edible. It applies also to shellfish, such as oysters and clams, where the shell-secreting mantle contains a high percentage of calcium. The livers of shellfish also contain much iron. Fish, especially salt-water fish and shellfish, generally contain much iodine and are particularly valuable in this respect. Concerning the possible value of the heavy metals in fish we have no exact data at present.

It seems permissible to conclude that fish as a class are a safeguard against mineral deficiencies in the diet, and that they deserve more attention than they have had from chemists and dieticians from this point of view.

V.—VITAMINS IN FISH AND SHELLFISH

By E. V. McCollum, *Professor of Chemical Hygiene, School of Hygiene and Public Health, Johns Hopkins University*

On the evidence brought to light by the extensive researches in the field of foods and nutrition during the last 20 years, it is now universally believed that there exist a number of chemical substances that are indispensable for normal nutrition in man and animals. When one or another of these is left out of an otherwise complete diet, certain pathological symptoms appear, which can be produced in no way other than by vitamin deficiency. The diseases characteristic of vitamin deficiency can be prevented or cured only by the inclusion in the diet of the vitamin with which each is associated. No one or more of the vitamins can be omitted from the diet without profound disturbance to health. Fortunately, most of our ordinary foods contain at least small amounts of one or more of them, so that when we eat a fairly wide variety of natural foods the danger of vitamin deficiency is small, except in the case of a single one, viz, vitamin D.

The vitamins are of unknown chemical nature and are known by the names vitamin A, vitamin B, vitamin C, vitamin D, and vitamin E. A lack of vitamin A in experimental animals caused the appearance of an eye disease, which results from a loss of power of the tear glands to produce tears. The eyes become dry and suffer profound injury as a result of this and of bacterial infection. The salivary glands are likewise affected, losing their capacity to secrete saliva. The nose and ears become filled with a purulent discharge. These are the most prominent effects of vitamin A deficiency.

Vitamin B is most abundant in natural foods. All ordinary foods used in America, except white flour, polished rice, degerminated corn meal, sugar, starch, and the fats and oils, contain more or less of the vitamin B. All lean meats are very poor sources of it, but liver, kidney, and other glandular organs are excellent sources of it.

Vitamin C is found in appreciable amounts only in fresh, raw foods, especially in fruits and vegetables. The citrous fruits are especially valuable in this respect.

Vitamin D is especially interesting in that it is contained in very small amounts in any foods thus far studied, except in the oils of fishes. Many foods of both animal and vegetable origin are apparently entirely lacking in it. The leaves of edible plants contain small amounts of it, at least in certain cases. Cereals, tubers, root vegetables, lean meats, ordinary animal and vegetable fats, fruits, etc., are entirely lacking in this remarkable nutrient principle. Vitamin D is especially important in the diet for the purpose of insuring the normal development of the bones. The condition which results from starvation for this vitamin (when the diet is not properly constituted with respect to certain other nutrients, especially calcium and phosphorus) is generally designated as rickets. It is not confined to the bones, but affects all the tissues of the body and may result in profound damage to health. Curiously enough, while the vitamin D is very abundant in certain fish oils it is apparently entirely lacking in the liver fats and in the other fats of the bodies of mammals, such as beef, pork, etc.

The vitamin E is concerned with the reproduction. It, like the vitamins A and D, is soluble in fats and oils and is found in certain of these. It is especially abundant in the oil from the germ of wheat. It is said to be absent from cod-liver oil and is certainly not abundant in the ordinary fats that are rich in vitamin A, such as butterfat, cod-liver oil, etc.

All fats and oils from fish or other marine animals whenever examined have been found to be rich in vitamin A. Oil from herring, shark liver, and cod liver are examples, the liver oils being especially rich. Whale oil and seal oil are likewise rich in vitamin A, probably because their food is rich in it. Lesser amounts of the vitamin have been found in the oils from salmon and menhaden. It seems probable that the fats in the flesh as well as in the livers of all marine animals are rich in vitamin A. It has been the custom for centuries in Japan to give eel fat to children who were suffering from lack of vitamin A. This disease was so common among children that it was well known as *hikan*. It is interesting that eel fat, like cod-liver oil, should have been discovered as a result of common experience to have therapeutic value and for very different conditions.

Herring and cod roe are the only roes that have been studied. These are found to contain vitamin A, probably in as large amount as do eggs generally.

It is said that vitamin B is lacking in codfish muscle and salmon muscle, but that the vitamin is present in the entire body of the herring. The latter result may mean that the herring muscle is lacking in it but that the substance is contained in the glandular organs. It is present in turbot roe and is probably found in the reproductive tissues of fish generally, as is true of mammals.

The most interesting aspect of the investigations of fish products from the food standpoint relates to the peculiar value of certain fish oils in the prevention and cure of rickets in children and in animals. Rickets is an extremely common disease affecting the skeletal development of children and of certain farm animals. Cod-liver oil is a specific remedy against this disease. It is generally agreed by pediatricians that every child should be given appropriate doses of cod-liver oil from early infancy as a routine measure to safeguard the development of the bones and probably also the teeth. This property is due to the presence in the oil of vitamin D, a substance distinct in its properties from vitamin A.

Vitamin D is apparently present in considerable amounts in the liver oils of fish generally, but the liver oil of the cod is believed to be exceptionally potent as a source of it. Cod, shark, and burbot liver oils are known to be effective in the cure of rickets.

It has long been observed that in regions where fish are regularly eaten in considerable amounts goiter is rare, whereas it is very common in many regions because of lack of iodine. Sea foods such as fish furnish this element in appropriate amounts to supply the needs of the body. A similar statement may be made concerning rickets in children. Even in those parts of the world where the climatic and hygienic conditions are such as to favor the development of bone defects these are rare among children where fish forms a prominent article of diet. The administration of cod-liver oil is an effective substitute for the eating of fish for this specific purpose.

Shellfish, such as oysters, clams, and lobsters, are of great importance. Oysters are so universally liked and their culture has been so much extended that they deserve especial mention in any discussion of the food value of fish. Little attention has been given to the study of the nutritive value of the oyster. Such observations as have been made show that it contains both the vitamins B and C. Since both oysters and clams are frequently eaten in the raw state, they occupy an unique position in that they are the only foods of animal origin which in the temperate regions can take the place, in a measure, of fresh, raw, vegetable foods. It is universally agreed that it is desirable to take some food daily which is capable of supplying vitamin C, since scurvy will develop after a few weeks of deprivation of this vitamin. There is good reason to believe that at certain times and places oysters and clams have played a special rôle as antiscorbutic foods in the human dietary.

Nothing is known of the vitamin content of the lobster. Crabs, especially soft-shell crabs, are probably comparable to oysters in their vitamin content, but no studies seem to have been made with them.

Modern researches on foods and nutrition have brought to light many surprises, both as regards the nutritive needs of the body and the dietary properties of individual foodstuffs, among which the most marked contrasts have been found. In no case have any foods gained more recognition as having unique dietary values than have the principal fish and shellfish.

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FIG. 1.—A catch of Lake Erie herring in spawning time (November, 1918). Part of a 30-ton catch. The lift was so heavy that the gill nets were not cleared of fish when they were lifted, as is usually done.

FISHING INDUSTRY OF THE GREAT LAKES [1]

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CONTENTS

[1] Appendix XI to the Report of the U. S. Commissioner of Fisheries for 1925. B. F. Doc. 1001.

INTRODUCTION

In the preparation of this account of fishing conditions on the Great Lakes, the reports of the Department of Marine and Fisheries of Canada and the Game and Fisheries Department of Ontario, which give statistics of the Canadian fisheries, and the statistical bulletins of the United States Bureau of Fisheries were drawn upon. I am indebted for certain dates relative to the commencement of fishing operations on the various lakes to the very excellent report of Richard Rathbun and William Wakeham with regard to the preservation of the fisheries in waters contiguous to the United States and Canada.[2] The sections dealing with fisheries regulations were prepared from the latest issues of the fish and game laws of the various Governments and were supplemented in certain cases by special rulings and license stipulations. Other material was, in the main, collected by me while studying the systematic relationships and natural history of the whitefishes and lake herrings of the Great Lakes since 1919, and present conditions as herein reported are such as obtained at some time subsequent to that date.[3] The systematic and ecological account of the commercial species has been reserved for another publication. The aim of this paper has been to picture, with a historical background, the condition of the fisheries of the Great Lakes as they are to-day and to call attention to the need of intelligent action to preserve those fisheries.

The statements of annual production appearing in the statistical publications, and which have been abstracted in the various tables herein presented,[4] do not, for one reason or another, lend themselves to statistical treatment. Many more data than are included in these publications are needed for statistical analysis; for example, the total yardage of gill netting or the number of gill nets in use is given, but it is not stated what percentage of these nets were of the various meshes employed in the fisheries.

The method of collecting statistics is also open to much objection, and I am aware that in several cases serious discrepancies occur between the actual and reported catches. The tables giving the total catch in pounds and which indicate the relative abundance of the species are therefore intended to show only how the production of the various lakes has changed in character. If the catch of those species that were sought in the beginning of the fisheries has declined, it may be assumed that those species are now rarer, and if new species appear in the tables, their appearance may be accounted for by the assumption that they have grown in favor rather than in abundance. The tables thus also show, although only roughly, the present abundance of the various commercial species.

The five Great Lakes occupy a group of valleys which apparently were changed into lakes by events associated with the glacial epoch, and are therefore, geologically speaking, of relatively recent date.

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[2] Preservation of the Fisheries in Waters Contiguous to the United States and Canada. Message from the President of the United States relating to the report of the joint commissioners. (H. Doc. No. 315, 54th Cong., 2d sess., Feb. 24, 1897; Washington.)

[3] This report was submitted to the bureau, virtually in its present form, in March, 1924, but publication has been unavoidably delayed. It has been revised since then only to include the latest statistical figures for American waters, so that changes in the fishing laws and such scientific publications as have appeared subsequent to that date have not been made use of.

[4] The quantity of salt fish is often given in barrels in the Canadian returns, and these have been converted into pounds at the rate of 200 pounds to the barrel.

They have a combined area of over 95,000 square miles, and all of them, excepting Lake Erie, have depths of 600 feet or more. A depth of over 1,000 feet is known to exist in Lake Superior. From a limnological point of view the lakes are very primitive; that is, they have little except algal vegetation, although, of course, larger plants grow in the bays and river mouths, in which semipond conditions obtain. The lakes are very cold, also, and in most of them the bottom waters beyond a depth of 350 feet are never warmer than 4° C. (39.2° F.).[5] The wind stirs up the water sufficiently so that oxygen is distributed throughout, and some sort of life occurs even at the maximum depths.

The conditions present in the lakes are favorable to the development of fish life, and before their commercial exploitation fish were extremely abundant in them. Records of the abundance of fish are found in the relations of the Jesuit Fathers as early as the beginning of the seventeenth century, and these accounts do not fail to mention the excellent quality of these fish. Even within the memory of the present generation the fish supply exceeded any limits now known to us. For the last 50 years the annual production has averaged over 100,000,000 pounds, and the output in 1922 totaled over 140,000,000 pounds, valued at more than $9,000,000. The capital invested in fishing runs into millions of dollars, and over 12,000 persons are directly engaged in the industry.

FISHING INDUSTRY

HISTORICAL

The original fisheries were prosecuted by means of seines, which were drawn along the shores during the spring and fall when the fish came into shallow water. At first enough fish were taken by this method to supply the limited demands, but as the fish became fewer (as a result of intensive and wasteful methods) and the demand increased, pound nets and gill nets were employed. All netting was originally made by hand, and there are fishermen still plying their trade who once spent their winter evenings weaving the webbing for their summer's use. The first pound nets were not radically different from those now in use, but the gill nets were much more crude. Instead of lead weights, stones, fastened by strings, sunk the nets and hand-whittled cedar splinters 6 to 10 inches long, split at one end and pinched onto the float line after the manner of a clothespin, served as floats. Both weights and floats were removed every time the nets were brought ashore, a procedure so laborious that only a few thousand feet of netting could be used. This equipment was carried by rowboats or sailboats to its place in the lake, which was always within sight of shore.

BOATS

The fishing industry has long outgrown such methods. Rowboats are no longer used except in conjunction with mechanically propelled craft, and sailboats have been abandoned since the early part of the present century. They were last in general use on the Canadian

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[5] Lake Superior lies 2 to 3 degrees of latitude farther north, and the temperature readings, so far known, indicate that this temperature probably is seldom exceeded below 200 feet.

shore of Lake Ontario. The fishing vessels are now driven by steam and gasoline. The gasoline boats as a rule are only small launches 25 to 50 feet long, and they are engaged chiefly near shore in the pound and trap-net fisheries (in which case they tow a rowboat) or where gill nets are set in the shallow waters near the harbor. However, there are a few large tugs that have installed modern, oil-burning engines. Most of the steam tugs are less than 65 feet in length, since this is the maximum length of a craft that may be operated with an unlicensed pilot and engineer, and some expense in salary for the pilot and engineer is thereby saved by the operators of smaller tugs. Most of the pilots, however, own their boats, and many of them are licensed. One of the largest tugs on the lakes, in use out of Alpena on Lake Huron, is 97 feet long with 80 gross tons displacement. Most of the boats are specially constructed for use in fishing and the largest ones have a cruising radius of more than 100 miles. Gill nets are the chief apparatus employed by tugs.

Until about 1891 gill nets were lifted by hand over a roller, but since about 1900 the tugs have been equipped with automatic lifters. There are two types of lifter, but the one most widely used is the revolving drum bearing along its circumference two rows of rubber-tipped teeth, which bite together and separate again as the drum revolves. The cork and lead lines of the gill net are caught by several teeth on one side of the drum and are carried along. As each pair of teeth releases the lines after bearing them about half a revolution, another pair closes over a new stretch of lines and in this manner the nets are hauled aboard. The speed of revolution can be controlled and the nets may therefore be lifted according to requirements.

APPARATUS

Hooks.—Large numbers of hooks are employed in certain fisheries, but their most important use is in the capture of lake trout. For trout fishing the hooks are tied to a fine line about 4 feet long, and these lines are fastened at definite intervals along a heavy cord. The length of the cord depends upon the number of hooks used and may be several miles. Ordinarily 2,500 to 3,000 hooks are set in a hook gang. Small bloaters (*Leucichthys hoyi*)—so-called because they bloat from the expansion of gas in the air bladder when brought to the surface—serve as bait, and when the main cord is set on the bottom these air-filled fish float the hooks off the bottom. The entire gang may also be floated at any desired depth level by the use of air cans.

Seines.—Seines have long since become unprofitable for general use and are now employed only in special fisheries. A seine is made of heavy cotton netting, and as generally used in commercial fisheries consists of a bag and wings. The wings are strips of netting not more than 20 feet wide and of any desired length. They are fastened on each side of the bag, which is only a pocket in which the fish are collected. In operation a section of the shore waters is surrounded by the extended wings, which are then drawn ashore, reducing the area of inclosure and forcing the fish into the bag.

Pound nets.—A pound net is constructed of coarse cotton netting and is maintained in position by a series of stakes driven into the bottom. The stakes are so arranged and the netting so employed that there are three parts to a pound—the lead, the heart, and the pot or crib. The lead is simply a fence of netting which extends from the bottom to the surface and runs in a straight line, usually from shore, until it enters the base of the heart. A lead may be 60 or 70 rods long. The heart is likewise a fence of netting, but the stakes are so driven that the netting on them roughly outlines a heart. The figure is not complete, however, since its halves do not join at the base. At its apex the heart is modified into the tunnel, a completely inclosed passageway that leads into the pot. The pot is a basket of netting open at the top and with sides extending above the surface.

In principle the net works as follows: The fish, in swimming along the shore, meet the lead, which for whitefish and trout is composed of netting with meshes 2½ to 3½ inches square [6] (5 to 7 inches stretched mesh), and find their way barred. They turn, then, toward deeper water, follow the lead, and enter the heart through the opening at its base. Once in the heart escape is not easy, and the fish eventually pass through the tunnel at the apex into the pot. To prevent the fish from becoming gilled in the netting its mesh in the heart is reduced to 5 inches and in the pot to 4 inches and 3 inches—3 inches on the outer side or back of the pot, which becomes the bottom in lifting, and 4 inches on the bottom and other three sides.[7] These nets are set on soft bottom, into which the stakes can be driven, and the pot is located at depths of 25 to about 80 feet. It is impossible to set pound nets at greater depths, as there is a limit to the length of stakes that can be obtained. The nets are usually lifted daily, and the fish are alive when taken.

Trap nets.—The trap net is a modification of the pound net, in which the lead is maintained in position by leads and corks instead of by stakes, and the heart and pot by anchors, and in which the pot and heart are entirely closed like a covered basket. The net may therefore be submerged, and for this reason the fishermen often call it the "submarine."

Crib nets.—A net called the crib net is widely used on Lake Erie and Saginaw Bay, which has features of both the pound net and trap net. There are, however, two pots connected by a tunnel and two hearts. The pots are covered, as in a trap net, but the hearts are open, as in a pound.

Fyke nets.—The fyke net is also a sort of trap net, but there is no lead or heart. Two wings of variable length, held in position by stakes, converge into a tunnel which leads into the pot. The pot is cylindrical and is supported by hoops. There may be several compartments in the cylinder, each connected with the other by a tunnel, by which arrangement the escape of the fish is much complicated.

Gill nets.—A gill net consists of two heavy cotton lines—the cork and lead lines—and the netting. The first line bears aluminum or wooden floats and the latter is strung with leads, both at intervals of 6 to 10 feet, according to the option of the fishermen. The netting proper is made of fine linen or sea-island cotton thread, the size of

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[6] The mesh of nets may be described as square or stretched. By square mesh is meant the length of one side of a quadrangular opening; by stretched mesh is meant the sum of the length of two sides of such an opening. The latter measurement is obtained by stretching the mesh until the opening is obliterated. Dimensions given elsewhere in this paper refer to stretched mesh.

[7] The figures given for size of the meshes are relative and are intended to show only that the size of the mesh changes in each part of the pound. The size of meshes used varies widely according to the laws or according to the species of fish sought.

the thread varying with the mesh of the netting, and is purchased according to order by the fishermen. It is then seamed onto the lead and cork lines, so that one diagonal of the quadrangular openings of the netting is perpendicular to these lines. Three sorts of gill nets are in use by the Great Lakes fishermen—(1) nets for whitefish and trout, which are regularly of 4 to 4¾ inch mesh, depending on the regulations of the various Governments, though nets up to 7 inches are used on the spawning grounds; (2) small-meshed nets, which are of 2⅛ to 3 inch mesh and are used for herring, chubs, perch, etc.; (3) nets of 1⅜ to 2 inch mesh, which are used to catch bait for the trout hooks in American waters only. In Canadian waters 2⅛ to 2¼ inch nets are permitted for this purpose. All three sorts of gill nets are set chiefly in the deeper waters of the Lakes to depths of 600 feet, though at certain seasons the first two are employed to advantage on the shoals. The nets are from 50 to 90 leads long and are handled in boxes, 3 or 4 nets to a box. In use they are united, end to end, to form gangs, one of which may reach 4 to 8 miles.

In setting a gang a buoy is thrown overboard, to which a line, somewhat longer than the depth of the water at that point, has been attached. A few rods from the lower end of this line an anchor is fastened, and the end of the line is made fast to the joined lead and cork lines of one end of the gang. The anchor is then thrown overboard and the net paid out from the moving steamer. When the end of the gang has been reached a second rope and anchor are attached to it. To the second rope a line with attached buoy is made fast and the net is allowed to sink to the bottom, where it stands upright like a tennis net. The fish swimming along the bottom run into the net and become entangled in the meshes. Since the fine threads of the net usually are caught under the gill covers of the fish they are said to be "gilled." The fish are often dead when taken.

The boats use either large-meshed gill nets exclusively and catch whitefish and trout, or use small-meshed nets exclusively; or they may, at certain seasons at least, have gangs of both. The gangs are lifted at intervals of one to six days, depending on the temperature of the water. The nets used to catch bait for the boats' "fishing hooks" are lifted daily or on every second day. The hook tugs use no other nets.

By the methods of fishing in general use on the Great Lakes (excepting Lake Erie) fish are captured from the surface to the bottom only in the shallower shore waters having a maximum depth of about 80 feet. In the deeper water they are taken by gill nets within about 5 feet of the bottom only. The fish are therefore free from capture in these deeper waters from the surface to within 5 feet of the bottom, except that trout may be taken by floated hooks.

In Lake Erie, however, nets have commonly been floated off the bottom since the beginning of the present century. From the practice of floating nets, Clarence Jackway, of Westfield, N. Y., is credited with having evolved the "bull net" about 1905, which is merely a very deep gill net. Where the ordinary gill net would take fish only within 5 feet from the bottom, the bull net, if set on the bottom, would catch fish to four or five times that height. Experience taught, however, that the currents along the bottom were frequently so strong that a bull net would be brushed flat, and for that

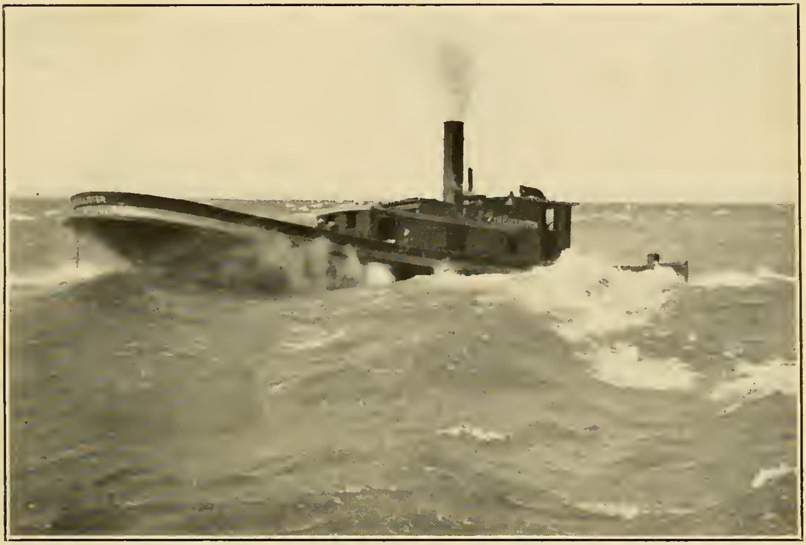

FIG. 2.—A rough day on Lake Michigan. Nets are not lifted if the lake is much rougher than this

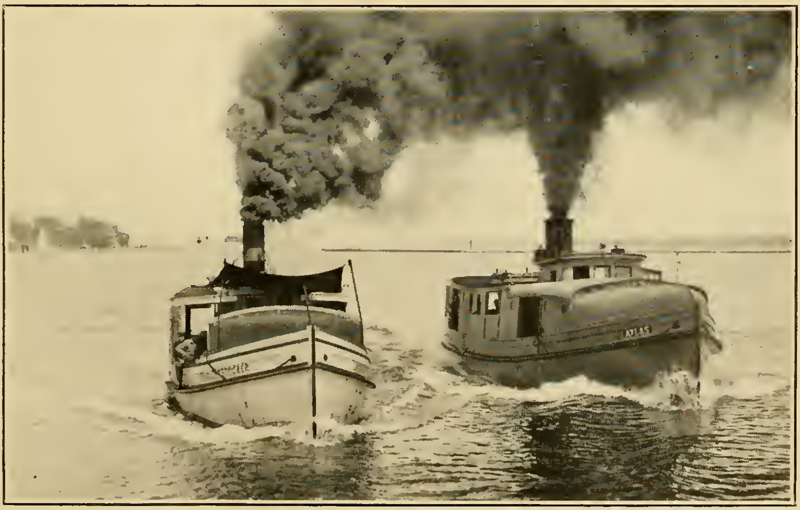

FIG. 3.—Returning to harbor with the day's catch of Lake Erie's fish. Note that these tugs are housed fore, while that in Figure 2 has an open deck. Both types are in use on the lakes

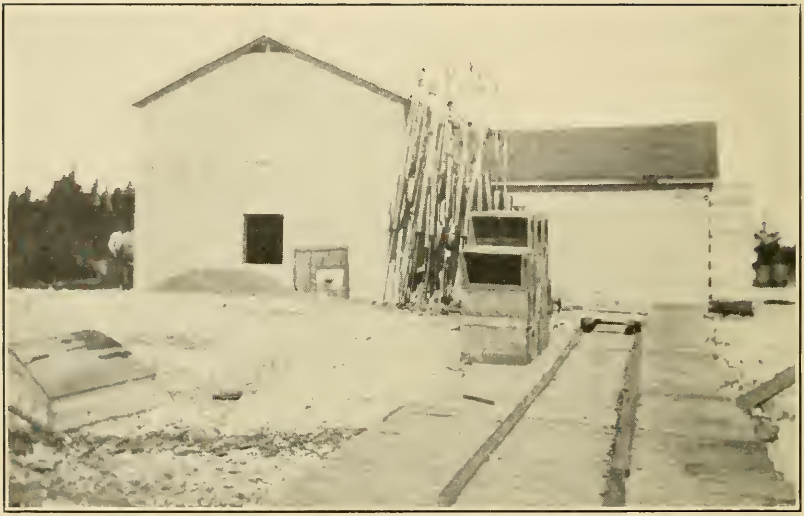

FIG. 4.—Typical fish-packing house. The tracks lead from the docks to the packing shed. At the left is the ice house. The buoys are those used for marking the location of the net gangs in the lake, and the boxes along the track are "lake boxes," in which the fish are brought ashore

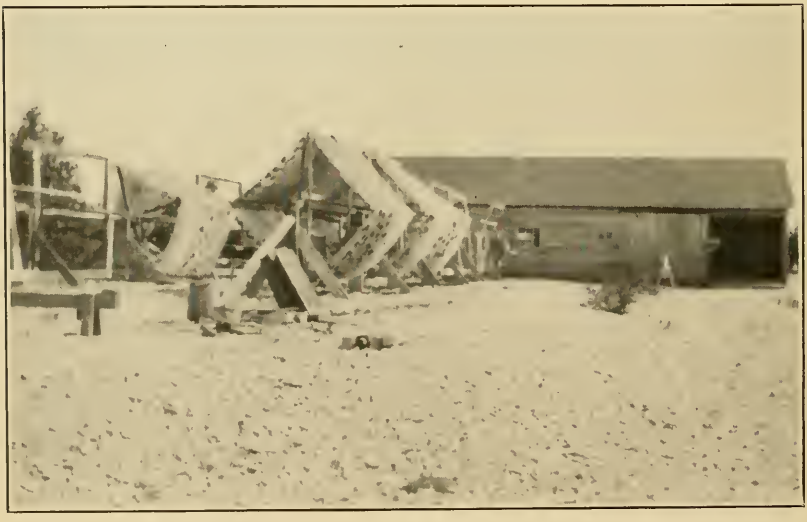

FIG. 5.—Typical net shed and reels. The nets are always reeled when brought ashore, and when mended are stored in such buildings as those shown here

reason this type of net is usually floated above the bottom. The vertical position of the gill-net gangs in Lake Erie varies from day to day—at times they are high, then on the bottom, according as the fish rise or drop. Relatively few of the bull nets are of larger mesh than 3 inches.

The practice of floating nets has been followed by European fishermen for many years, and the method was employed in the taking of herring, presumably by immigrants from Europe, on the western end of Lake Superior and also at certain points on the Canadian shore of Lake Erie long before 1900. The herring fisheries here, however, had not attained much importance, and the method was therefore little advertised, so that it remained for the American fishermen on Lake Erie to invent it anew. It is said that a fisherman at the eastern end of the lake by accident rearrived at the idea of floating nets about 1902, when a part of his gang, which had become entangled in the buoy line and was therefore suspended between the surface and the bottom, made a good catch of fish. At present the idea, on account of its usefulness in Lake Erie, has spread to other lakes, and even trap nets are floated in certain localities at certain seasons.

ORGANIZATION

Only two men are required to operate pound and trap nets, and the labor of lifting such nets is soon performed.

The personnel in the gill-net industry is differentiated into two classes—the "lake hands" and the "shore hands." The larger boats carry six or seven men—a licensed pilot, a licensed engineer, a fireman, and a crew of three or four men, who must be trained in the fishing industry. When fishing is heavy an additional man may be added to the crew. The pilot determines where the nets are to be set and is responsible for the boat in general; the engineer and fireman run the engine; and the crew lift and set the nets, remove the fish from the netting, dress them, and when the nets are brought ashore put them on the reels to dry. The engineer and fireman are exempt from duties other than those pertaining to their machinery, except that the fireman often is expected to help with the reeling.

The boats leave port at any time from 2 to 6 a. m., and usually return (depending on the length of the cruise) in the afternoon, but sometimes not until late at night. In any case, the nets must be spread on the reels before the men's work is ended. When the weather interferes with lifting the nets the boat crew has a holiday, but if there have been two such holidays in a week the following Sunday usually is reckoned a working day. The lake hands are laid off when the fishing season is over.

The nets are mended and put in readiness to set again by the shore hands, who, unlike the boat workers, have regular working hours. In the winter, when the boats do not fish, these men are kept employed in making new nets or more carefully repairing the old ones. The shore hands may properly be called skilled labor, and experience gives them an amazing dexterity in handling netting.

The laborer usually is given a definite wage, except on Lake Erie, where the boats often fish "on shares." Where such an arrangement exists no wages are paid to the lake hands, but the catch of a boat is sold to the company owning it and the proceeds are divided. The

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owner gets about one-third and the remainder is prorated among the employees.

Excepting on the American shore of Lake Erie, and sometimes in the larger ports elsewhere, labor is not organized. On the American shore of Lake Erie the labor organizations are so powerful that in a measure they fix the minimum price per pound for their catches. Everywhere it is becoming increasingly difficult to obtain help. No new recruits are being added to replace those who die and the fluctuating supply of unskilled labor can not be used.

PRODUCTS

Most of the fish are sold fresh, when they are shipped in wooden boxes containing 100 to 150 pounds of fish well packed in ice. The express companies require adequate ice packing and charge one-fourth the weight of the fish extra for the ice, however much or little it may weigh. The fish are sorted and packed by one or two men who do nothing else, and are shipped according to the instructions of the manager.

Some of the fish companies have a retail trade (which, however, never assumes the proportions which the furnishing of fresh fish at cheap prices should), but most of the products are sold to distributors. Large producers or wholesalers on the Lakes maintain freezers, in which their catches are frozen and kept until market conditions are favorable. Except for the chubs and some Lake Erie herring, which are smoked, and sometimes the herring from other lakes, which are often salted, the bulk of the fish is put on the market in a fresh state. All of the fish are dressed as soon as caught, excepting those intended for the Jewish trade in the New York markets. Whitefish, wall-eyed pike, carp, and suckers are the chief support of this trade and are mainly taken in pound and trap nets. The salted and smoked fish are prepared chiefly for the consumption of the foreign-born population, but the latter product is also widely esteemed by the native population where its qualities are known. Unlike the ocean herring, these lake fish are salted lightly and are smoked over a fire which cooks them at the same time. Thus prepared the product is perishable and must be disposed of within a week or two.

A small quantity of oil is rendered from the fish offal at a few of the ports, but for the most part the offal, though abundant and rich in oil, is destroyed because there are so many difficulties in the way of converting it into a marketable product. Latterly the practice of making caviar out of whitefish and herring roe to take the place of sturgeon caviar, which is becoming rare, has spread to various ports, but the production has not yet become significant.

The principal species in the Great Lakes, as given by the Bureau of Fisheries' census for American waters for the year 1922, given in order of magnitude of the catch, are ciscoes (herring and chubs), blue pike, lake trout, carp, sauger suckers, yellow perch, whitefish, yellow pike, and sheepshead. Species of minor importance include catfish and bullheads, lawyer, eel, white bass, Menominee whitefish, pike, bowfin, rock bass, sturgeon, and sunfish. The Canadian statistics for 1922 do not separate the species in so much detail. The principal species listed in order of abundance on the Canadian shore are herring, trout, blue pike, whitefish, "coarse fish" (including every species not enumerated), yellow perch, yellow pike, pike, and carp. Species of minor importance are sturgeon, eel, catfish, and chubs. The relative importance of the species varies from census to census, and the production of the Lakes is by no means equal, nor is the proportion of the species the same for each lake.

In the succeeding sections are given a historical résumé and a statement of present conditions for each of the Great Lakes.

LAKE MICHIGAN

DESCRIPTION

Lake Michigan is the only one of the Great Lakes that lies wholly within American jurisdiction. On the north and east its waters are controlled by the State of Michigan, on the west by Wisconsin and Illinois, and at the extreme south by Indiana. The lake is about 325 miles long, with an average width of 65 miles and an area of about 22,000 square miles. In the lake bottom are two basins—one at each end—separated in the center by an uneven stretch about 60 miles in length, which bears several well-defined though uncharted reefs. From the south the bottom slopes very gradually (at the rate of 1 or 2 fathoms to a mile) into a basin with a maximum recorded depth of 97 fathoms. In this depression a somewhat circular area, about 40 miles in diameter, is inclosed by the 60-fathom contour. The rise to the elevation in the center is rather abrupt and begins about 100 miles from the southern shore. The most extensive depression extends for about 100 miles in the northern half of the lake and is overlaid by 90 to 144 fathoms of water. The 90-fathom contour roughly outlines a triangle, with the apex pointing north. For about 50 miles the figure has an average width of 30 miles and then tapers rapidly. So far as is known this area is virtually a desert. The rest of the northern sector is dotted with islands and reefs, with conspicuous depressions between. Green Bay, with an approximate area of 1,700 square miles and a maximum depth of about 20 fathoms, and Grand Traverse Bay, with an area of about 300 square miles and a maximum depth of more than 100 fathoms, are the only extensive bays, and both lie near the north end. The bottom along the shore is largely sand, but there are stretches of clay and, in the north, of rock. The deeper waters overlie clay for the most part.

FISHING INDUSTRY

HISTORY

The exact date when fishing operations began on Lake Michigan is not known, but it was without doubt coincident with the founding of settlements along its shores. On account of the proximity of good markets the fisheries resources have been exploited to the limit from the earliest times, and the lake has been exceeded only by Lake Erie in productiveness and amount of capital invested. The industry was originally prosecuted with seines and later with gill nets. Pounds were not used much before 1860, and they have never been used very extensively except in the bays and around the islands in the northern sector of the lake. The principal fishing at first was for the whitefish, but trout became increasingly important after 1880, and even before 1870 other species (principally herring in Green Bay) were significant in the fisheries. The sturgeon was originally discarded, but by 1880 it had found a market and had risen to second place in abundance.

The whitefish and sturgeon, although extremely abundant at first, soon decreased because of wasteful fishing methods and the pollution of shores by sawdust, fish offal, etc., and the gill-net fisheries were carried into deeper water, where chiefly trout were caught. A few boats also fished with hooks for trout on the west shore as early as 1870, but the method decreased in effectiveness as the trout supply fell off, and not until about 1900, with the perfection of a new technique, did hook fishing begin to assume an important rôle in fishing methods.

The predilection for smoked fish of the Teutonic peoples who settled abundantly along the shores soon gave rise to another industry. About 1880, out of Milwaukee, a fisherman began bringing ashore the deep-water herring that became snarled in abundance in his trout nets, and finding them suitable for smoking on account of their rich flesh, he began to fish nets of 3-inch mesh for them. During the nineties this method of fishing spread to almost all the ports on the lake where gill nets were used, and the maximum annual output probably approached 10,000,000 pounds. These fish have decreased decidedly in abundance, and where previously boats fished for nothing else, now all boats use small-meshed nets only when it is most profitable. With the decrease of the whitefish and sturgeon from the shores the pound nets depended chiefly on suckers, perch, and other "rough fish," and latterly pounds have given place, as elsewhere, to the less expensive trap net as a means of taking such fish.

The quality of the production has varied with the change in apparatus, but since these changes did not affect the entire lake at the same time, but rather were instituted in different sections as conditions demanded them, statistics, unless they be very detailed, can not be expected to reflect their effects. The nine censuses made by the Federal Government do not give the required details, but they show in a very general way what the trend has been. In Table 1 is given the relative abundance of the principal commercial species for the nine years when censuses were taken. The interesting features of the table are the decline of the sturgeon to insignificance after 1890, the increase in importance of the trout after 1880, and the immense increase in the importance of the chub fisheries and the improvement in whitefish production between 1899 and 1922.

TABLE 1.—*Relative abundance as shown by the weight, in pounds, of the annual catch of the principal commercial species of fish of Lake Michigan, as shown by various censuses*

Species	1880	1885	1890	1893	1899	1903	1908	1917	1922
Whitefish	12, 030, 000	8, 682, 000	5, 455, 000	2, 330, 000	1, 510, 000	1, 972, 000	2, 490, 000	3, 047, 000	1, 547, 000
Sturgeon	3, 839, 000	1, 406, 000	946, 000	311, 000	108, 000	56, 000	70, 000	[1] 10, 000	9, 000
Herring and chubs [2]	3, 050, 000	3, 312, 000	6, 082, 000	13, 279, 000	22, 072, 000	14, 684, 000	21, 842, 000	18, 259, 000	6, 810, 000
Trout	2, 659, 000	6, 431, 000	8, 364, 000	8, 216, 000	5, 488, 000	9, 049, 000	7, 892, 000	8, 650, 000	8, 735, 000
Perch (including some white bass)	(3)	(3)	1, 943, 000	3, 451, 000	3, 077, 000	3, 313, 000	3, 256, 000	2, 362, 000	1, 244, 000
Suckers	(3)	(3)	1, 800, 000	1, 690, 000	1, 043, 000	2, 917, 000	2, 510, 000	2, 118, 000	1, 519, 000

[1] Closed season on sturgeon in Wisconsin.
[2] After 1885 the catches are in large part chubs.
[3] Not itemized.

PRESENT STATUS, METHODS, AND APPARATUS

There were engaged in the fishing industry on Lake Michigan, according to the census of 1922, 87 steam tugs, with a total tonnage of 1,709, and 269 other vessels, with a tonnage of 2,442, equipped with 35,930 gill nets. There were, in addition, rowboats and small power boats which used 704 pound and trap nets and 10,453 gill nets besides fyke nets and seines. The number of vessels and boats was reported to have been greater only in 1893, but the amount of apparatus employed was the least on record since 1890, and the total production was the smallest on record.

Most of the boats are engaged in gill netting for trout, whitefish, and chubs, though in late years the markets for chubs have become so unstable on account of the increased use of Lake Erie herring for smoking, and the supply so uncertain, that few boats fish for chubs exclusively but many have gangs of both kinds of nets.

Many vessels, particularly on the Wisconsin shore, fish hooks for trout only. The effectiveness of this method, when properly employed, and the relatively small cost of operation have maintained its popularity. In 1917 a number of the hook tugs migrated to the waters of Lakes Huron and Superior for part of the season, a practice which has become more common as the trout supply in Lake Michigan has fallen below that of the other lakes. Those tugs that can make their way through the ice frequently fish all winter.

Pound nets and trap nets are scattered here and there all along the shores, but they are used most in the northern end of the lake, in Green Bay and Grand Traverse Bay and in the sector north of those regions. The catches are principally "rough fish," but many herring and whitefish are taken also in certain localities. Trap nets are now far more numerous than pound nets.

FISHING DISTRICTS

The principal gill-net centers are on the Michigan shore at Manistique, Charlevoix, Northport, St. James, Frankfort, Ludington, Grand Haven, and St. Joseph; on the Indiana shore at Michigan City; on the Illinois shore at Waukegan; and on the Wisconsin shore at Racine, Milwaukee, Port Washington, Sheboygan, Manitowoc, Kewaunee, Sturgeon Bay, Washington Harbor, and Marinette. Practically all the pound and trap nets licensed on the lake are employed in the north from Green Bay to Grand Traverse Bay. The boats engaged in this fishery are for the most part small launches, and as these can find shelter in any of the bays and harbors they are not assembled at any particular point, as is the case with large gill-net boats.

PRINCIPAL SPECIES

The Federal census of 1922 indicates that, listed in the order of magnitude of the catch, lake trout, chubs and herring, whitefish, sucker, and yellow perch constitute the principal species taken in the lake. The total number of pounds of each of these species caught in 1922 is shown in Table 1.

LAKE TROUT

Since 1885 Lake Michigan has produced more trout than all the other Great Lakes together. Trout support the fisheries with large-meshed gill nets and are still caught out of almost all ports, but the principal catches are made in the northern end of the lake around the islands and on the reefs, on the reefs off the Wisconsin shore, and in the southern basin. The southern trout, which are taken chiefly by Milwaukee, Racine, and Grand Haven tugs, live and spawn on clay at depths of 40 to 60 fathoms. The northern trout are shoal forms and spawn off the shores on rock bottom. There are no deep-water trout known in the north. The principal mode of capture is by means of gill nets, though hooks are used out of almost every port, but most commonly on the Wisconsin shore.

Trout were little esteemed as long as whitefish were plentiful, and relatively few were caught. In 1890, however, the catch of trout was greater than that of any other species, but since then it has been exceeded in abundance by herring and chubs in every census except that of 1922. The species is apparently maintaining itself and is in no danger of extermination, though it is by no means as abundant as formerly. It is only nominally protected by a closed season, since both Wisconsin and Michigan, within the jurisdiction of which States the spawning grounds lie, permit fishing if the spawn be saved. Trout are extensively propagated by both the Federal and State Governments.

CHUBS

In all Federal statistics the "chubs" have been grouped with the lake herring—a fish by no means equal to them in value or importance except in Lake Erie—under the name "cisco," and since little has been published pertaining to these fish, a short general account may be of service to those who may wish to understand the general scope of the fisheries.

There are in Lake Michigan seven species of deep-water herring, three of them until recently unknown to science, which are known to the trade and to the majority of the Lake Michigan fishermen as "chubs." The fishermen also call them "longjaws," "bluefins" (abbreviated to "jaws" and "fins"), "mooneyes," and "kiyis". All these names are used locally in varying senses and are not applied to the same fish by fishermen in different parts of the lake, but wherever any of these colloquial names are current any one of them may be used to designate a catch containing the seven species. All seven are fat, herringlike fish. They differ from one another in their choice of habitat, but all inhabit the deeper waters of the lake. Each ranges during the year over a rather broad, vertical zone, and the habitat zones of all the species overlap more or less at all times, so that in most large catches of chubs, at least, a few individuals of all seven species are taken, except when the nets are set on the spawning grounds of any one of the species, and in that case only the spawning species is taken. Usually, however, one or two species constitute the bulk of any large catch. The proportion of the various species varies at the different ports and also with the season at the same port.

Chubs are caught almost solely in gill nets, which in the waters of the State of Michigan are of 2¾-inch mesh and in the waters of other States are of 2½-inch mesh. The chub nets are fished on the bottom

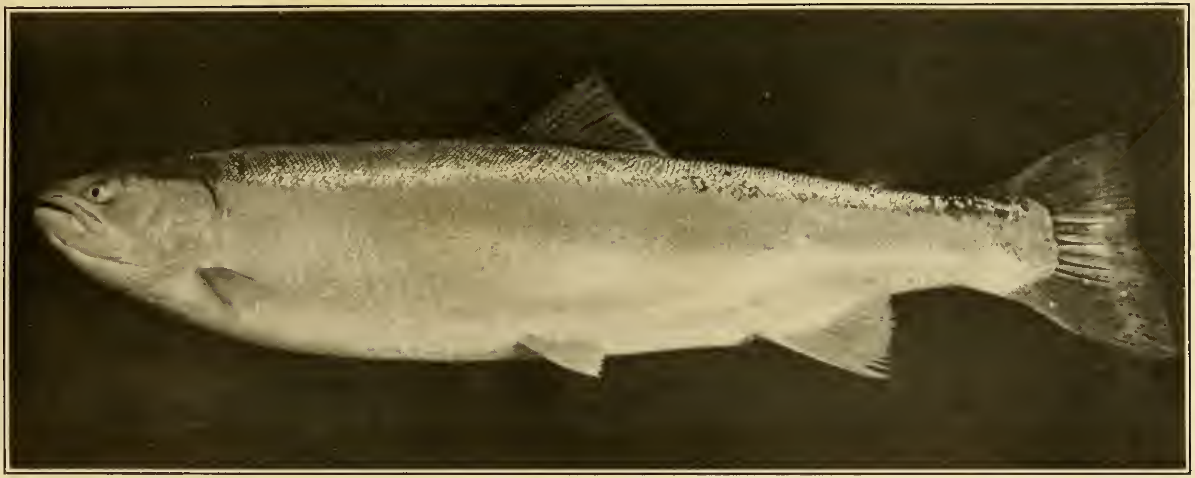

FIG. 6.—Steelhead trout taken in Lake Michigan in June, 1909. Weight, 17 pounds. Steelheads have been introduced into the Great Lakes and are common in sections of Lake Michigan

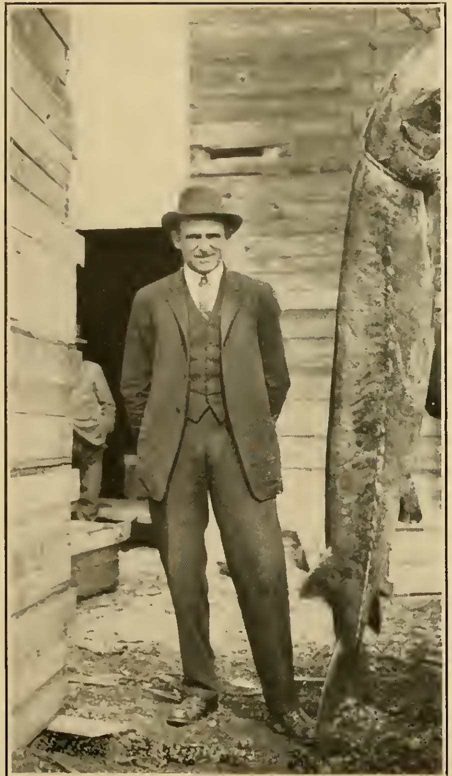

Fig. 7.—Sturgeon. This huge specimen of an almost exterminated species was captured in Lake Superior on June 29, 1922, and weighed 310 pounds. Its length may be judged from comparison with a 6-foot man. Specimens of such size have seldom been taken in the Great Lakes

Fig. 8.—Lake trout. The specimen shown weighed 56 pounds and was taken in Lake Michigan in the catch of a gang of trout hooks. Trout of this size are no longer common in the Great Lakes

as a rule between 35 and 70 fathoms, the depth usually depending on the behavior of the species which is predominant in the catches.

As each species exhibits peculiarities in the selection of a habitat, so each has a definite spawning behavior, and no two species are known to spawn on the same grounds. The spawning grounds for one species may be in water as shallow as 50 to 60 feet, and for another as deep as 300 to 350 feet, and as for the time of spawning, the eggs of one species or another are deposited during some part of every month in the year except June and July. Some spawning grounds of each of the species are known, and the fish are taken abundantly while they are spawning.

At present the greatest quantity of chubs is taken along the Wisconsin shore, especially from Manitowoc southward. This productive area extends around the lake as far north as Grand Haven on the east shore. Some chubs are caught all along the shores of the lake except in Green Bay, where the water is too shallow, but northward from Manitowoc and Grand Haven the ledge along the shore becomes narrower and the species of chubs fewer, until in the northern end of the lake the industry is supported solely by one or two species, compared with five or six in the more hospitable southern end.

As far as can be learned, chubs were first taken about 1869 in Grand Traverse Bay out of Northport. These fish were caught only in November, when they were spawning along the shores, and 3¾-inch nets were used. They were salted and sold to wholesale grocers along with whitefish and other species. About 1883 chubs were taken out of Racine in 3-inch and 2⅞-inch nets and about 1885 they were caught out of Milwaukee in nets with a 3-inch mesh. By 1885 they were also being produced out of other ports on the west and east shores of the lake, but only at certain seasons and in limited quantities to meet the demand for salt fish and cheap fresh fish.

The market for such products at that time was not large, and not until they came into demand for smoking were chubs extensively caught. Trout and whitefish had long been prepared smoked, but C. H. Fischer, of Milwaukee, is credited with having first introduced smoked chubs. About 1885 the smoked product had become so popular that it was shipped to various large cities of the middle west and many of the fishermen took to chub fishing. By 1891 chubs were being caught regularly from Sheboygan to St. Joseph, and the supply for a time exceeded the demand. During the nineties, however, there was a sharp decline in the abundance of these fish at ports where they had been taken for several years, and nets of 2¾ inches were substituted for larger mesh. Since in general the larger fish were in better demand, persons who had begun late to fish for chubs used the largest possible mesh at first.

By 1900 chub fishing had become an industry at most of the ports on the lake, but by 1910 chubs had so declined in numbers that the Wisconsin boats reduced the mesh of the chub nets to 2½ inches. Their example was followed later by vessels from Illinois and Indiana, but Michigan fisherman have never been allowed to use a net of smaller mesh than 2¾ inches. In these small-meshed nets there were now taken in abundance three species of smaller chubs, of which only the largest individuals were ever gilled in the 2¾-inch nets previously in use, and the chub-fishing industry for a time flourished as never before.

Chubs have latterly again become scarce, and in the summer of 1920 chub fishing had to be discontinued out of many ports. Since then the catches have been larger, but any increase can be only temporary. One of the species—the blackfin—has already become commercially extinct, and the longjaw, which is the principal species off Charlevoix, is conceded to be much reduced in numbers. None of the species has ever been protected anywhere and no serious effort to propagate them has ever been made.

Trout fishermen in general are opposed to chub fishing because small trout are caught in the chub nets. The percentage of small trout taken is often high, it is true, but it has not yet been ascertained that small trout are present throughout the area frequented by the various species of chubs, and it seems not improbable that when the behavior of the former is better known the use of chub nets may be so regulated that the capture of undersized trout will be reduced to a minimum.

HERRING

The most important herring fisheries are located in Green Bay, where they are taken by means of gill nets and pounds chiefly in the fall, when they come ashore to spawn. Some are also taken in the deepest waters of the bay by gill nets in summer and are known then as bluefins. In fall they are either salted or sold fresh. Some are taken for market at points along the lake shore, but the quantity is relatively insignificant. The price paid is so low (in the past not more than 1 to 3 cents per pound) that unless the fish can be taken abundantly and easily it is not worth the effort to fish for them. They are nowhere protected by a closed season, and none are propagated.

WHITEFISH

From first place in the fisheries of Lake Michigan in 1880, the whitefish now ranks third in quantity and is produced from areas that were least exploited in 1880. Practically the entire yield is taken in pound nets and gill nets around the islands of Michigan at the north end of the lake. Over most of the lake where this fish was once abundant it is now scarce. The causes of depletion have been pointed out by every investigator and are those factors which will eventually eliminate the species elsewhere—wasteful and extravagant modes of fishing and pollution. As in the case of the trout, there is no effective closed season, but the species is extensively propagated.

YELLOW PERCH

The yellow perch is taken chiefly by the gill nets and trap nets of the shore fishermen. Most of the catch now comes from the Green Bay region, though some of it is produced out of almost every other port. Formerly they were much more abundant, according to the fishermen, and in many localities they have become commercially unimportant. Except in Wisconsin, where they are protected from April 15 to May 20, there is no closed season for perch. Some are propagated.

SUCKERS

Suckers ranked fourth in quantity among the fish of this lake in 1922, and though they have maintained their relative position in the fishery, as shown by previous censuses, the fishermen generally concede that they are less abundant than formerly. They are caught chiefly in traps, but also to some extent in gill nets. The white sucker is the principal species marketed, though the sturgeon-nose is sold to a greater extent here than in any of the other upper-lake regions. A few suckers are taken everywhere, but the bulk of the catch originates in Green Bay, with the next largest quantity from Grand Traverse Bay. Most of the catch is now sold fresh, but in 1885 it was chiefly salted. There is no closed season for suckers and none are propagated.

STURGEON

The sturgeon is now practically exterminated and claims mention only because of the important position it once held in the fisheries. Prior to about 1875 these fish were either drawn onto the beaches or else fatally wounded and released in the lake when taken in the pound nets, and immense numbers are said to have been destroyed in this way. By 1880 sturgeon had a market value, and the catch of this species on the lake in that year amounted to nearly 4,000,000 pounds. In 1890 the output had fallen to less than 1,000,000 pounds, and thereafter the decline was rapid. Except in Wisconsin, where there has been a closed season since 1915, sturgeon may still be taken at any time, and in certain waters there are not even size limits to protect the immature. No sturgeon are propagated.

OTHER INDIGENOUS SPECIES

All the species of fish native to the basin occur in Lake Michigan and are marketed. In 1922 there were taken more than 1,000,000 pounds of fish other than those mentioned above, most of which were produced in Green Bay.

INTRODUCED SPECIES

CARP

The carp has gained a foothold in Lake Michigan and is to be found almost everywhere. It is important in the fisheries only in Green Bay, where 742,000 pounds were marketed in 1922.

STEELHEAD TROUT

The steelhead is likewise established in the lake and spawns abundantly in several of the larger streams emptying into it, and probably also on the beaches. It is important in the commercial fisheries along the Indiana shore only, but there are ports on other shores where it could be taken in commercial quantities if the law permitted.

SMELT

The smelt has been planted several times in inland lakes of Michigan, notably Torch and Crystal Lakes in the lower peninsula and in Trout and Howe Lakes in Marquette County in the upper peninsula. It is now known to be well established in all of these lakes except Torch. It has also escaped into Lake Michigan and is apparently spreading there at a rapid rate. In what numbers it occurs is not known, but specimens have been taken off Frankfort and in Grand Traverse Bay off Northport and even across the lake in Big Bay de Noc and at Manistique.

The introduction of the smelt into the Great Lakes must be deplored since its presence there can not serve any useful purpose and there is some reason to believe that it is a menace to native species now commercially important. It has been argued that the smelt is itself a valuable food fish and that it serves as food for trout. In reply it may be said that there is difficulty at present in finding a market for species quite or almost as delectable as the smelt, and that if the lake originally supported a trout population many times the size of the present one it is probably capable of taking care of the few remaining individuals, especially since none of those now taken show any evidence of undernourishment. Furthermore, even if the species should become marketable, the nets required to capture fish as small as the smelt would most probably be destructive to the young of the native species. On the other hand, Carl L. Hubbs and J. Metzelaar, of the University of Michigan, who recently completed an analysis of the stomach contents of smelt collected in Crystal Lake during August and September, 1923, found that the present food of the smelt consists almost exclusively of the pelagic minnow *Notropis atherinoides*. If in Lake Michigan the smelt preys upon the small whitefish and trout that are at first pelagic, its introduction must have important consequences. We have already accumulated so much experience from the introduction of foreign species of vertebrates that it would seem unnecessary to caution against a continuation of the practice, and it is to be hoped that no organization will in the future assume the responsibility of the importation of any uncontrollable nonindigenous animal.

FISHING REGULATIONS

APPARATUS

Gill nets.—The States of Michigan and Illinois do not permit the use of nets with a mesh smaller than 4½ inches for taking trout and whitefish. Wisconsin and Indiana allow a 4-inch mesh. For the capture of chubs the State of Michigan allows nothing less than 2¾-inch mesh. Other States allow a 2½-inch minimum, and the law of Wisconsin provides that nothing larger than 2¾-inch may be used. Formerly a 3½-inch net was allowed for bluefins but was employed largely to take young trout. Fish other than chubs may be taken in Indiana with nets having a minimum mesh of 2¼ inches; in Wisconsin and Illinois 2½ inches in the minimum size; in Michigan they may be taken only with 2¾-inch nets, except that 2½-inch mesh may be used for herring from November 1 to December 15, or at any time if set not more than 2 fathoms below the surface in waters of not less than 10 fathoms depth. Wisconsin has special laws for Green Bay, effective since January 1, 1925, which differ from those in force on Lake Michigan in that the minimum mesh for general use shall be 2⅜ inches, but that 2⅛-inch nets may be used to catch herring from December 1 until the ice goes out. In Wisconsin nets used for catching bait for the trout hooks are of 1⅜-inch mesh, and in Indiana and Michigan they measure 1½ to 2 inches.

Seines.—In Wisconsin seines may have a mesh of not less than 3 inches, in Illinois not less than 5 inches, and in Michigan not less than 4 inches in the wings and 2¼ inches in the bag. The length of seines is restricted to 1,000 yards in Illinois, and their use is prohibited from April 15 to July 31, inclusive. Michigan laws prohibit the seining of whitefish and trout, but Indiana has no laws regulating seining in Lake Michigan.

Pounds and traps.—A pound or trap in Wisconsin may not have a pot of mesh larger than 2 inches; in Illinois the pot mesh may not measure less than 4½ inches for trout and whitefish or less than 2½ inches for other species; in Indiana the mesh of the back may not be smaller than 2 inches, as manufactured, and of the rest of the pot not smaller than 2½ inches. In Michigan pound-net pots for whitefish and trout may not have a back of net measuring more than 2 inches, as manufactured, for at least 15 feet below the surface of the water, and not less than 3½ inches on the bottom and sides, as used; or, if the mesh of the pot does not measure less than 4 inches, as fished, the net need not have a small-meshed back. For use in taking other fish Michigan laws further provide for a pound with a pot having a back made of mesh no larger than 2 inches and sides and bottom not less than 2¼ inches. For the taking of herring alone between the dates of October 1 and June 15, a pound, the pot of which is constructed of netting with a mesh of not less than 2 inches thoughout, as manufactured, may be used where such nets do not take immature whitefish and trout as well.

SIZE LIMITS

Indiana does not limit the size of any Great Lakes species taken except wall-eyed pike, which may not be less than 12 inches long. Wisconsin has established the minimum legal size of trout as 12 inches; of whitefish, 13 inches; suckers, 12 inches; perch, 7 inches; wall-eyed pike, 16 inches; catfish, 20 inches; buffalofish, 18 inches; and all others, 8 inches. In Illinois a minimum weight of 1¼ pounds, dressed, obtains for trout and whitefish; a minimum length of 15 inches for buffalofish; 8 inches for bullheads; 10 inches for white bass; 7 inches for perch; and 13 inches for catfish. Pike and wall-eyed pike may not be taken in nets in the Illinois waters of Lake Michigan. The minima provided by Michigan laws are as follows: Trout, 1½ pounds round or 1¼ pounds dressed; whitefish, 2 pounds round or 1 pound 10 ounces dressed; sturgeon, 20 pounds round; suckers, 1 pound round; wall-eyed pike, 1¼ pounds round; catfish and pike, 2 pounds round; bullheads, 8 ounces; perch, 9 inches.

CLOSED SEASONS

Indiana has no closed season for the Great Lakes. Wisconsin provides a closed season for trout from October 15 to November 21; for whitefish from October 15 to December 1; pike and wall-eyed pike, March 10 to May 1; and all others, except trout, whitefish, suckers, carp, and herring, from April 15 to May 20, inclusive. There is a closed season on sturgeon at all times in Wisconsin. Illinois prohibits fishing for trout and whitefish from November 1 to December 1, inclusive, while Michigan provides a closed season for trout from October 10 to November 4, inclusive, and for whitefish from November 20 to December 15, inclusive. Wisconsin and Michigan permit net fishing during a closed season if the spawn be saved, impregnated, and delivered to the proper authorities.

LAKE SUPERIOR

DESCRIPTION

Lake Superior lies at the head of the Great Lakes and is the largest, deepest, and coldest of the chain. It receives the waters of Lake Nipigon to the northward and drains through St. Marys River into the North Channel. The lake is broadly crescentic in shape, with a length of about 355 miles and a width on the western half of about 70 miles and on the eastern half of 90 to 110 miles. Its area is about 32,000 square miles. The main body of the lake is more than 100 fathoms in depth, and a sounding of 196 fathoms has been recorded. The shore on the outer curve of the crescent is precipitous, and at many points a 100-fathom depth can be reached within 2 miles of land. The bottom slopes more gradually from the southern shore, and the 50-fathom contour is on the average about 5 or 6 miles out. There are several bays and a number of large islands in the lake, in and around which conditions are more tempered than in the lake itself. These areas, however, are relatively insignificant, and the only important stretches of shallow water lie in the Apostle Islands region, Whitefish Bay, and in the bay region on the north shore. The shores are rocky for the most part, except on the south, where there are broad stretches of sand, gravel, and clay. Most of the bottom in the deeper parts is clay.

FISHING INDUSTRY

HISTORY

The fishery resources of Lake Superior were the last to be tapped, though the earliest explorers had some idea as to their wealth. As the other lakes began to show signs of depletion, these remoter areas were investigated in order to meet the demand for fish. The opening of the interior lakes of Canada is but another and the last step in this movement.

As elsewhere, the whitefish was the principal species sought and a pound-net fishery to take them was established at the head of Whitefish Bay at Whitefish Point about 1860. From thence the fisheries spread westward, and less than 10 years later fishing operations were begun on the Canadian side. The Canadian fishing grounds have never been so extensively exploited, and when about 1890 production fell off on the American shore much American capital was transferred to the other side. A considerable percentage of the money invested in the Canadian fisheries at present is American.

Seines were largely used on the southern shore in the earliest fisheries, but to a less extent elsewhere because the bottom does not favor their use over most of the Minnesota and Canadian shores. Pound nets were never so important in the fisheries of Superior as in those of the southern lakes because of unfavorable bottom conditions, and such as were used were located chiefly in the bays and around the islands. Latterly their use has markedly declined on the American shore, to be replaced sixfold by the less expensive and more conveniently operated traps. There are a great many more pound nets in use now than there were in the nineties, and most of them are employed on the Canadian shore.

The principal fishing gear in use everywhere has been the gill net. The first gill nets were set along shore for whitefish and trout, and except on the Canadian shore the size of the mesh was not very effectively regulated until after 1913. After 1890 the use of nets for trout was supplemented on the west shore by hooks, which were baited with pieces of fish. In recent years the whole-bait method has been most commonly employed, having received impetus from the success achieved with it in Lake Michigan. Lake Michigan fishermen have during recent years migrated to Lake Superior as far west as Marquette to fish hooks, but their operations have been much hampered by the difficulty of finding bait in Lake Superior with the 1½-inch nets. When the shore species became less abundant the nets were shifted deeper and the deep-water trout or ciscowets for a while supported the industry. The large-meshed nets are at present fished chiefly inside 60 fathoms.

About 1899, with the growing demand for fish by the smoked-fish trade, a fishery for bluefins at depths of 60 to 100 fathoms arose and was prosecuted with exceptional vigor out of Grand Marais, Marquette, Ontonagon, and Bayfield on the south shore and to less extent in a few other places, chiefly on the American side of the lake. The nets used were of 3 to 3½ inch mesh. After about six years the supply declined sharply. Fishing with the small-meshed nets was continued more or less actively out of some of the ports along the southern shore until about 1915, but the bluefins became rarer and rarer and only the inclusion of large quantities of small ciscowets in these nets made their use profitable. At present none are employed anywhere.

Chub fishing has been carried on at intervals and for short periods only at several ports, chiefly American, and though these fish are abundant they find no favor in the Chicago markets and most of those caught are consumed locally.

The catching of herring in November has become an increasingly important industry since 1900, and at present these fish are extensively taken around the Apostle Islands and in Thunder Bay. A few are also taken along the Minnesota shore, at Isle Royale, and at Marquette.

The history of production has been about the same on both sides of the boundary. In Tables 2 and 3 are given itemized accounts of the catches of the principal species over a period of years.

TABLE 2.—*Relative abundance of the principal species, as shown by the weight, in pounds, of the annual catch of the principal species in the American waters of Lake Superior, as shown by nine censuses*

Species	1880	1885	1890	1893	1899	1903	1908	1917	1922
Whitefish	2, 257, 000	4, 571, 000	3, 213, 000	2, 732, 000	693, 000	794, 000	910, 000	302, 000	380, 000
Trout	1, 464, 000	3, 488, 000	2, 613, 000	4, 342, 000	3, 118, 000	4, 954, 000	2, 752, 000	2, 588, 000	2, 833, 000
Herring	34, 000	324, 000	199, 000	660, 000	1, 125, 000	4, 742, 000	5, 360, 000	12, 258, 000	7, 394, 000
Sturgeon	---------	182, 000	47, 000	62, 000	4, 000	13, 000	67, 000	---------	---------
Suckers	---------	---------	---------	118, 000	11, 000	183, 000	290, 000	342, 000	296, 000
Bluefins, including chubs	---------	---------	---------	36, 000	435, 000	2, 385, 000	227, 000	---------	---------
All other species	60, 000	258, 000	42, 000	144, 000	41, 000	131, 000	[1] 587, 000	56, 000	83, 000

[1] Probably includes fish from inland waters.

TABLE 3.—*Relative abundance of the principal species, as shown by the weight, in pounds, of the annual catch, and the amount of apparatus employed in the Canadian waters of Lake Superior, as shown by 10 censuses. (From 1895 on the catches of a few inland lakes are included, but the statistics of Lake Nipigon have been subtracted wherever they appeared)*

Species	1880	1885	1890	1895	1900
Whitefish	354, 000	606, 000	978, 000	930, 000	461, 000
Trout	312, 000	911, 000	691, 000	1, 391, 000	1, 331, 000
Herring	----------	----------	4, 000	23, 000	89, 000
Wall-eyed pike	31, 000	83, 000	90, 000	33, 000	40, 000
Coarsefish	----------	----------	45, 000	----------	----------
Sturgeon	----------	----------	97, 000	33, 000	13, 000
Pound nets ....number	2	5	15	49	37
Gill nets ....yards	42, 000	315, 000	189, 000	399, 000	439, 000

Species	1905	1910	1915	1920	1922
Whitefish	523, 000	281, 000	979, 000	301, 000	300, 000
Trout	1, 983, 000	3, 987, 000	3, 624, 000	1, 108, 000	1, 495, 000
Herring	191, 000	801, 000	3, 223, 000	1, 903, 000	604, 000
Wall-eyed pike	19, 000	177, 000	179, 000	83, 000	101, 000
Coarsefish	14, 000	7, 000	157, 000	114, 000	113, 000
Sturgeon	----------	7, 000	16, 000	9, 000	9, 000
Pound nets ....number	35	37	57	45	53
Gill nets ....yards	448, 000	909, 000	916, 000	641, 000	613, 000

In considering these statistics it must be borne in mind that the production has varied from year to year in different sections of the lake, and that the figures given for the entire lake do not reflect this variation. In the Canadian waters of the lake these local fluctuations have been especially great, since the fishing districts have never been as crowded as on the American side, and when old grounds were exhausted the gear was simply moved to new ones. The abolition by Canada of the closed season, since the war, which has made possible the capture of trout and whitefish over a longer period each year, has also helped to increase the catch in recent years.

Up to 1890 whitefish constituted the most important element in the catches in American waters and usually the most important in Canadian waters, but after that date trout occupied first position and the catches of whitefish dwindled. On the American side herring grew in favor from about 1900, and since 1908 have exceeded the output of trout. They did not become significant in the Canadian yield until 1910, and then for several years crowded the trout out of first place in abundance.

Sturgeon and other shore species have never been abundant anywhere. Of these shore forms the wall-eyed pike has always been in demand, and since 1903 on the American side and about 1913 on the Canadian side the production of suckers has increased. The amount of apparatus used on the Canadian shore has declined since 1915, while the statistics for 1922 showed an increase over previous censuses in the number of traps and pounds used on the American side but a decrease in the number of gill nets employed.

PRESENT STATUS, METHODS, AND APPARATUS

There are at present less than a dozen tugs engaged in fishing on the American side of Lake Superior, but there are a number of smaller vessels at various ports. Usually one or two hook tugs from Lake Michigan operate out of ports as far west as Marquette during the spring months. A few local boats also fish hooks, but none of them do so throughout the season, as is the case on Lakes Michigan and Huron, for the reason probably that the small fish needed for bait are scarce and can not always be had.

Most of the boats fish gill nets, and trout is the principal species sought. The nets are usually set in less than 60 fathoms, and at present few ciscowets or fat trout are taken. Small-meshed nets are used in November for herring where these occur in commercial quantities, and at certain ports this fishery is very important. The chubs spawn at about the same time, and a few lifts of these may also be taken.

In addition to these larger craft there are a considerable number of smaller ones that fish gill nets near the shores and operate trap nets and pound nets. The catches of most of these consist principally of rough fish, but they also take whitefish and trout and supply the local demand for herring and chubs.

There are still fewer large boats engaged in fishing on the Canadian shore, though there are several that transport fish or combine fishing with transporting. Gill nets are the chief apparatus employed, and trout are mainly caught. The best ciscowet grounds in the lake lie off the eastern shore, and ciscowets are an important item in the fisheries out of Port Coldwell.

All trout spawn in the early fall in Lake Superior, and the fishing season is over by November, but all the gill-net boats that conveniently can fish herring in Thunder Bay during that month. In recent years the use of pound nets in the bays of the north and east shores has increased, and in 1922 there were 53 such nets. They produce most of the whitefish and rough fish taken on that shore.

Hook fishing is insignificant in the Canadian waters, and in winter practically all fishing operations are suspended on both sides of the boundary.

FISHING DISTRICTS

The most important fishing centers on Lake Superior are Sault Ste. Marie, Grand Marais, Munising, Marquette, Houghton, Ontonagon, Bayfield, and Duluth on the American shore, and Fort William, Port Arthur, Rossport, Port Coldwell, and Michipicoten Island on the Canadian side. There are also individual fishermen located in camps among the Apostle Islands, in villages on Isle Royale, and along the Minnesota shore, whose fish are transported (in the case of the former) to Bayfield and (in case of the others) to Duluth. Across the boundary there are numerous fishing camps among the islands between Fort William and Rossport, from which the fish are collected by Fort William and Port Arthur boats; and several fishing settlements lie between Michipicoten River and Gros Cap, from whence the fish are carried to Sault Ste. Marie. The fish from these small fisheries form the greater part of the total production from the ports that receive them for distribution.

PRINCIPAL SPECIES

In 1922 the principal species in the American waters, judged by weight of catch, were herring, trout, whitefish, and suckers; in Canadian waters the census of 1922 showed that trout, herring, whitefish, and wall-eyed pike were most important. Detailed statements of the catches of these species at the time of the various censuses are given in Tables 2 and 3 (p. 572).

LAKE TROUT

The shoal trout is the most important species of Lake Superior. It supports the gill-net fishery out of every port and is the principal species taken in most of the pounds. A small percentage of the catch on the American side of the lake is taken by hooks.

There are several races of trout in the lake, not including the ciscowet, and some of them grow to large size, especially among the islands along the north shore. The ciscowet, which is a deep-water race, so fat that it may be called inedible, is now common only at points along the Minnesota shore of Lake Superior and the eastern shore of Ontario in depths of 60 fathoms or more. It supports a fishery during most of the season at Port Coldwell.

Trout are now less abundant than formerly, according to the testimony of the fishermen and as indicated by the census returns. On the American shore, census figures show that there has been a marked decrease since 1903. Though the registered amount of apparatus has been about the same during the period, the production given for each of the last three census years has been only a little over half of that recorded for 1903. In Canadian waters the fact that the amount of apparatus used is decreasing in the face of higher prices is a good indication of a decrease in abundance. There is no closed season on trout in Canadian waters and virtually none in Michigan and Wisconsin, since all fishermen are permitted to fish for spawn during that period. Minnesota has a closed season in November, but the fish usually spawn in October and the closed season has therefore no protective effect on the spawning fish. Trout are extensively propagated artificially.

WHITEFISH

The whitefish is virtually extinct along the American shore from a commercial point of view and is present in appreciable numbers only around the Apostle Islands and in the vicinity of Whitefish Bay. The census of 1922 showed a catch of only 380,000 pounds, and this with about the greatest amount of equipment and highest prices in the

FIG. 9.—Fishing through the ice on Lake Superior. The nets are set through a series of holes chopped in the ice. Note that the catch is chiefly wall-eyed pike and whitefish

FIG. 10.—Lake Superior on May 7, 1923, still jammed with ice. Stannard Rock Light, on the right, is one of the most interesting lighthouses on the Lakes, inasmuch as it is built on a submerged rock, 28 miles from land, and is surrounded by depths of 400 or 500 feet

history of the fishery. The catch of 1885 was over 4,500,000 pounds. This fish has disappeared to an alarming degree along the Canadian shore also, though the shifting of fishing apparatus, chiefly pound nets, to new districts has helped to maintain the output in the last 10 years. From about 1,000,000 in 1895, the catch has fallen to 300,000 pounds in 1922. Most of the whitefish now produced on the Canadian shore are from Black Bay, Nipigon Bay, and along the east shore of the lake, and they are taken in pound nets. The closed season is the same for whitefish as for trout. The laws of Minnesota with respect to closed seasons need not to be considered, as the State has no productive whitefish areas within its jurisdiction.

HERRING

Until 1899 herring were taken chiefly for local consumption, but thereafter herring fishing became increasingly important. The war gave a decided impetus to production, particularly on the Canadian shore. The chief catches are made during the spawning season in November, and the most favorable spawning grounds are on the west end of the lake from the Apostle Islands to Thunder Bay. These two extremes have been the most productive areas. Fishermen with small equipment also fish for herring to some extent in summer with floated nets off the Minnesota shore and off Isle Royale.

The species never has been and is not now protected or propagated, and in one center of abundance—namely, around the Apostle Islands—it is generally conceded to be considerably less abundant now than formerly. In Thunder Bay herring have not been taken in sufficient quantities long enough to show any marked decrease, but the dumping of wheat screening on their spawning grounds is said to have affected the abundance in the last few years.

BLUEFIN AND CHUBS

Bluefins were first caught in numbers about 1897, chiefly out of Ontonagon, but the industry did not become important until 1900. Nets of 3 to 3½-inch mesh were used, and the average size of the fish taken was 1½ pounds. These fish were caught throughout the season on the bottom at depths of 60 to 100 fathoms, and were so abundant that for several years some boats fished for nothing else and lifts of 3 tons were not uncommon. The principal catches were made out of Ontonagon, Marquette, and Grand Marais on the Michigan shore, but they were also fished out of Bayfield, Wis., and Grand Marais, Minn., and to some extent along the Canadian shore, chiefly on Michipicoten Island. About 1907 the catch fell off sharply and bluefin fishing was gradually discontinued, until at present no one fishes for them anywhere and it is not known that they occur any longer in commercial quantities. At no time were any but the largest individuals taken, and it is therefore not clear as to how intensive fishing could have so abruptly reduced the supply. This species has disappeared in the same fashion in Lakes Michigan and Ontario, but still occurs abundantly in parts of Lake Huron.

Chubs are everywhere numerous but are not in demand. A few are caught every year somewhere along the American shore, chiefly for local use. Since there is only one generally distributed species of chub in the lake, and since the area suited to it is quite restricted, it is not likely that it could support an intensive fishery for long.

OTHER INDIGENOUS SPECIES

Lake Superior contains few localities in which it is possible for the shore species to thrive, and except for the bays of the north shore, Whitefish Bay, and around the northern islands and the Apostle Islands there are no sheltered places. Consequently sturgeon were never abundant and the wall-eyed pike is confined to the areas mentioned. The sturgeon is almost extinct and the wall-eyed pike is of minor importance, particularly on the American shore. Suckers are also relatively scarce. They have been marketed on the American side for more than 30 years, but only in the last 10 years have they been brought to market from Canadian waters.

FISHING REGULATIONS

Jurisdiction over Lake Superior is divided between Ontario, Minnesota, Wisconsin, and Michigan; Wisconsin controlling a geographically small, but very important section.

APPARATUS

Gill nets.—Except for Wisconsin, which permits the use of a 4-inch gill net for taking whitefish and trout, the other governments allow nothing smaller than 4½-inch mesh. With respect to the capture of herring the laws vary. Minnesota permits 2⅜-inch netting to be used until such time as Wisconsin may declare a minimum of 2½-inches. Wisconsin allows a 2⅜-inch mesh in November and December; Michigan 2½-inch from November 1 to December 15, or at any time if set not more than 2 fathoms below the surface in waters of not less than 10 fathoms; and Ontario 2½-inch, or 2¼-inch if fished in less than 8 fathoms. Michigan permits 1½ to 2-inch nets, and Wisconsin 1⅜-inch nets for the purpose of taking bait for hooks.

Seines.—Seines in Wisconsin may be of not less than 3-inch mesh, and in Michigan of not less than 4 inches in the wings and 2¼ inches in the bag. No whitefish or trout may be taken with seines in Michigan waters. Ontario and Minnesota do not regulate the mesh of seines.

Traps and pounds.—For traps or pounds Minnesota has no regulations, since none are employed on that shore. Ontario prohibits traps but does not regulate the mesh of pound nets. Wisconsin states that the mesh of pound-net pots may not be larger than 2 inches. The Michigan pound-net law has been devised with more care, and the mesh of pound-net pots may not be smaller than 3½ inches, as fished, with a back made of net no larger than 2 inches, as manufactured, for at least 15 feet below the surface of the water. The back may be constructed of any size mesh if 4-inch netting is used elsewhere in the pot.

For the taking of herring, where not more than 10 per cent of the year's catch is of mature whitefish and trout, not less than 2¼-inch mesh may be used in the pot and not larger than 2-inch mesh in the back. For the taking of herring alone, between the dates of October 1 and June 15, a pound with the pot of netting not smaller than 2 inches throughout, as manufactured, may be used where such nets do not take immature whitefish and trout.

SIZE LIMITS

Wisconsin has no size limit for any species. Minnesota prohibits the taking of whitefish or trout less than 16 inches in length and wall-eyed pike smaller than 14 inches. The provincial law of Ontario prohibits the taking of whitefish under 2 pounds in the round, trout under 2 pounds in the round, herring under 6 ounces in the round, wall-eyed pike under 15 inches, perch under 9 inches, and sturgeon under 42 inches. The minima provided by Michigan laws are as follows: Trout, 1½ pounds round or 1¼ pounds dressed; whitefish, 2 pounds round or 1 pound 10 ounces dressed; sturgeon 20 pounds round; sucker 1 pound round; wall-eyed pike 1½ pounds round; pike 2 pounds round; bullheads 8 ounces; and perch, 9 inches.

CLOSED SEASONS

Minnesota prohibits the taking of trout during November. Wisconsin prohibits the capture of trout and whitefish during October. Michigan protects trout from October 10 to November 4 and whitefish from November 20 to December 15, but issues permits to fish for spawn. Ontario has no closed season.

The protective legislation is so variable that somewhere and at some time it must miss its purpose. There is no protection for herring, though Minnesota has signified a willingness to prohibit the capture of herring during November, when the species spawns, if Wisconsin will enact a similar law. The taking of chubs is prohibited only in Minnesota, where they are protected when spawning in November.

LAKE HURON

DESCRIPTION

Lake Huron is situated in the center of the Great Lakes chain and its waters lie about equally within the jurisdiction of the Province of Ontario on the east and the State of Michigan on the west. It receives the waters of Lake Superior through St. Marys River, and those of Lake Michigan through the Straits of Mackinaw. It drains southward through the St. Clair River, Lake St. Clair, and the Detroit River into Lake Erie. Its greatest length, from the head of the St. Clair River to the Straits of Mackinaw, is about 250 miles, and the greatest width (near the middle) about 100 miles. Excluding Georgian Bay and the North Channel, the lake has an area of approximately 17,500 square miles.

Lake Huron is divided into two approximately equal areas by the Big Reef, which extends continuously from Point Clark, Ont., to North Point, Mich. North of the reef lie the deepest waters of the lake. The 30-fathom contour is rarely more than 10 miles from shore, and a considerable portion of the area lies within the 60-fathom curve. The maximum depth of 125 fathoms known in the lake is found here. The southern portion is shallower. Here depths of 30 fathoms and less are more extensive and the maximum depth known is only 54 fathoms. The bottom alongshore is variable in character, consisting of rocks, bowlders, gravel, sand, clay, and mud, irregularly distributed. The deeper waters overlie chiefly clay and mud.

Separated from the main body of the lake and wholly within Canadian territory are the divisions known as the North Channel and Georgian Bay. Their water surfaces are approximately 1,500 and 5,000 square miles. From the junction of the North Channel with the St. Marys River to the foot of Georgian Bay at Collingwood is a distance of about 240 miles, while the greatest width of the district, from the mouth of the French River to the junction of Georgian Bay with Lake Huron, is about 60 miles. The North Channel and the northern and eastern shores of the bay are dotted with numerous islands and reefs, and the best fishing grounds are in these sections. The water in the North Channel deepens from north to south, with the maximum depth of 29 fathoms off the Manitoulin Island, which forms its southern shore. The average depth is about 20 fathoms. The floor of Georgian Bay is also tilted, but from east to west, so that the deepest waters lie hard off the Bruce Peninsula. From the east the slope is gradual and the 40-fathom contour approximately bisects the bay from north to south. The descent into depths of 60 to 90 fathoms is rapid. The shores are for the most part rocky, but stretches of sand, gravel, and clay are not uncommon. In the deep water the bottom is clay.

FISHING INDUSTRY

HISTORY

The fishing industry was established on Lake Huron later than on Michigan or the lower lakes. Seines and pound nets were not used as extensively from the beginning as on the lower lakes, and until 1880 it appears that gill nets were the main apparatus employed.

Gill netting was begun in Lake Huron, around Alpena, about 1835, and at about the same time in Georgian Bay. Whitefish were the chief species sought, and the nets were therefore set in shallow water. When the supply of whitefish was exhausted the nets were shifted into deeper waters for trout. In 1902 chub fishing, which had for many years been a considerable industry on Lake Michigan, was begun on Lake Huron out of Alpena, and by 1911 boats were fishing chubs out of about 10 ports on the lake, using 2¾-inch gill nets on the American side and 3-inch nets on the Canadian side. In Georgian Bay chub fishing began about 1912. Chubs have fallen off in the last five years so that few boats now fish them exclusively, and the gill-net industry has since been supported by trout and whitefish.

Hook fishing, introduced on the lake by Lake Michigan fishermen about 1916, has grown in favor on both sides of the boundary, but its development has been hampered somewhat on the Canadian shore by the restrictions against bait catching.

Pound nets are said to have been introduced on the American shore as early as 1854, but they were not fished in very considerable numbers till after 1885. The number increased during the nineties, but with the increase in value of "rough fish" they have in recent years given place largely to trap nets and are now employed extensively only in Saginaw Bay and the Thunder Bay region. On the Canadian shore pounds were first fished about 1882. Most of the pounds have been licensed in the North Channel and at the lower end of Lake Huron. The number has fluctuated considerably and their use has at times been prohibited, particularly in parts of Georgian Bay, but in the last few years the quantity of such nets has increased.

Seines were never very widely used, probably because the bottom in many areas is too rough to permit drawing the nets, and only in Saginaw Bay and at the lower end of the lake as far north as Goderich does seine fishing appear to have attained any importance. By 1880 the more profitable method of fishing with pound nets became so general in Saginaw Bay that there was no longer room or inducement to haul the seines, and in 1894 the Canadian Government substituted pound-net licenses for seine licenses. In the last 10 years, with the increase of carp, seines have again come into growing use in these areas.

The production of the lake has varied, both in quantity and quality, from year to year. These changes are too complicated to be treated in detail, but in Tables 4, 5, and 6 is shown the general trend of production in American and Canadian waters.

TABLE 4.—*Relative abundance as shown by the total weight, in pounds, of the annual catch of the principal species in the American waters of Lake Huron, as shown by nine censuses*

Species	1880	1885	1890	1893	1899	1903	1908	1917	1922
Herring, including chubs	246, 000	1, 265, 000	2, 514, 000	2, 758, 000	3, 699, 000	4, 715, 000	4, 791, 000	5, 381, 000	5, 496, 000
Whitefish	2, 700, 000	1, 425, 000	1, 004, 000	1, 178, 000	592, 000	692, 000	719, 000	996, 000	1, 300. 000
Trout	2, 084, 000	2, 539, 000	1, 505, 000	3, 439, 000	1, 887, 000	2, 108, 000	1, 358, 000	2, 079, 000	2, 108. 000
Wall-eyed pike	---------	940, 000	[1] 1, 483, 000	[1] 827, 000	1, 110, 000	1, 598, 000	829, 000	994, 000	1, 260, 000
Sturgeon	204, 000	215, 000	365, 000	79, 000	30, 000	34, 000	9, 000	4, 000	2, 000
Suckers	---------	(2)	1, 110, 000	1, 824, 000	1, 107, 000	2, 690, 000	2, 575, 000	1, 776, 000	1, 889, 000
Perch	---------	(2)	1, 817, 000	1, 758, 000	2, 740, 000	1, 911, 000	1, 805, 000	844, 000	633, 000
Catfish	---------	808, 000	172, 000	109, 000	574, 000	155, 000	174, 000	33, 000	64, 000
Carp	---------	---------	---------	---------	6, 000	37, 000	407, 000	1, 145, 000	1, 065, 000

[1] Including pike. [2] Not itemized.

TABLE 5.—*Relative abundance as shown by the total weight, in pounds, of the annual catch of the principal species in the Canadian waters of Lake Huron, as shown by 11 censuses*

Species	1875	1880	1885	1890	1895	1900
Whitefish	1, 166, 000	762, 000	1, 233, 000	442, 000	58, 000	27, 000
Trout	375, 000	469, 000	610, 000	1, 410, 000	1, 450, 000	1, 027, 000
Herring	1, 049, 000	183, 000	1, 382, 000	1, 346, 000	741, 000	261, 000
Wall-eyed pike	165, 000	22, 000	246, 000	182, 000	285, 000	281, 000
Sturgeon	------------	5, 000	347, 000	223, 000	517, 000	147, 000
Mixed and rough fish	------------	------------	----------	39, 000	105, 000	27, 000
Perch	------------	------------	------------	------------	102, 000	17, 000

Species	1905	1910	1915	1920	1922
Whitefish	78, 000	92, 000	56, 000	83, 000	47, 000
Trout	968, 000	893, 000	985, 000	847, 000	884, 000
Herring	403, 000	365, 000	302, 000	180, 000	173, 000
Wall-eyed pike	408, 000	169, 000	167, 000	141, 000	171, 000
Sturgeon	17, 000	14, 000	12, 000	9, 000	10, 000
Mixed and rough fish	146, 000	92, 000	80, 000	99, 000	104, 000
Perch	13, 000	92, 000	161, 000	129, 000	126, 000
Chubs	------------	------------	269, 000	206, 000	130, 000

TABLE 6.—*Relative abundance as shown by the total weight, in pounds, of the annual catch of the principal species in the waters of North Channel and Georgian Bay, as shown by 11 censuses*

Species	1875	1880	1885	1890	1895	1900
Whitefish	2,346,000	1,042,000	1,421,000	5,498,000	1,355,000	1,530,000
Trout	826,000	1,001,000	3,369,000	3,497,000	3,062,000	2,913,000
Herring	53,000	12,000	187,000	78,000	600,000	161,000
Sturgeon			478,000	127,000	79,000	176,000
Wall-eyed pike		10,000	353,000	635,000	592,000	690,000
Mixed and rough fish	23,000	21,000	39,000	48,000	136,000	38,000
Pike			17,000	38,000	270,000	100,000

Species	1905	1910	1915	1920	1922
Whitefish	1,018,000	1,072,000	1,335,000	1,303,000	1,306,000
Trout	2,346,000	2,795,000	3,881,000	1,965,000	2,816,000
Herring	160,000	343,000	258,000	52,000	70,000
Sturgeon	44,000	[1] 18,000	33,000	15,000	14,000
Wall-eyed pike	594,000	247,000	417,000	301,000	273,000
Mixed and rough fish	84,000	144,000	471,000	431,000	441,000
Pike	100,000	94,000	177,000	100,000	195,000

[1] After 1909 the catches of other species not previously itemized were greater than of sturgeon.

The Canadian waters are divided roughly into three districts—Lake Huron proper, Georgian Bay, and the North Channel. The statistics published by the Ontario government do not separate accurately the catch of these three regions, fish taken in Lake Huron being included with those of the other two districts and some taken in Georgain Bay being credited to the North Channel. However, except off the Duck Islands and off Tobermory, few fishing boats penetrate far into the waters of Lake Huron proper north of Cape Hurd, and for convenience the North Channel and Georgain Bay are treated as a unit. Lake Huron proper really includes, then, only the ports from Southampton to the American boundary.

The most interesting features of Table 4 are the decline, in American waters, of the whitefish from first place in 1880 to sixth place in 1890, which position it has held practically ever since. The sturgeon is gone as an important element in the fisheries and the perch and catfish are declining. Suckers, on the other hand, are coming to the fore, and the introduced carp has captured a prominent place.

As shown in Table 5, for the Canadian side of Lake Huron proper, the whitefish has become relatively insignificant since 1890 and the sturgeon since 1900. Chubs and perch, which of late years have increased in importance in the catch, have become more marketable rather than more abundant. Trout have maintained first place since 1885 with the decrease of the whitefish, and herring have kept a relatively high position though the weight of the catches has steadily declined. Table 6, for the North Channel and Georgian Bay, shows that trout have definitely replaced the whitefish in relative abundance since 1895. The table may be taken to indicate that wall-eyed pike have become less abundant and that pike and rough fish have come into greater demand rather than increased in numbers. Sturgeon have passed out as a commercially valuable species.

Fig. 11.—Lifting a pound net. The punt is inside the pot and the lifting has just begun. The stakes of the heart are visible in the background. This pound is on Lake Huron

Fig. 12.—The pound net lifted. The fish have been driven into the opposite end of the pot and may now be scooped up

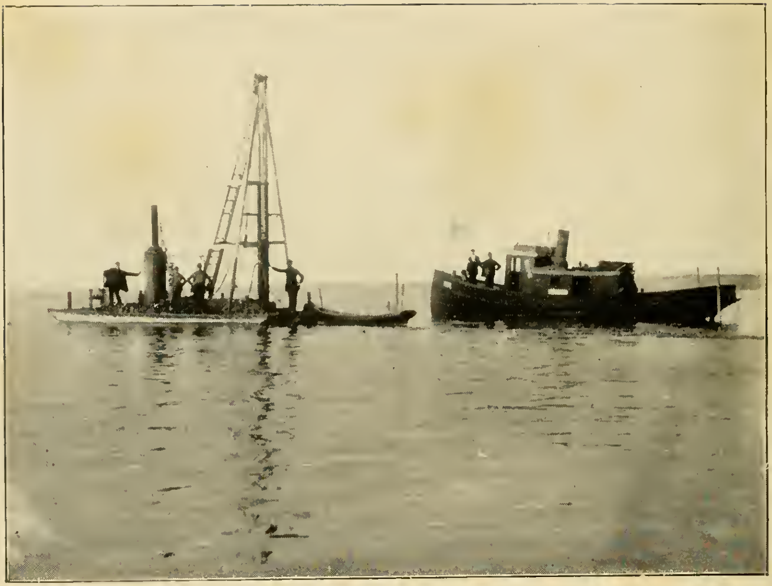

FIG. 13.—Tug and stake driver used to drive the pound-net stakes into the bottom

FIG. 14.—Herring pound net with fish gilled in the netting

PRESENT STATUS, METHODS, AND APPARATUS

The principal fisheries on the American side of Lake Huron are at present conducted by means of gill nets and the chief product taken by them is trout, but at certain seasons whitefish are also an important element in the catch. Latterly no boats have fished for chubs exclusively, but in the spring of 1923, when for a time Lake Huron chubs brought 15 cents per pound (the first time in history that such fish brought a higher price than trout), all the boats owning suitable nets took to chub fishing, and in a few weeks the price fell to 5 cents and the nets were pulled out. Alpena is now the only important chub-fishing port. Small-meshed nets are also used to a considerable extent to take herring, Menominees, and perch, but except that the large tugs frequently make a few lifts of the two last-mentioned species in fall and sometimes again in spring, these nets are used only by the shore fishermen.

Hook fishing for trout is carried on out of several ports, but the practice has not spread very rapidly in the last few years.

The chief pound-net district in American waters is in Saginaw Bay, and large numbers of traps and fykes are also employed in this region. Elsewhere traps have largely replaced pounds. The increasing value of "rough fish" has been responsible for the rise of an important trap-net fishery at the north end of the lake, which vies in production with the established fisheries in Saginaw Bay.

On the Canadian shore a large portion of the production is yielded by pound nets, most of which are located in the North Channel district, on the north and east shores of Georgian Bay and on the shores at the foot of the lake. In 1922, 288 pound nets were licensed in the Canadian waters, and these produced most of the whitefish, wall-eyed pike, pike, and rough fish, and a significant percentage of the trout taken in that year. Most of the gill nets are in use in Georgian Bay and in the main lake, and their catches are chiefly trout, though some whitefish and chubs are also taken. Hooks are also rather commonly employed in these sections to take trout. No trap nets are allowed, and there are few fishermen who use small-meshed nets for herring and rough fish along the shores.

FISHING DISTRICTS

Gill netting is carried on chiefly out of Cheboygan, Alpena, and Harbor Beach on the American side, and to a lesser extent out of Detour, Rogers, and Oscoda. Southampton, on Lake Huron, is the largest tug center on the Canadian shore, but there are numerous other hamlets and stations out of which are operated small boats having a considerable equipment of gill nets. In Georgian Bay the fishing ports are for the most part towns, and those most worthy of mention are Tobermory, Meaford, Owen Sound, Collingwood, and Parry Sound. In the North Channel and around the islands that inclose it are many sheltered harbors, and the fishing boats are therefore widely scattered in this section.

Most of the pound nets and trap nets in use on the American shore are employed in Saginaw Bay, though many are also fished in the straits, around islands at the north end of the lake, and in the vicinity of Thunder Bay. The chief pound-net areas on the Canadian shore are around the islands in and inclosing the North Channel and off the north and east shores of Georgian Bay and on the shores at the southern end of Lake Huron.

PRINCIPAL SPECIES

On the American shore, according to the census of 1922, chubs and herring, which are grouped together in the statistics, were first in abundance. The other important species, in order of their abundance, were trout, suckers, whitefish, wall-eyed pike, carp, and yellow perch. On the Canadian shore in 1922 the lake trout was by far the principal species, with herring, wall-eyed pike, chubs, and perch ranking next. In the North Channel and Georgian Bay trout and whitefish comprise the bulk of the take, with wall-eyed pike and pike also important in the catches. The relative and absolute abundance of these species over a period of years are given in Tables 4, 5, and 6.

LAKE TROUT

Trout occur throughout the lake and in its bays (excepting Saginaw Bay), and also on the reefs in the center of the lake. For the last 40 years this species has been the chief element in the gill-net fisheries, and in some areas, particularly on the Canadian shore, it has entirely replaced the whitefish.

There are several races and they all live in relatively shallow water. These races may differ in behavior, especially in the matter of time of spawning, the black trout on the Big Reef, for example, spawning as late as December. There are no longer any important fisheries for trout in 60 fathoms and deeper, and chub nets set at these depths take relatively few small individuals. Trout are taken largely in gill nets, though in 1917 about one-third and in 1922 about one-fourth the entire catch on the American shore was on set lines by hook fishermen. Until recent years large quantities were also caught for the market on trolling lines in early summer when the trout rise off the bottom. Some are still caught in this manner but the number is now insignificant. The pound nets in certain localities, especially in the North Channel, are also effective in the capture of trout. There is at present virtually no closed season on trout, but quantities of fry are planted yearly.

WHITEFISH

Half the lake's annual production of whitefish at present comes from North Channel and Georgian Bay. The most productive areas are from Parry Sound northward in Georgian Bay and around Manitoulin Island. The catch in Lake Huron is made chiefly from Harbor Beach northward. Gill nets and pounds are the principal apparatus of capture.

The whitefish was originally the most abundant species taken in the commercial catches. It appears to have maintained itself best in North Channel and Georgian Bay, where it still holds second place, but in the lake as a whole it has fallen to fourth place on the American shore and to seventh on the Canadian shore. Though there are now no areas in Lake Huron and a very few elsewhere in which a gill-net fisherman could operate if he had to depend on whitefish alone, there appears to have been no serious depletion in this fishery since 1900 and in several localities the fishermen even report increases. It is not possible to establish statistically the question of abundance during this period, since the statistical bulletins do not furnish the kind of data that are needed. In some areas of greater abundance the increase has been attributed to the effects of propagation, but in others, particularly in North Channel and Georgian Bay, where no plants were made previous to the reported increase, some other explanation must be sought. The increased catches of 1917 and 1922 in American waters, on which to a greater or less degree the opinions of increase are based, were at least in part due to the higher value of rough fish, which are taken in the shoal waters along with the whitefish. Thus, while the opening of the interior lakes of Canada has kept the price of whitefish down to a point where in many areas it would be unprofitable to prosecute fisheries dependent on this species alone, with the rise in value of species taken incidentally, the shore fisheries have been stimulated and the catch of whitefish, even though the species may not actually be more abundant, has increased.

HERRING

The bulk of the catch of lake herring or blueback is taken in the pound nets of Saginaw Bay. Herring are taken also on the American shore in the fall by gill nets out of Oscoda, Alpena, and along the northern shores of the lake. The Canadian fishermen take few herring, relatively and absolutely, and the bulk of the catch is produced along the Bruce peninsula and at the south end of Lake Huron. There has never been a closed season on herring, and few have ever been planted, but the fishermen at Bay City are of the opinion that the supply has not diminished significantly.

Each locality has its own race of herring, and these races are often characterized by size differences, considerations that have induced the Michigan legislators to permit a 2½-inch mesh for the taking of these fish. One of the largest races occurs in Thunder Bay and northward to Middle Island, where it is the object of a considerable fishery when it spawns in November.

Originally the herring was but little esteemed and was taken, as in other lakes, only if it could be sold at all. Latterly, with the falling off of other available species, it has been caught regularly at localities where it could be taken in quantities. Most of these fish are salted, though increasingly large quantities find their way to the markets in the fresh state.

CHUBS

Fishing for chubs began later in Lake Huron than in any of the other lakes. What factors were responsible for the delay is not exactly clear, inasmuch as their presence was discovered many years previously when the deep-water trout nets took them, but it is probable that trout were sufficiently abundant and prices satisactory enough to afford no stimulus for experimenting with a new industry, particularly when it involved the purchase of an entirely different equipment of netting. In 1902 chubs were fished for in 60 fathoms off Alpena with 2¾-inch nets, and a few years later they were taken off the Duck Islands with 3¼-inch nets, which were later reduced to 3 inch. From 1911 to 1918 was the period of greatest production, and at some time during this period boats were fishing chubs out of Cheboygan, Rogers, Alpena, Harbor Beach, Goderich, Kincardine, Southampton, Tobermory, Lion's Head, Cabot's Head, and Wiarton.

There are four species of commercial chubs in Lake Huron, all but one apparently of general distribution throughout the deeper waters of the lake and of Georgian Bay. They are taken only in gill nets, which are of 2¾-inch mesh in American waters and 3-inch mesh in Canadian waters. The chub nets usually are set in depths of 60 fathoms or more, except where such depths are not attainable, as at the northern and southern ends of the lake, and then 30 fathoms usually is the lower limit. The spawning season for the four species ranges between the middle of August and January, and some of the spawning areas of two of the species are known. At this time they are taken as abundantly as possible. Chubs have never been protected by a closed season, nor are they propagated.

It is generally believed by American fishermen that chubs have decreased in Lake Huron. At any rate, it is now necessary to increase the equipment in order to maintain the catch, and off Cheboygan, where one species is caught on its spawning grounds in September and October, the lifts are no longer as heavy as formerly. On the Canadian shores the decrease is more marked. With 3-inch nets the Canadian fishermen have always had a considerably smaller percentage of the chub population to draw from, and they were early forced to discontinue fishing where they met the American 2¾-inch nets, as off the Duck Islands. Off Southampton the catches on the chub grounds west-northwest of the city fell off after about three years, and the boats have been unable to find new grounds. In Georgian Bay chubs have been fished since 1912, but since about 1916 the numbers taken have been much reduced. The fishermen say that the lawyer is now a conspicuous element here in the chub nets set at 60 fathoms. Whether the lawyer has appropriated the area vacated by the chubs or is directly responsible for their decrease is not known.

WALL-EYED PIKE

Only the yellow race of the wall-eyed pike is commercially important in Lake Huron, and the principal catches on the American side are made in the pounds and traps of Saginaw Bay and in Canadian waters chiefly in the pounds around the islands of the North Channel, on the east coast of Georgian Bay, and around Sarnia on the St. Clair River. The wall-eyed pike has always been esteemed as a food fish and has been intensively fished for. Latterly the demand has increased and the price of the fish has risen enormously at certain seasons (40 cents per pound has been paid by the New York markets), and production everywhere has fallen off. The fish is nowhere protected by a closed season but is extensively propagated.

YELLOW PERCH

In American waters the yellow perch is taken in abundance only in Saginaw Bay, while on the Canadian shore the bulk of the catch is made off Huron County at the lower end of the lake. Pounds and traps are the principal mode of capture. Perch were an important element in the fisheries on the American shore as early as 1885, and during the late nineties and between 1900 and 1908 production was greatest. There has been a decrease from the maximum recorded catch of 2,740,669 pounds in American waters in 1899 to 633,188 pounds in 1922. On the Canadian shore perch have been much less important, and until 1894 were not reported in the statistics of the fisheries. The maximum catch recorded was only 321,680 pounds taken in 1907, which was never approached before nor has it been since. There is no closed season for perch. The species is propagated to some extent, but only in American waters.

SUCKERS

The white sucker is the principal one of this species marketed, and most of the production is sold fresh in the round to the New York markets. At present the chief catches are made in trap nets in American waters north of Cheboygan, in traps and pounds in Saginaw Bay, and with pound nets in the North Channel. Up to 1890 practically the entire catch of suckers on the American shore came from Saginaw Bay and Saginaw River, but since about 1905 an increasingly large percentage has come from the northern waters and the abundance of suckers in Saginaw Bay has diminished, so that in 1917 a little more than one-third of the total catch, which was roughly 60 per cent more than it was in 1890, originated in Saginaw Bay. In 1922, however, the northern sucker fisheries declined and those in Saginaw Bay improved so that the bulk of the catch again originated in Saginaw Bay. Fishermen hold that the pollution of Saginaw River has seriously affected the abundance of the sucker in that area.

On the Canadian shore suckers have become increasingly important since 1910.

There is no closed season for suckers, and none are propagated.

STURGEON

The sturgeon has never been extremely abundant in Lake Huron, but in the earliest fisheries of the lake it was commonly hauled ashore from the pounds and seines as a nuisance. By 1880 it was marketable on the American side of the lake, and by 1885 it was generally taken for sale in Canadian waters. At present it is the most expensive and rarest fish in the lake. The principal production is now credited to North Channel and the St. Clair River mouth, but no more than 30,000 pounds are now produced annually. There is no closed season for the species and none are propagated.

OTHER INDIGENOUS SPECIES

The only other native species of importance in the fisheries are the pike in the North Channel and Georgian Bay and the Menominee in the northern American waters.

INTRODUCED SPECIES

CARP

The carp is the only abundant nonindigenous species in the lake. The catch is taken almost exclusively in Saginaw Bay, and seines are the chief apparatus of capture. In the census of 1903 it was insignificant (37,491 pounds) in the American fisheries, and in 1917 ranked fourth with 1,145,250 pounds. The catch in 1922 was slightly less in quantity and relatively less important.

GIZZARD SHAD

The gizzard shad or sawbelly is a small commercially unimportant fish that is said to have found its way into Lakes Erie and Michigan from the Mississippi drainage through certain connecting canals and is now working its way northward. In November, 1919, a fisherman brought me specimens which he selected from the swarms present in his pound nets in Colpoy Bay (a small indention in Georgian Bay), and it is said that in 1920 they were extremely abundant in Saginaw Bay. The presence of the gizzard shad here has no ecological significance so far as is known.

FISHING REGULATIONS

Regulations similar to those promulgated by the governments of Michigan and Ontario for Lake Superior are in force. (See p. 576.)

LAKE ERIE

DESCRIPTION

Lake Erie has an area of approximately 10,000 square miles, exceeding in size only Lake Ontario. Its length is about 250 miles and the average width is about 45 miles. It is bounded on the north by the Province of Ontario, on the west by the State of Michigan, on the south by Ohio and Pennsylvania, and on the east by New York. Lake Erie receives the waters of the upper Great Lakes through the Detroit River, and drains through the Niagara River. The deepest water occurs in the eastern sector, in that part which is bordered by Pennsylvania, New York, and the portion of the Canadian shore lying eastward of Long Point. The maximum depth recorded is 35 fathoms off Long Point. The stretch for 100 miles between Long Point and Point Pelee is a nearly flat plain covered by no more than 14 fathoms of water. East of Point Pelee is a shelf with numerous islands and reefs, having a maximum depth of 7 fathoms.

FISHING INDUSTRY

HISTORY

Lake Erie offers most favorable conditions for the growth of fish, and in practically every census, in spite of its small size, it has led all the lakes in quantity of production. On account of its shallowness, warmth, and diversified conditions many species of fish occur in its waters, and no less than 15 species have at one time or another been important in the commercial catches.

Every device known to the fishermen of the Great Lakes is employed on Lake Erie. In a general way the kind of apparatus used depends upon the species to be taken, and since in the past the important species have varied from year to year, and since the devices of capture have gradually been improved, the history of the fisheries of this lake is extremely complicated. For that reason in the historical treatment emphasis will be laid on the changes in production rather than on the modes of production.

Fishing is said to have been begun on Lake Erie as early as 1815. Seines were used, chiefly in the rivers and bays, until about 1850, when pound nets were introduced at the west end and gill nets at the east end in the American waters. The first species sought to be taken with the new apparatus was the whitefish, but soon small-meshed nets were used for other species. Commercial fishing appears to have been in full swing by 1870, and has grown in intensity since then. Gill nets, pound nets, trap nets, fyke nets, seines, and set lines were the chief apparatus employed on the American shore, similar apparatus being used in Canadian waters except that no trap nets were allowed.

On no other lake has the use of pounds and traps assumed such proportions as on Lake Erie. The shore fisheries—that is, the fisheries conducted with pound nets, trap nets, and gill nets by small boats along the shores—have been extremely important on both sides of the boundary, and the output has exceeded that of the large boats fishing gill nets only. In late years, on the American shore, the pound net has been almost entirely replaced by the crib net, which has a much lower original cost and can be moved at will. The gill-net fisheries have increased in importance with the introduction, about 1899, of the steam lifter, an improvement which made it possible for every boat to handle a great many more nets, and latterly with the practice of floating gill nets. Nets have been extensively floated since about 1903, and bull nets have become more and more widely used since about 1906, chiefly in American waters (see description on page 558), practices that have made it possible for fish to be caught while swimming off the bottom and which have increased the catch of the fish considerably.

In 1879 most of the gill netting on the American shore was carried on east of Ashtabula and practically all pound netting west of that place. Thereafter the use of gill nets in conjunction with the pound nets was begun, until in 1899 most of the gill nets as well as pound nets were owned in the west. By 1903 the pendulum had started to swing back, and in 1922 the gill nets were again owned chiefly in the east. In 1890 gill nets took most of the blue pike, sturgeon, whitefish, and trout, while the majority of herring, yellow perch, saugers, wall-eyed pike, catfish, and practically all other fish were taken in other nets. (While the pounds took the larger quantity of herring, the fish were smaller and brought less return to the fishermen.) In 1903 gill nets took most of the herring, blue pike, whitefish, and yellow perch, and excepting the seines, which took all the carp, the rest of the species were taken in greatest abundance in other gear. In 1922 the gill nets took only herring in greatest abundance, and again excepting the seines for carp, all other species were taken most abundantly with traps and pounds.

West of Port Stanley, on the Canadian shore, pound netting has been the principal industry. Gill netting was carried on chiefly from Port Dover eastward until about 1905, when Port Stanley became the principal gill-net center on the lake and has remained so since, but the east has owned the bulk of the remaining gill nets. The Canadian statistics do not separate the production according to apparatus employed, so that it is not possible to state how the constitution of the catches of the various kinds of apparatus has changed from year to year.

The fisheries have always been of more importance on the American shore, though the relative importance has changed decidedly in recent years. Where in 1885, with a catch of 51,456,000 pounds in American waters, the ratio between American and Canadian production stood 6.7 to 1 in favor of the United States, in 1899, with a catch of 58,393,000 pounds, the ratio was 5.7 to 1, and in 1922, with a catch of 55,079,000 pounds on the American shore, it had dropped to 3.1 to 1 in favor of the United States. Production on both sides of the lake has varied considerably from year to year in the last few decades, and this variation has not always been correlated with variations in the amount of apparatus employed. In the two succeeding paragraphs sufficient data are given to show what the relation of apparatus and production has been, and a discussion of the changes in the quality of the production follows.

According to the latest statistics issued by the Bureau of Fisheries, in 1922 there were engaged in the fisheries in American waters 1,041 vessels and boats, which operated 42,404 gill nets, 3,931 trap and pound nets, and 213 seines. In Table 7 are given the statistics of the last three censuses made of the fisheries on the American side of Lake Erie, showing the relation between apparatus and catch. The figures for traps, pounds, and seines are the highest on record, and only in 1890 were more gill nets reported. The number of vessels and boats employed (608 in 1903; 1,133 in 1917; and 1,063 in 1922) is the highest since 1893.

TABLE 7.—*Relation between gear employed and production of fish in the American waters of Lake Erie since 1903, as shown by censuses taken from 1903 to 1922*

	Number	Total yield	Yield per net
1903:			
Gill nets—		*Pounds*	*Pounds.*
Vessels	28,755	12,421,089	432
Boats	6,396	937,733	147
Pound nets and traps	1,469	5,837,420	3,974
Seines	110	2,633,267	23,939
Total		21,829,509	
1917:			
Gill nets—			
Vessels	38,007	17,151,247	451
Boats	9,571	1,853,294	194
Pound nets and traps	5,011	13,319,548	2,658
Seines	285	5,505,997	19,319
Total		37,830,086	
1922:			
Gill nets—			
Vessels	36,555	24,297,307	665
Boats	5,849	1,636,282	280
Pound nets and traps	3,931	22,118,403	5,627
Seines	213	5,618,210	26,377
Total		53,670,202	

The entire 1917 production was over 3,000,000 pounds less than that of 1908, which was 41,906,000 pounds; but the catch for 1908 was almost double that shown by the census of 1903. The catch in

1922 was nearly 12,000,000 pounds greater than that of 1908 and almost 15,000,000 pounds greater than the 1917 catch. The increase since 1903 has been chiefly in the production of rough fish by the shore fisheries and in the catch of herring.

The statistics of the Province of Ontario, for the Canadian shore of Lake Erie, show that in 1922 there were 39 tugs, 158 launches, and 204 sail and row boats, employing 1.362,748 yards of gill net and 655 pound nets, which yielded a total of 17,686,240 pounds of fish products. In Table 8 are given the statistics of 14 censuses, showing the relation between apparatus and catch.

TABLE 8.—*Relation between gear (except seines) and production in the Canadian waters of Lake Erie, as shown by various censuses*

Year	Pound nets	Gill nets	Yield	Year	Pound nets	Gill nets	Yield
	Number	*Yards*	*Pounds*		*Number*	*Yards*	*Pounds*
1875	16	5, 665	959, 000	1910	295	506, 600	14, 421, 000
1880	54	330	2, 008, 000	1912	297	569, 753	22, 007, 000
1885	132	33, 520	7, 654, 000	1914	499	681, 672	17, 020, 000
1890	197	49, 200	8, 423, 000	1916	638	1, 546, 005	10, 088, 000
1895	204	111, 700	8, 706, 000	1918	689	1, 587, 740	19, 496, 000
1900	258	301, 590	10, 495, 000	1920	637	1, 402, 600	16, 812, 000
1905	275	395, 400	7, 318, 000	1922	655	1, 362, 748	17, 686, 000

The table shows an immense increase in the development of the Canadian fisheries since 1910. The upward movement began with a great increase in quantity of the apparatus for taking herring around Port Stanley, and the catches of this species increased thereafter so that in the next year herring made up about two-thirds the output of fish on the entire lake. After that apparatus increased everywhere, until the peak was reached in 1918, but production has not kept pace with the increase in apparatus employed.

Table 8 shows that the increase of apparatus has been greater than the increase in production on the Canadian side. From 1916 to 1922 the number of yards of gill netting in use increased ten times and the number of pound nets three times over the figures for 1895, while production only doubled. Table 7, for the American shore, though only three censuses are given, shows with each census not only an increase in total production but in general, also an increase in the productivity of the gear, facts that point to an improvement in the fisheries.

Conditions do not warrant the unquestioned acceptance of the conclusions that might be drawn from the data in Table 7. Depletion is generally considered to be less serious in the Canadian waters of Lake Erie, and for that reason, in part, the duty on Canadian fish was asked by American fishing interests. The figures may be interpreted to show the opposite.

Production in American waters in the season of 1925 and also in the winter of 1925–26 is reported to have been unusually low, a situation one would not expect from the census of 1922. Furthermore, in 1922, in the face of 50 per cent and greater increases in the productivity of gear, the amount employed was less than in 1917. This is not the usual economic reaction to prosperous conditions. It may also be argued that between 1917 and 1922, for which period statistics are lacking, production may have declined and gear have been reduced on that account. In such a case, the increased production of 1922 may be quite as well explained by assuming possible fluctuations in the five variables mentioned in the following paragraph, as by assuming that fish have become more numerous. Finally, it is not entirely probable that fish can increase under conditions of pollution, virtually unrestricted and most intensive fishing, and little propagation.

It has been stated elsewhere in this paper that the available statistics of the Great Lakes fisheries can not be statistically treated and in these two tables the reason can be shown.

1. None of the figures show the mesh of the gear employed. The size of the mesh determines not only the kind of species that will be taken but also the abundance of the species in the catch. The data given on page 611 indicate that a fishery for deep-water Leucichthys in Lake Ontario, which might soon fail with a 2¾-inch minimum mesh, would flourish if the mesh were reduced ¼ inch. Of course, in Lake Erie the size of meshes used has not varied greatly in the last few years, but there have always been two classes of gill nets, one chiefly for whitefish and one for smaller species. Thus, the increased catch may be due chiefly to the catch of smaller fish by nets with smaller mesh.

2. The length of the gill nets is given in Canadian waters, but not the depth, which is an extremely important factor. For American waters no dimensions whatever are given. The effectiveness of such apparatus depends also to a very great degree on its state of repair, the material of which it is spun, the fineness of its threads, etc.

3. The method of employing the apparatus is nowhere reflected in the statistics. On other pages it has been stated that the floating of nets has greatly increased the catches.

4. It is not known whether market conditions favored the capture of all species throughout the season of each year for which statistics are recorded. In 1920 thousands of pounds of blue pike and herring could not be sold because the markets were glutted, and the fisheries reacted accordingly. Such conditions have obtained at other times and their effects, of course, determine production.

5. Even if gear, market conditions, etc., were stabilized and the number of fish in the lake remained unchanged, the yield would certainly vary from year to year as a result of other conditions, especially those influenced by the weather. Being taken at about 5-year intervals, the American statistics do not permit evaluation of this annual fluctuation, even if the data were given in sufficient detail.

If, then, fish are not more abundant now than formerly, the increase in or the maintenance of the general level of production must be determined by some other factor, and the only other factor likely to influence production is increased demand, which is reflected in higher prices.

Since there are no cities on the Canadian shore of Lake Erie, and since the populaton of the Province of Ontario may obtain its fish supply from other lakes that are nearer, the Canadian fishermen are chiefly dependent on American markets. Therefore the following table of comparative prices for American waters will apply to the Canadian side also. There are statements of value for each year in the Ontario statistical bulletins, but the values given were constant over long periods, and hence must have been fixed arbitrarily.

TABLE 9.—*Average price per pound, in cents, and index number of prices of the principal commercial fishes of the American waters of Lake Erie, as shown by the various censuses taken*

[Base of index numbers: Average price in 1899=100]

Species	1890, average price	1893, average price	1899		1903		1908		1917		1922	
			Average price	Index No.	Average price	Index No.	Average price	Index No.	Average price	Index price	Average price	Index No.
Whitefish	4.95	6.09	7.36	100	7.59	103	8.17	111	13.26	180	18.80	255
Trout	4.27	4.92	5.41	100	5.29	98	4.84	89	10.45	193	8.86	164
Herring	1.03	1.24	1.29	100	3.80	294	2.70	209	6.10	473	4.98	386
Yellow pike	4.30		4.98	100	5.44	109	4.15	83	11.55	232	14.84	297
Blue pike	1.98	2.50	3.07	100	3.83	125	3.01	98	6.57	214	4.96	162
Sauger	1.24		2.49	100	2.46	99	3.05	122	6.11	245	4.92	198
Sturgeon	3.55	3.96	6.76	100	7.34	109	14.40	213	21.36	316	27.74	410
Black bass	5.44	3.80	7.38	------	8.02	------	------	------	------	------	------	------
Perch	1.06	1.37	1.59	100	3.27	206	3.69	232	7.26	457	5.98	376
Suckers	------	1.09	1.15	100	1.21	105	1.47	128	3.51	305	3.10	269
Carp	------	2.59	1.42	100	1.67	118	1.81	127	4.54	320	4.12	290
Catfish	2.38	3.04	3.04	100	4.11	135	4.49	148	6.24	205	7.24	238
Sheepshead	------	------	.67	100	.70	105	.90	134	2.43	363	2.41	360
Lawyer	------	1.20	------	------	.72	------	1.02	------	1.23	------	1.72	------
Bowfin	------	------	------	------	.56	------	------	------	1.34	------	------	------
White bass	------	------	1.92	100	3.40	177	4.75	247	6.02	314	4.11	214
All commodities	------	------	------	100	------	115	------	120	------	236	------	199

This table discloses a great increase in price for every species since 1899. This increase is particularly noticeable between 1908 and 1917. Between 1917 and 1922 the prices of whitefish, yellow pike, sturgeon, catfish, and lawyer continued to increase. All of the other species decreased in price. It must be remembered that 1917 was a year of inflated values in general, and prices in 1922, while not inflated as much as in 1917, were far above those of the earliest years given in this table. Although the values given in the table indicate that prices of certain fishes have doubled, trebled, and, in some cases, quadrupled, since the earliest years, it is not evident whether the greatly increased prices in 1922 may be explained entirely by the generally inflated values of recent years, or whether they indicate the relatively increased demand for fish.

In order to examine this feature, index numbers of the prices of fish with the year 1899 as a base, as compared with the index numbers of all commodities,[8] based on the same year, have been graphically shown in Figure 15. The curve for all commodities, as shown by the heavy line, indicates that in general wholesale prices were nearly two and one-half times as high in 1917 as they were in 1899, and fully twice as high in 1922 as in 1899. If the demand for the various species of fish had remained relatively the same as in 1899, it would be expected that the prices would have very closely followed the heavy line curve; but that is not the case. It is evident from the graph that the great majority of species now cost relatively much more than in 1899, even when inflated values are taken into consideration. Trout and blue pike alone have fallen below the general level of prices. Saugers have followed general prices very closely. All other

[8] From Wholesale Prices, 1890 to 1922, Bulletin, U. S. Bureau of Labor Statistics, No. 335, 1923. Washington.

principal species have increased in value out of proportion to general prices.

It may be concluded from this that the demand has outstripped the supply of all species except sauger, trout, and blue pike since 1899, and that the supplies of sturgeon, herring, perch, and sheepshead are so far below the demand that the prices are relatively twice as great now as they were in 1899.

Along with price advances and the change in the quantity of production, there has also been a change in the quality of the production. According to the Federal statistics of 1922, the principal species taken in American waters, in order of size of catch, were herring, blue pike, sauger, carp, perch, sheepshead, yellow pike, and suckers. The relative abundance of the various species, as published in the censuses, is shown in Table 10.

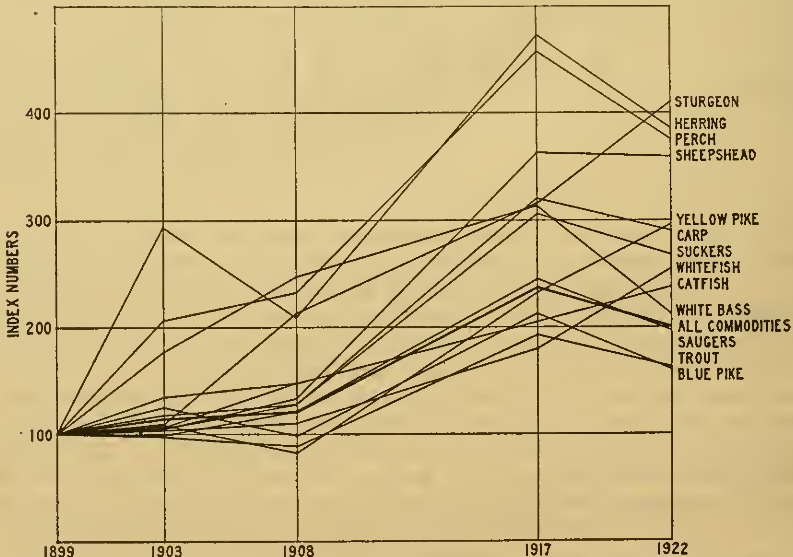

FIG. 15

TABLE 10.—*Relative abundance of the most important species as shown by the total weight, in pounds, of the annual catch of the principal species in the American waters of Lake Erie, as shown by nine censuses*

Species	1880	1885	1890	1893	1899	1903	1908	1917	1922
Whitefish	3,333,000	3,531,000	2,341,000	1,292,000	2,066,000	302,000	1,503,000	1,755,000	922,000
Herring	11,774,000	19,354,000	38,868,000	20,931,000	33,427,000	8,788,000	10,599,000	17,160,000	16,158,000
Trout	26,000	106,000	121,000	203,000	32,000	15,000	6,000	1,000	1,000
Yellow pike	----------	2,694,000	2,105,000		1,735,000	908,000	3,506,000	1,291,000	1,813,000
Blue pike	----------	7,899,000	7,488,000	12,529,000	4,544,000	4,915,000	9,072,000	2,057,000	14,542,000
Sauger	----------	5,466,000	4,179,000		3,026,000	1,940,000	2,417,000	3,929,000	6,002,000
Perch	----------	1,601,000	2,870,000	2,594,000	3,315,000	830,000	1,742,000	959,000	2,969,000
Sturgeon	1,970,000	4,727,000	2,078,000	793,000	789,000	294,000	63,000	28,000	15,000
Suckers	----------	2,373,000	[1]	1,360,000	1,568,000	721,000	1,719,000	1,035,000	1,598,000
Sheepshead	----------			----------	1,147,000	642,000	1,394,000	2,855,000	2,362,000
Carp	----------	----------	----------	635,000	3,633,000	3,546,000	8,893,000	6,044,000	5,899,000
Catfish	----------	2,802,000	1,926,000	776,000	1,002,000	181,000	579,000	628,000	1,337,000
White bass	----------	----------	----------	----------	1,596,000	27,000	217,000	286,000	1,022,000

[1] Very few sheepshead were marketed before the late nineties.

It appears from this table that until 1890 the order of abundance was as follows: Herring, blue pike, sauger, sturgeon, whitefish, catfish, yellow pike, and suckers. The yellow perch changed places with the sturgeon in 1890, but in 1899 the sturgeon and catfish fell permanently below eighth place and the list was disturbed by the appearance of the carp and white bass. In the census of 1903 the white bass and whitefish dropped out of the series and the sheepshead and sucker came in. (The sucker, being a cheap fish, has fluctuated in importance from year to year according to the tone of the markets.) In 1908 the whitefish recovered eighth place from the sheepshead, and in 1917 displaced the perch from sixth.

The main features of the 1922 statistics are the great rise in importance of the blue pike and perch, occasioned by an enormous increase in production, and the decline in importance of the carp and whitefish. The latter again dropped out of the series in this census. Thus, of the eight species that were most important in the fisheries before 1890, five still maintained that distinction in 1922.

The principal species on the Canadian shore in 1922 were, in order of abundance, blue pike, herring, perch, "coarse fish" (including suckers, sauger, and white bass), whitefish, wall-eyed pike, carp, and pike. The relative abundance of the various species as shown by the annual catches at five-year intervals over a period of years is given in Table 11.

TABLE 11.—*Relative abundance as shown by total weight, in pounds, of the annual catch of the principal species taken in the Canadian waters of Lake Erie, as shown by 11 censuses*

Species	1875	1880	1885	1890	1895	1900
Herring	316,000	854,000	5,935,000	5,393,000	5,139,000	6,526,000
Whitefish	125,000	205,000	186,000	204,000	148,000	401,000
Yellow pike	193,000	143,000	685,000	961,000	1,642,000	1,218,000
Pike	13,000	19,000	17,000	62,000	30,000	821,000
Sturgeon	-----------	213,000	459,000	580,000	319,000	169,000
Perch	-----------	-----------	-----------	-----------	396,000	694,000
Coarse and mixed fish	268,000	169,000	208,000	552,000	977,000	559,000
Bass	39,000	69,000	110,000	134,000	45,000	37,000

Species	1905	1910	1915	1920	1922
Herring	3,015,000	6,959,000	5,594,000	9,651,000	6,306,000
Whitefish	304,000	1,383,000	1,832,000	838,000	751,000
Yellow pike	1,692,000	923,000	607,000	166,000	505,000
Blue pike	-----------	-----------	4,882,000	3,354,000	6,312,000
Pike	935,000	[1] 2,516,000	630,000	115,000	143,000
Sturgeon	74,000	61,000	56,000	-----------	36,000
Perch	552,000	674,000	1,042,000	1,272,000	2,109,000
Coarse and mixed fish	703,000	883,000	948,000	900,000	1,227,000
Carp	-----------	979,000	904,000	431,000	233,000

[1] These fish were certainly not all pike, but probably included blue pike.

The interesting features of the table are the rise in production and the corresponding change in relative abundance since 1910, at about which time the increased demand for certain species raised the prices paid by American markets. The statistics have not been treated in a way to permit detailed analysis, but nevertheless certain tendencies are indicated by them. The sturgeon has declined to insignificance, and blue pike, perch, and "coarse fish" have steadily risen in importance since 1910. The whitefish, which also rose to prominence at that time, fell off to an alarming degree by 1920. The once important carp has steadily declined. Bass and other game fish have for many years been placed on the protected list everywhere in Lake Erie and also in others of the Great Lakes.

PRESENT STATUS, METHODS, AND APPARATUS

The amount of apparatus in use on Lake Erie, as stated in Table 8, has latterly been reduced on the Canadian shore and production has fallen off. Statistics for American waters also show a decline in the quantity of apparatus employed. As in the past, the fisheries on the western flat are at present mostly shore fisheries, conducted by means of traps on the American side and by pounds across the boundary. Their products are rough fish, though at certain seasons a few whitefish are also taken. Gill nets, chiefly of 3-inch mesh, are also abundantly employed by the shore fishermen to take the same species, and at certain seasons seines are used, principally for the capture of carp in the marshes.

The tugs operating with gill nets alone are owned almost entirely on the eastern half of the lake. They use principally 3-inch herring nets, which at certain seasons they also set for blue pike and perch. All boats are now equipped with bull nets, and every boat has the necessary apparatus for floating nets. At certain seasons 4½ to 4¾ inch whitefish nets are employed, but only for short periods, but most boats have a few gangs of such nets.

The fishing seasons vary in different sections of the lake, and it is now common practice for the tugs to migrate to other ports or even into the waters of other States and to return home again when fish appear near their own ports. There are no such migrations across the boundary line; though the Canadian authorities have had difficulty with American tugs that set nets in Canadian waters, and a patrol is maintained and such nets as are found are seized.

Considering the immense quantity of netting employed in so small an area as Lake Erie, it is surprising that any fish are left. At times, however, the fish seem to avoid all netting, and floated or sunken nets are alike useless. At such times fishing is discontinued or the efforts of the fishermen are directed toward less elusive species.

FISHING DISTRICTS

On the American shore the principal gill-net ports, in geographical order, are Cleveland, Ashtabula, Erie, and Dunkirk, while on the Canadian shore Port Maitland, Port Dover, Port Burwell, Port Stanley, and Rondeau are most important. There are very important shore fisheries scattered all along the lake, particularly at the western end, but since the small boats engaged in these fisheries can find shelter almost anywhere along the shore they are not collected into harbors as is the case with the gill-net tugs. Cleveland, Loraine, Vermilion, Huron, Sandusky, and Toledo are the important centers handling the shore production on the American side of the lake, and on the Canadian shore most of such fish are shipped from Kingsville, Leamington, Rondeau, and Port Stanley.

FIG. 16.—Boats comprising the fishing fleet operating on Lake Nipigon lying at anchor off the little fishing station of Macdiarmid

FIG. 17.—A typical Lake Erie wholesale fish house, located at Sandusky. The small launches are used in the shore fisheries, and the larger boats collect the production of the fishermen among near-by islands

FIG. 18.—Clearing the gill nets. One man is arranging the net in the box as it is delivered by the lifter (the drum in the center); the other is removing the fish (herring) from the netting. At the right are the cleared fish in "lake boxes." Above these are the "net boxes," in which the netting is handled

FIG. 19.—Setting gill nets from the stern of a moving tug. The nets have just been lifted, so that the snarls have to be gotten out as the nets are let into the lake

PRINCIPAL SPECIES

Unlike any other of the Great Lakes the chief production of Lake Erie is "rough fish"; that is, species other than whitefish, herring, and trout. The species taken most abundantly in 1922 in American waters were, in order of abundance, herring, blue pike, sauger, carp, perch, sheepshead, yellow pike, and suckers. In 1922 the principal species on the Canadian side were blue pike, herring, perch, whitefish, and yellow pike. The relative abundance of these and other species as shown by the annual catches made on both sides of the international boundary at various censuses are given in Tables 10 and 11 (pp. 592 and 593).

WHITEFISH

Whitefish formerly were produced principally on the flat at the western end of the lake, where they spawned, but now most of them are taken at other places on the lake, especially out of Erie, Dunkirk, and Port Maitland. Trap nets and pounds are chiefly used to take them in the west, while gill nets are employed in the east. In American waters the total catch showed decided improvement between 1903 and 1917. It is stated by the fishermen that the pollution of the Detroit River has driven the fish from many of their spawning grounds at the western end of the lake, and since 1920 the catches on these grounds are said to have been almost insignificant. The Canadian whitefish supply was not exploited to the limit until about 1908, and the catches in the last three years have fallen off considerably in spite of increased apparatus. The species is nowhere protected by a closed season, but spawn is collected to the capacity of the various State and Federal hatcheries.

HERRING

The herring were for many years the mainstay of the fisheries, but with the rise in value of "rough fish" they no longer occupy so important a position. They occur throughout the lake except on the western flat, where they have been practically exterminated; but there are several races, and the schools do not migrate from one end of the lake to the other, as many of the fishermen suppose. They are taken chiefly in special gill nets, which may be 25 feet deep and are often floated off the bottom. The pound nets on the north shore are also an important apparatus of capture. It is interesting that at certain seasons the fishermen find it impossible to take them with netting of any sort.

Originally herring were so abundant that the fishermen were content if they could dispose of a fraction of what they were able to catch, but in late years their numbers have become very much reduced, and were it not for the fact that the price asked for them by the organized producers has risen to such an extent that the demand is thereby curtailed, the species must by now have been more seriously depleted. As it is, it is certain that the herring fishery could not have been maintained at its present level without the use of floated nets. The nets often take too many fish to suit the dealers, and it is not uncommon to limit the weight of the lift that a boat may bring ashore, or even to cease fishing operations entirely if the supply exceeds the demand. Large quantities are stored in freezers and are later sold frozen or smoked. On account of their rich flesh and large size they have lately competed strongly with the chubs, which are superior in quality but much smaller in size and consequently are taken in nets of ½-inch smaller mesh.

No States protect the herring with a closed season, but in recent years space in hatcheries not filled by whitefish eggs has been given over to the rearing of herring fry.

WALL-EYED PIKE

There are in Lake Erie two races of wall-eyed pike—the yellow and the blue. Intermediates, called "grays," are also sometimes recognized.

The status of the blue pike has so far never been established. Various scientists have expressed the opinion that the "blues" are different from the "yellows," but except for rate of growth and color no differences have been fixed. The yellows occur chiefly on the flat at the western end of the lake; the blues occur there, too, but are most common in other sections. The laws of practically all the States differentiate between the two as between two species, and the size limit for the blue race is lower in every State. The gill-net tugs frequently fish for the blues, but both kinds are commonly taken in the pounds and traps, the blues often in such abundance that they can not be sold.

The yellows have decreased in abundance, and in 1917, in American waters, the blues showed a decrease, but since then they have again increased, particularly at the eastern end of the lake. In Canadian waters they have been taken abundantly for only 10 years, and their production appears not yet to have passed it zenith.

There is no closed season to protect either race, but the yellow pike is protected in New York and has everywhere been extensively propagated. Recently attempts to propagate blue pike met with some success. It is interesting to note that of the two species the blues are holding their own better.

SAUGER

The sauger is a close relative of the wall-eyed pike and is often combined with it in the statistics. The chief catches are made in the waters of western Ohio. It is caught in the same apparatus with blue pike, and is not protected or propagated. Apparently it is maintaining itself as well as are its relatives.

YELLOW PERCH

The bulk of the perch catch is taken on the western flat, though some are found all along the lake's shores. Pounds and traps are the chief apparatus of capture, though many perch are also taken by gill nets.

The yellow perch has long been a favorite in the American markets, and even before 1890 it occupied a prominent place in the catches of Lake Erie. The supply fell off sharply before 1917, and about 1910 the production on the Canadian shore began to increase. From 1890 to 1899 the perch held fourth place in the production on the American side, but in 1917 it had fallen to ninth place. However, the price obtained rose from 1.5 cents in 1899 to 7.2 cents in 1917. In 1922 it ranked fifth, with an average price of 5.98 cents. On the Canadian side in 1910, at the beginning of the great spurt in production, the perch ranked about seventh, but by 1920 it had risen to third place, being exceeded in abundance only by the blue pike and herring.

STURGEON

Sturgeon were first made use of on Lake Erie, where they were marketable, as early as 1860. The catch of this species in 1885 amounted to nearly 5,000,000 pounds, but after 1890 production fell rapidly, and in 1922 only 15,000 pounds were reported. Practically the only sturgeon now produced are taken at the eastern and western ends of the lake on the Canadian shore and in New York waters. In Canada the apparatus of capture includes pounds, night lines, and gill nets, and excepting pounds the same gear is used in New York. The quantity caught decreases from year to year and the extermination of the species seems certain.

As yet no protection is granted the sturgeon by any State except Ohio, but all have a size limit. None are propagated. Ohio has a permanent closed season on all sturgeon, and Pennsylvania, New York, and Ontario individually enacted laws for a closed season, but suspended their operation because their neighbors had not at that time enacted similar legislation.

SHEEPSHEAD

The sheepshead is taken chiefly on the western flat, and until 10 years ago was considered hardly worth bringing ashore. The demand has now increased, however, and in 1922 this fish brought an average price of 2.4 cents, as compared with 0.9 cent recorded in the census of 1908. In 1923 as high as 6 cents was paid to the fishermen. The catches are made almost entirely with trap nets, and in the past three years have declined considerably. The species is not protected by a closed season and is not propagated.

SUCKERS

Suckers occur all along the shores, but most of the catch is now made on the western flat in trap nets, though other devices are used also. Suckers have long been in demand as a cheap fish, and the supply shows a general decrease. There is no closed season and no propagation.

OTHER INDIGENOUS SPECIES

Every fish taken in Lake Erie now has a market value. Most of the less important species are relatively rare and the price of some of them is low. As a general thing these are taken only incidentally in the catches of more valuable and abundant species. Among these miscellaneous fish may be mentioned the catfish, bullheads, white bass, pike, mooneye, sunfish, rock bass, bowfin, lawyer, and trout.

All of them except the trout and possibly the lawyer thrive best on the western flat and are taken chiefly in traps.

The trout frequents the deeper waters at the eastern end of the lake, and is caught in gill nets. Catfish, bullheads, and white bass at one time or another held an important place in the fisheries, but though they still bring good prices their numbers have been much reduced. The trout is one of the most valuable species in the lake and also one of the rarest. It was never as abundant in Lake Erie as in the other Great Lakes, and in late years has become so rare that almost no effort is made to take it. None of the species mentioned are protected by a closed season and none of them are propagated.

INTRODUCED SPECIES

CARP

The carp is now one of the most abundant species on the American shore of Lake Erie and has become quite popular with the fish dealers. The principal catches are made west of Sandusky, where they are taken in the marshes at certain seasons by means of seines. They are often kept alive in ponds and sold during the winter when fish are scarce and prices are higher. New York City is the most important market for carp. These fish were not originally planted in Lake Erie but are said to have escaped into the lake from private ponds about 1883. They increased rapidly, and 10 years later were abundant enough to be mentioned in the census. In the last 5 years carp have decreased significantly everywhere in the lake.

GOLDFISH

Goldfish are reported to be very abundant in Maumee Bay, where they are taken in traps in the spring. It has been estimated that from 10 to 15 tons are taken annually in the bay, but they have no market value and are therefore liberated. Carl L. Hubbs, of the Museum of Zoology, University of Michigan, informed me that individuals of the species are not uncommonly caught in the nets at Monroe, and fishermen report occasional specimens on the north shore.

GIZZARD SHAD

The gizzard shad, or sawbelly, is one of the commercially insignificant species of the lake. It is said to have entered the lake through canals from the southward, and has now spread even into Lake Huron.

FISHING REGULATIONS

Fishing laws on Lake Erie are administered by the States of New York, Pennsylvania, Ohio, and Michigan, and the Province of Ontario. These laws are compared in the following sections.

APPARATUS

Gill nets.—Michigan and Ontario do not permit the use of gill nets of smaller mesh than 4½ inches for taking whitefish, and in New York nothing smaller than 4¾-inch netting may be used. Ohio and Pennsylvania do not regulate the size of the mesh for taking whitefish but prohibit the taking of fish smaller than 1¾ pounds in the round.

The laws regarding trout nets are the same as for whitefish, except that Pennsylvania requires that the mesh be not smaller than 5½ inches. For all other species excepting sturgeon no net of smaller mesh than 3 inches may be employed, except in Michigan where the minimum mesh is virtually 2¾ inches.

The laws provide for the use of 2½-inch nets for taking blue-backed herring from November 1 to December 15, but few such fish occur in Michigan waters at that season. Until 1923 2¾-inch nets were allowed in the eastern end of the lake in Canadian waters.

For the capture of sturgeon the State of New York requires 10-inch nets. Michigan, Pennsylvania, and Ontario have no regulations with respect to nets for catching sturgeon but limit the size of the fish that that may be taken, while Ohio entirely prohibits their capture.

Ontario and Pennsylvania have enacted laws to prohibit the use of bull nets. In Ontario waters no gill net may be deeper than 36 meshes, while in Pennsylvania 30 meshes is the maximum depth allowed. The Ontario law has been in force since January 1, 1923, but in Pennsylvania the law will not become effective until Ohio and New York have provided similar restrictions.

Seines.—In Michigan the mesh of seine wings may not be smaller than 4 inches and that of the bag not less than 2¼ inches, while in New York no seine with smaller meshes than 3 inches is licensed. Ohio places no restriction on the use of seines in the open lake, but permits nothing less than 4-inch mesh in the marshes. In Ontario and Pennsylvania there are no regulations governing seines.

Pound nets.—In Michigan pound nets for taking whitefish and trout may have the mesh of the bottom, sides, and front of the pot not less than 3½ inches in size, as used, and that of the back not more than 2 inches, as manufactured, for at least 15 feet below the surface of the water. If the mesh of the bottom, sides, and front of the pot is not less than 4 inches, as used, the size of mesh necessary in the back is not specified. Pound nets with the front, sides, and bottom of the pot of mesh not smaller than 2¼ inches and the back with meshes of not more than 2 inches may be used for other fish if they do not catch more than 10 per cent of mature whitefish and trout in a season. The size of mesh in the lead and heart is also specified throughout, and provision is made for the use, from October 1 to June 15, of a pound with a pot made of mesh not smaller than 2 inches throughout, as manufactured, for the purpose of taking blue-backed herring.

There are no regulations governing the mesh of pound nets in Ontario, but the size of the fish that may be taken is regulated. In Ohio one-third the back of the pot of pounds must be constructed of mesh not less than 2⅞ inches in size, as fished, and the back shall hang squarely. In Pennsylvania no pound-net pot may have a mesh of less than 2½ inches, as fished. New York does not license pound nets.

Trap nets and fyke nets.—In Michigan, Ohio, and Pennsylvania the laws governing trap nets and fykes are practically the same as for pounds. In Ontario no traps are licensed and the mesh of fykes may be not less than 2½ inches. In New York no trap net or fyke may have meshes smaller than 3 inches.

SIZE LIMITS

The regulations governing legal size of fish are given in Table 12.

TABLE 12.—*Minimum size limits of fish that may be taken in Lake Erie, as decreed by the laws of the various States*

Species	New York	Ontario	Pennsylvania	Ohio	Michigan
Whitefish	1¾ pounds, round.	2 pounds, round.	1¾ pounds, round.	1¾ pounds, round.	2 pounds, round.
Herring		8 ounces	6 ounces, round.	11 inches	
Blue pike		11 inches	11 inches	do	
Yellow pike	12 inches	15 inches	13 inches	13 inches	1½ pounds, round.
Sauger			11 inches	11 inches	
Catfish				15 inches	2 pounds, round.
Perch		9 inches		9 inches	9 inches.
White bass		do		do	
Bullhead				do	8 ounces, round.
Sheepshead		12 inches		11 inches	
Carp		3 pounds, round.		15 inches	
Sturgeon	42 inches	42 inches	48 inches	(Closed season).	20 pounds, round.
Trout	15 inches	2 pounds, round.			1½ pounds, round.
Sucker					1 pound, round.
Pike					2 pounds, round.

Ontario specifies that the length of a fish shall be measured from the tip of the nose to the center of the tail. Other States do not define length.

CLOSED SEASONS

There is a winter closed season along the lake in Pennsylvania from December 16 to March 1, both dates inclusive, during which all fishing is prohibited. In Ontario the closed season extends from December 15 to March 15 west of longitude 80° 30′ west, and in Ohio it covers the period from December 15 to March 14. New York has no winter closed season but will probably enact one for the sake of uniformity.

Whitefish and trout are protected nowhere except in Michigan, where a closed season operates during the spawning period. However, Ohio prohibits using nets on the reefs except with the permission of the Secretary of Agriculture. Since whitefish spawn on the reefs, the taking of spawn is in this way controlled. Michigan has never had trout in its waters and at present has but few whitefish, but the State has declared a closed season on whitefish from November 20 to December 15. Fishing is permitted during the spawning season if the spawn is saved. New York provides in its fishing licenses that the spawn of these species must be saved.

Yellow pike are protected in New York waters from March 2 to May 9, both dates inclusive. The blue pike, which are by far the more numerous, are not included in this protection.

No sturgeon may be taken in the State of Ohio. New York, Pennsylvania, and Ontario have tried for a number of years to come to an agreement to protect the sturgeon, but so far have met with no success, and fish larger than the minimum size provided by the various State laws may still be taken. It is deplorable that laws can not be enacted to save the sturgeon.

There are no closed seasons in any State for the protection of any species except those mentioned.

The laws are in no respect so seriously at variance with one another as in the matter of trap and pound nets. The smallest mesh that may be used in New York is 3 inches, in Pennsylvania 2½ inches, and in Ohio 2⅞ inches. In Michigan the mesh of the back of the pot may not be larger than 2 inches unless the mesh of the rest of the pot be at least 4 inches in size. Ontario has no regulations at all governing the size of mesh. Furthermore, some of the States do not distinguish between meshes *as manufactured* and *as fished.* Before the netting is used it is tarred, and this treatment increases the diameter of the twine and the water later shrinks it; all of which reduces the size of the mesh. The Ohio law alone specifies that the mesh shall *hang squarely* so that small fish may be able to escape. If the netting is not properly strung, the openings of the mesh are reduced and the escape of small fish is restricted. Many conservationists believe that up to a certain point the meshes of trap nets can not be made too small, since when they are small fewer fish gill themselves in the twine when the net is lifted. This might be true if the fishermen could be persuaded to take time to lift their nets so slowly that it would be possible to sort out the marketable fish and release the rest without injuring them; but such procedure is not always practicable, and the young are too frequently injured or even destroyed in the lifting. There are, furthermore, provisions in the laws of most of the States permitting the possession of from 3 to 10 per cent of undersized fish.

Many States fail to provide size limits for certain species. However, except for the sucker and the pike the other undesignated species are not sufficiently important in the various States, where the laws now make no provision for them, to become the objects of particular legislation.

LAKE ONTARIO

DESCRIPTION

Lake Ontario is the smallest and the farthest east of the Great Lakes and is bounded on the north and west by the Province of Ontario and on the south and east by the State of New York. It has a length of 185 miles and an average width of 40 miles, and, with its bays, a total area of about 7,300 square miles. There are no islands or shoals except near the outlet, where it discharges into the St. Lawrence River. The shores everywhere slope rapidly into deep water, but most rapidly on the south, and the deep trough runs nearer this shore. The 30-fathom contour on an average runs less than 3 miles from land on the southern shore, while on the north it is about 5 to 10 miles distant. The trough broadens toward the east and is overlaid by depths of 70 to 90 fathoms in the western half and by 90 to 123 fathoms in the eastern half. The bottom over most of the lake is clay, with narrow stretches of sand and rock along the shores, particularly among the islands at the eastern end.

FISHING INDUSTRY

HISTORY

The fisheries of Lake Ontario began with the settling of its shores, and the first species sought were the whitefish and trout. These were taken with seines, which gear, it is said, was used as early as 1807. Fishing by this method was conducted principally on the northeastern and eastern shores, but seines were also drawn wherever the bottom was suitable. According to all accounts large numbers of sturgeon and herring were included with the whitefish and trout, but these were not desired and were destroyed as nuisances along with the smaller whitefish. The catch was salted, and this practice was continued until about 1860, when the fish became rare in the shore waters. Gill nets were then employed, since thereby the deeper waters could be reached. Pound nets were never widely used on Lake Ontario, and in recent years none have been licensed. With the general decline in abundance of whitefish and trout gill nets of smaller mesh were set for herring and the sturgeon was marketed.

The catch of trout and whitefish in American waters dropped off to insignificance as early as 1885, and by that year the chief production on the Canadian shore was herring and ciscoes. The latter were discovered in the western waters about 1860, and played an important rôle in the fisheries of that section for many years. The best fishing grounds on the Canadian side are at the east end of the lake, and at first fishing was most intense there. With the exhaustion of the original whitefish and trout grounds here and the increase in the demand for herring the center of fishing activities swung to the west end of the lake westward from Toronto. By 1910 the economic forces that stimulated fish production on the Canadian side of Lake Erie and in other Canadian waters at about the same time were felt on Lake Ontario, and fishing apparatus increased enormously, resulting in a more intensive and extensive exploitation of the fishery resources, particularly of the salmonids. Since this date over two-thirds of all the netting on the lake has been employed in a small sector to the eastward from Brighton.

Only a narrow shelf along the American shore is suited for shore fishing, and since this area was thoroughly exploited from the beginning the American fishermen had no other place in which to look for whitefish or trout and turned their attention to other species.

About 1875, out of Oswego, a large deep-water herring was discovered in 60 fathoms and deeper, which supported the fishing industry out of that port for about 12 years. These fish were known as "bloaters" and were caught with 3½ to 4 inch nets. Bloater fishing spread along the shore, and by 1890 was established at Wilson. By 1895 the bloater was everywhere so rare that no one fished in deep water, and since then the little fishing done on the American shore has been carried on chiefly by means of trap nets, which had been in growing use since 1885.

The trend of the fisheries on the American shore may be clearly expressed by a digest of the statistics over a period of years, itemized in Table 13.

TABLE 13.—*Weight, in pounds, of the annual catch of the principal species of fish taken in the American waters of Lake Ontario, as shown by eight censuses*

Species	1880	1885	1890	1893	1899	1903	1908	1917	1922
Whitefish	1,064,000	90,000	148,000	45,000	161,000	25,000	56,000	88,000	54,000
Trout	569,000	20,000	41,000	6,000	15,000	4,000	14,000	23,000	46,000
Herring (including bloaters)	611,000	403,000	598,000	164,000	86,000	121,000	35,000	424,000	187,000
Sturgeon	545,000	386,000	541,000	125,000	189,000	110,000	37,000	10,000	34,000
Wall-eyed pike	(1)	[2] 269,000	331,000	[2] 216,000	197,000	68,000	154,000	35,000	141,000
Perch	(1)	(1)	358,000	131,000	407,000	122,000	35,000	31,000	30,000
Catfish and bullheads	(1)	442,000	471,000	69,000	518,000	349,000	122,000	45,000	107,000
Suckers	(1)	(1)	279,000	47,000	278,000	773,000	128,000	71,000	77,000
Pike	(1)	----------	129,000	----------	100,000	31,000	87,000	15,000	19,000
Carp	----------	----------	----------	----------	1,000	4,000	4,000	25,000	138,000
Eels	(1)	61,000	257,000	(1)	123,000	73,000	44,000	41,000	45,000
Lawyer	----------	----------	----------	----------	----------	----------	----------	61,000	15,000

[1] Not itemized. [2] Including pike.

In 1880 whitefish, trout, herring, and sturgeon made up over 75 per cent of the total production of 3,640,000 pounds; the greatest year on record. In the six censuses taken between 1885 and 1908 the catch of these species, combined, was less than half that of "rough fish"—principally wall-eyed pike, perch, eels, suckers, and such other species as frequent the shores. The high point in the production of rough fish was reached in 1890, and the catch has declined since, so that in 1917, even with the stimulant of war prices, the total yield of these species fell below that of any previous census and was exceeded by the 424,000-pound catch of herring in that year. In 1921 the New York law was amended to permit fishing to within ½ mile of shore, instead of 1 mile, and it is possible that the slightly increased catch of 1922 was partly due to the enlarging of the available fishing grounds.

The history of Canadian fisheries has been more cheerful, due to better fishing grounds on that side of the lake and also to the greater care taken of them. After the whitefish and trout fell off (in about 1885) the chief fisheries were for ciscoes, herring, and rough fish, and not until 1905, when netting was more commonly used in the eastern waters, which have always produced most of the whitefish and trout, did these species rise to prominence again. They are now the mainstay of the Canadian fisheries, though significant quantities of herring and rough fish are also produced. Ciscoes have for many years been commercially extinct. Herring were caught chiefly west of Toronto until 1918, but since then they have become rarer in these waters and the catches in the east have increased so that now the east side of the lake exceeds the west side in the output of these fish. Rough fish have always been most abundant in the east.

PRESENT STATUS, METHODS, AND APPARATUS

On the American shore only small launches are now used in the fisheries and trap nets and fyke nets are their chief equipment. Occasionally, however, a larger boat, usually from Lake Erie, equipped with abundant up-to-date apparatus, has been lured to Lake Ontario by the prospect of great fish wealth present in the deeper waters, into which the frail craft of the native fishermen do not venture, but the prospectors soon become disillusioned and return whence they come. There are still a few gill-net fishermen, mainly at the eastern end of the lake, who fish during the summer for whitefish and herring, and some fishermen still use gill nets at certain seasons for taking sturgeon. Hooks are also used for taking sturgeon, as well as for eels. No pound nets are licensed.

Many of the fishermen now ply their trade only when runs of certain species may be expected, and at other times they withdraw their netting. The schools of herring that come ashore at certain places in the fall receive especial attention.

The best fishing obtains off the Canadian shore, and the majority of fishermen on the lake are Canadians. Here, also, the fishing boats are small launches and rowboats, but gill nets are the chief apparatus. These are lifted by hand. Trout and whitefish are the principal species taken with large-meshed gill nets and herring with the small-meshed nets. Pound and trap nets are not licensed. Fykes may be fished but are used only at the eastern end, where their catch consists chiefly of rough fish. Hooks are also employed in this region for taking eels and catfish, and a few seines are operated here and elsewhere. The amount of apparatus engaged in the fisheries is increasing.

FISHING DISTRICTS

Since only small boats are employed in the fisheries, these can find shelter almost anywhere along the shore, and the principal fishing districts may be most conveniently designated by the larger political subdivisions. On the New York shore these are Jefferson and Oswego Counties, and on the Ontario shore Lincoln and Halton Counties on the west and Durham, Northumberland, and Prince Edward Counties, including the Bay of Quinte, on the east are the important districts.

PRINCIPAL SPECIES

The principal species on the American shore in 1922, the last census year, was the herring, of which about 187,000 pounds were taken. Wall-eyed pike ranked second, with 141,000 pounds, while carp and bullheads came third and fourth, respectively, with 138,000 and 107,000 pounds.

On the Canadian shore in 1922 whitefish ranked first, with a production of 2,098,000 pounds, while trout were second with 721,000 pounds. Coarse fish—chiefly suckers, pike, catfish, eels, wall-eyed pike, carp, and perch—ranked next in order of abundance. The production in 1917 and 1922 is more fully shown in Tables 13 and 14.

TABLE 14.—*Weight, in pounds, of the annual catch of each of the important species and amount of gill netting used in the Canadian waters of Lake Ontario, as shown by 10 censuses*

Species	1880	1885	1890	1895	1900
Whitefish	729,000	360,000	404,000	126,000	129,000
Trout	249,000	307,000	106,000	109,000	60,000
Herring, including ciscoes	233,000	1,503,000	2,484,000	1,407,000	1,095,000
Sturgeon	16,000	55,000	41,000	39,000	18,000
Pickerel	139,000	229,000	135,000	245,000	34,000
Pike	80,000	255,000	213,000	445,000	232,000
Eels	(1)	18,000	29,000	37,000	40,000
Perch	(1)	(1)	(1)	249,000	283,000
Catfish	(1)	(1)	(1)	(1)	267,000
Carp			(1)	(1)	(1)
Mixed and coarse fish	978,000	936,000	780,000	714,000	722,000
Gill nets, yards	399,000	236,000	305,000	346,000	462,000

[1] Not separated from "mixed and coarse fish."

TABLE 14.—*Weight, in pounds, of the annual catch of each of the important species and amount of gill netting used in the Canadian waters of Lake Ontario, as shown by 10 censuses*—Continued

Species	1905	1910	1915	1920	1922
Whitefish	472,000	694,000	817,000	2,027,000	2,098,000
Trout	75,000	413,000	555,000	462,000	721,000
Herring, including ciscoes	1,390,000	997,000	1,801,000	1,291,000	345,000
Sturgeon	14,000		1,000		1,000
Pickerel	48,000	60,000	85,000	46,000	144,000
Pike	203,000	378,000	366,000	311,000	250,000
Eels	19,000	104,000	219,000	91,000	146,000
Perch	179,000	128,000	119,000	107,000	74,000
Catfish	135,000	269,000	267,000	170,000	177,000
Carp	(1)	140,000	112,000	65,000	121,000
Mixed and coarse fish	257,000	367,000	438,000	413,000	448,000
Gill nets, yards	499,000	1,075,000	887,000	1,057,000	1,600,000

[1] Not separated from "mixed and coarse fish."

WHITEFISH

The whitefish originally ranked first in the fisheries on the American shore, but few are now taken and these are produced for the most part in Jefferson and Oswego Counties. At other points along the American shore they are taken only occasionally. The whitefish is now first in abundance on the Canadian side of the lake and still supports a fishery out of many ports, but by far the most productive whitefish area lies eastward from Brighton. The best spawning grounds are also in this region. Gill nets are the principal apparatus of capture. There have been times when in many sections the species was rarer than at present and the fishermen ascribe the increase to planting and to the unusually low mortality among the alewives in recent years. There is no closed season for whitefish on the lake, but the species is extensively propagated.

LAKE TROUT

The lake trout is now an insignificant element in the American waters and such few as are taken come from the eastern end of the lake. On the Canadian shore the trout is next in importance to the whitefish, and its geographical distribution is similar to that of the whitefish, being most abundant at the eastern end. The fish is taken chiefly in gill nets, though there was a time prior to 1900 when set lines were employed to some extent. There is no closed season on trout and the species has not been very extensively propagated.

HERRING

On the American shore of Lake Ontario herring are taken principally in the area from Sodus Bay eastward to the St. Lawrence River. Most of them are caught in the fall in trap nets and gill nets when they come ashore to spawn, but a few fishermen, particularly in Oswego County, fish for them with gill nets during the summer and take them abundantly in water as deep as 200 feet.

On the Canadian shore most of the herring are taken in shallow water at the west end of the lake and in the Bay of Quinte region. Herring are also found at the west end in deep water, and until 1923 it was permissible to use a mesh of 2½ inches to take them in this area. These deep-water herring are fatter than those taken along the shores or from other sections of the lake, and are sometimes smoked. The use of 2½-inch nets dates back to the "cisco" fishing of 1860 and thereafter, but the fishermen are unanimous in their opinion that these herring have succeeded the "ciscoes."

Herring are not protected by a closed season, but are sometimes propagated. They have fluctuated in abundance from year to year in certain areas of the lake, now appearing on certain spawning grounds in immense schools and then forsaking them for a period of years, often to return again in apparently undiminished abundance.

BLOATERS AND CISCOES

The bloater is a deep-water herring that attained a weight of about 1½ pounds, which was taken principally along the American shore, though for three or four years, in the nineties, it was also taken out of the Canadian ports at the west end of the lake. Nowhere else does a depth of 60 fathoms (which is the depth at which the bloater lived) occur within sight of shore, and the sailboats, which were chiefly in use at that time, could not set nets and expect to find them again unless it was possible to take range of their location from points along the shore.

The first fishery for bloaters was carried on out of Oswego about 1875. A fisherman operating out of that port found a few individuals in the outer ends of his whitefish gangs and conceived the idea that it might be profitable to fish them. The fish were sold fresh and were so much in demand that at one time there were several boats engaged exclusively in bloater fishing out of that port. The industry gradually spread to the westward, and by 1890 bloaters were being taken out of Wilson. At first they were extremely abundant and it was never necessary in American waters to use a net of smaller mesh than 3 inches, and usually the mesh employed was 3½ inches, but before 1900 the bloater was commercially exterminated, and efforts to revive the industry since then have met with absolute failure. Repeated efforts to locate these fish, made by me in the summers of 1921 and 1923, failed, and not a single specimen was found, so that it appears likely that the species is extinct. No cause for its extermination suggests itself. At no time were any but the largest examples of the species taken, and so far as known it had no important vertebrate enemies. The case has close parallels in the related blackfin of Lake Michigan and the bluefin in Lake Superior, which suddenly became commercially insignificant, though not extinct, under identical conditions.

The "ciscoes" were also deep-water fish, which were discovered off Burlington Beach about 1860. Until about 1895 they were taken in 2½-inch nets at a depth of 35 fathoms and more, chiefly in late fall when they spawned. In the nineties, from all accounts, the bloaters appeared off the shore, because the Canadian fishermen found it necessary to use nets of 3¼ inches to take them. These nets were used for three or four years. Since 1900 there have been no more "ciscoes," according to the fishermen.

What the "ciscoes" were can not be positively stated, but it is likely that they were *Leucichthys hoyi*, which is known to occur more of less abundantly in other parts of the lake, though none are taken because nets of small enough mesh are not permitted. Two other species of deep-water herring occur with *hoyi* in depths of 50 to 70 fathoms, but these are also small and can not be taken in the minimum 3-inch net which is now allowed. The nets of 2½ inch and 2¾-inch mesh set by me in the summer of 1921 showed that these three species occur off Wilson, Rochester, and Sodus Point. Since about half the entire area of Lake Ontario is frequented by no other fish than these three species and the lawyer, it would be a distinct economic gain if they might be taken commercially.

OTHER INDIGENOUS SPECIES

The "rough fish" are found only in the shallowest water, and such areas have been pretty well protected on Lake Ontario. The New York law allowed no nets within 1 mile of shore from about 1890 until 1921, and the Canadians licensed practically no traps or pounds. The chief species are sturgeon, eels, pike, wall-eyed pike, suckers, catfish, bullheads, perch, and lawyer. The Atlantic salmon, which was at one time abundant in the streams emptying into Lake Ontario, is now probably extinct.

The sturgeon, once valueless, is now the most valuable of all the species in the lake, and though almost exterminated it is still abundant enough on the American shore so that several fishermen make particular efforts during the summer to capture it. Gill nets and set lines are used, and the output is a few hundred fish yearly.

The eel, which obtains access to the lake from the St. Lawrence River, is taken chiefly on night lines, and all the other species are taken in fykes, traps, or gill nets. The greatest amount of each species, except the sturgeon and lawyer, is taken on the Canadian side, where the most sheltered situations occur.

The lawyers are abundant enough everywhere, but the Canadians have no market for them and the Americans have just begun to utilize them. The campaign of the United States Bureau of Fisheries to acquaint people with the food qualities of this species is no doubt largely responsible for the increased demand.

None of the species mentioned in this section are protected by a closed season except the wall-eyed pike, which in New York may not be taken from March 2 to May 9, both dates inclusive. However, most of the wall-eyed pike in American waters are of the blue race, and these are not protected in any manner whatever.

INTRODUCED SPECIES

ALEWIFE

An account of the Ontario fisheries is not complete without mention of the alewife, which was present in abundance in the lake as early as 1873, according to a letter found in the files of Fisheries Inspector John W. Kerr, of Hamilton, dated June 10, 1873. It is supposed to have been introduced, and is at present very abundant along the shores but is not taken for market. Its chief interest lies in the heavy mortality among adults in the spring, when they are said to occur frequently in windrows on the beaches. To the decay of these carcasses the fishermen attribute in large part the decrease of the whitefish, and from personal observations I believe that it is not improbable that this may have been a factor. On August 24, 1923, while witnessing the lifting of a 3-inch gill net set for lake herring in 30 fathoms off Sandy Pond, from three to nine dead and decayed fish were brought up between each two corks (about 8 feet), wrapped about the threads of the net. The nets had been out for two nights and a stiff breeze had induced the currents, which swept the fish along the bottom and entangled some of them in the nets.

CARP

Another important nonindigenous species is the carp, which is thriving in Lake Ontario, where conditions are suited to it. They are caught for market at several points on both the American and the Canadian shore, chiefly at the eastern and western ends. They are taken for the most part in seines and traps on the American side and by seines on the Canadian shore.

SHAD

Shad were introduced into Lake Ontario many years ago and for a time were occasionally taken. Specimens are still reported at rare intervals.

FISHING REGULATIONS

APPARATUS

Gill nets.—The New York law allows no gill net of a mesh less than 4¾ inches to take whitefish or trout in Lake Ontario, and the Ontario law allows none smaller than 4½ inches. For sturgeon New York requires a gill net of not less than 10-inch mesh, while Ontario has no requirements but regulates the length of the sturgeon that may be possessed. For all other species gill nets of not less than 3-inch mesh are legal. In addition, the New York law specifies that no net may be set within ½ mile of land or within 1 mile of the mouth of the Niagara River, except that nets may be set for herring from October 15 to December 15 outside of an area 500 feet from shore and outside a radius of 1,000 feet from the mouth of any river, bay, inlet, or outlet. There are exceptions to this law in the case of some of the larger bays.

No Canadian fisherman may use a gill net of greater depth than 36 meshes, and certain restrictions are placed on fishing in the Bay of Quinte.

Seines.—No seine of less than 3-inch mesh may be used in New York waters. Ontario does not specify the size of mesh that may be used.

Trap nets.—Pound nets are not licensed on Lake Ontario. Trap nets are prohibited in the Ontario waters of the lake, but fyke nets are allowed and may be of a mesh not smaller than 2½ inches. Both traps and fykes are allowed in New York but may not be of mesh smaller than 3 inches.

SIZE LIMITS

New York State prohibits the taking of whitefish of less than 1¾ pounds in the round, trout less than 15 inches in length, wall-eyed pike (yellow only) less than 12 inches, or sturgeon less than 42 inches.

The Ontario law prohibits the taking of whitefish or trout under 2 pounds in the round, herring under 8 ounces, carp under 3 pounds, sturgeon under 42 inches, wall-eyed pike (blue) under 11 inches, wall-eyed pike (yellow) under 15 inches, perch under 9 inches, sheepshead under 12 inches, and white bass under 9 inches.

CLOSED SEASONS

There is no closed season on any species except that wall-eyed pike (yellow) may not be taken in New York waters from March 2 to May 9, both dates inclusive.

CONSERVATION OF THE GREAT LAKES FISHERIES

DEPLETION AND ITS CAUSES

The preservation of the fisheries has been discussed often during the past 50 years, and more excellent suggestions have been made than have been followed. In the meantime the fish supply has continued to decrease. No argument is necessary to prove that fish are now less abundant than they were 50 years ago, but it is of interest to express, if possible, the relationship between present and past abundance. The complete statistics for American waters gathered in 1917 disclose a 100 per cent inflation in the value of fisheries products, which stimulated a production hardly equal to that of a preceding survey in 1908 and below the level reached in 1890 and 1899. Fifty per cent more gill nets and about 90 per cent more traps were needed to attain this level. The 1922 data show the amount of apparatus to have declined somewhat, and the catch to have increased slightly, but the quantity of apparatus is still greater than that reported at any census previous to 1917, and the catch of what were "rough fish" in 1880 is by far the highest on record. On the Canadian shore fishing has not been prosecuted so intensively or extensively as on the American shore until within the last 10 years, but the Canadian statistics show the same unequal relationship between the increase in apparatus and the increase in production. The statistics do not show what part of the total yield is made up of previously undesirable species, nor do they reflect the effectiveness of the superior apparatus now generally employed.

If we turn from incomplete statistics to a consideration of the testimony of the fishermen we are forced to the same conclusion. While in certain localities the pursuit of the remnants of certain species has so fallen off as to allow them to maintain their numbers or even to increase somewhat, in general, the situation can not be viewed with any satisfaction. We are faced with the extermination of the sturgeon in all the lakes, of the bluefin in Lake Superior, the blackfin in Lake Michigan, and the bloater in Lake Ontario, and with the reduction of the whitefish from first place in abundance in 1880 to fourth place in 1922, with that place contested closely by the sucker, which was in 1880 not considered worth the catching.

POLLUTION

The pollution of the streams and shores that serve as feeding and spawning grounds for the fish is believed to have contributed in no small degree to the reduction of the fish supply. In the days of lumbering, sawdust, bark, and logs were thrown into the water, and often streams were blocked with this refuse. The bottoms of the lakes are still strewn with this debris, and in stormy weather the nets in shallow water are in danger of destruction from the logs and bark, which have been preserved in the cold water for the last five decades and are washed hither and thither by the waves. These substances have probably long since ceased to be chemically active, but their mechanical effect in smothering the bottom can not be negligible.

In later years the pollution of rivers and bays by modern industrial plants has made barren some of the most productive fishing grounds, and the continuation of the evil is not only preventing the recovery of these grounds but is spreading its effects. The dumping of ashes into the lakes by steamboats must also have an effect, even on waters so extensive in area as those of the Great Lakes, especially when one considers that the tonnage of shipping that annually passes through the Soo locks alone is greater than that through the Panama Canal. The total weight of such waste must every year run into thousands of tons, and so generally is it distributed that it is not uncommon to pick up clinkers in the gill nets in deep water.

The practice of dumping fish offal into the lake, even where gulls are at hand to feed on it, is also to be deplored. The gulls are not always hungry enough to consume even such particles as float and those that sink lie on the bottom for months, decomposing but slowly because the water is of such low temperature. There are laws prohibiting the dumping of fish refuse, but it is not surprising that such laws are not strictly adhered to when their violators are constantly and in every way reminded of pollution from more noxious sources.

The effects of this pollution are mechanical or chemical, or both. No one can defend the introduction into the lakes of substances that smother the bottom, but it is possible to argue in favor of certain forms of chemical pollution. The argument must be drawn from analogy of the effects of such chemicals in small lakes, but since the conditions in shallow lakes are so radically different from those in bodies of water like the Great Lakes that they even maintain an entirely different fauna it must be admitted that a strict analogy is not possible. The fact that pure water will not maintain aquatic life is generally known, and it is a conspicuous feature of the waters of the Great Lakes that they are relatively so very pure. The quality of the water, within certain limits, of course, affects fish only indirectly by influencing their food. In the case of the Great Lakes we know that prior to human interference in their economy the animals that comprised the food of the typical Great Lakes' species were sufficiently abundant to support a fish population vastly denser than that of to-day, and it must follow that to introduce into the water foreign substances of unknown effect may be deleterious to this food supply.

WASTEFUL FISHING METHODS

Even though the fishermen may be justified in their complaints against others for spoiling the waters for fish, they have no one but themselves to blame for the wasteful fishing methods that have been one of the main factors in the decline of the fisheries. It has often been recorded how sturgeon, herring, and other fish, and immature whitefish and trout were originally destroyed because they were a nuisance in the seines and pounds, and how, after fish became rarer, nets were even set with the special object of taking the immature individuals, often of a size too small to be marketable. Such fish must have been diminutive indeed. The failure of the responsible Governments to check such wanton destruction can not be too severely censured, but in view of the fact that other natural resources have been and still are being squandered in the same way it is not surprising that wealth apparently so unlimited as that of the Great Lakes should not have been conserved.

More interest has been shown in conservation on the Canadian side of the boundary than on the American side, and the Canadian laws regulating fishing not only antedate most of those on the American side by many years but have been throughout much more conservative.

REMEDIAL MEASURES

LEGISLATION

At present there are laws everywhere regulating the taking of fish, which are more or less effectively enforced. It has already been shown how these laws often vary in character on the same lake, due to diversity of opinion among the legislators responsible for their framing, and it has also been shown how the enactment of protective legislation lags behind the need for protection. The necessity for protecting the fish can be understood by anyone, but few persons other than fishermen can appreciate the significance of the variations in the stipulations of the laws, particularly of those governing the size of the mesh of the netting.

By way of illustrating the importance of apparently insignificant differences in the provisions of these regulations, data relative to the difference in effectiveness of nets which differ in size of mesh to the amount of ¼ inch are given. The netting used for the experiments was linen gill netting of 2½ and 2¾ inch mesh set in Lake Ontario in 1921 at depths of more than 60 fathoms. The two kinds of nets were equal as regards quality and fineness of thread, manner of hanging, and length of pieces, and the fish caught were of two species only, both practically equal in the matter of absolute size attained. On July 4, off Braddock Point Light, three pieces of 2¾-inch net took 22, 20, and 19 fish, and one piece of 2½-inch net took 59 fish. On July 16, off Wilson, three pieces of 2¾-inch net took 49, 48, and 51 fish, while one piece of 2½ took 106 fish. Thus, a difference of ¼ inch in these two cases more than doubled the catch. From these results it may be conjectured what bearing the inequality of the provisions of the various laws regulating the size of netting has on the conservation of the fisheries. Variations in the type of apparatus allowed is a subject too complicated to discuss in all its phases within the limited scope of this paper, however, and I will therefore pass on to a consideration of the quantity of apparatus used, a subject which has been recommended to conservationists for attention before but which so far has received but little.

There are no laws limiting the number of nets that may be set or the quantity of fish that may be taken in the Great Lakes. The Canadian authorities have placed definite limits on the amount of fish that may be caught annually in the important inland lakes but have not applied such restrictions to the Great Lakes, most probably because they are so large. It is this immensity in size that sustains the general belief in the inexhaustibility of their resources. Most people believe that water is all that any fish requires and that any and all fish can survive and thrive if only there is water, but the fisherman knows that the maintenance of the fish supply is dependent on other things as well. Certain species occur only within certain depth limits, and within these limits only where certain bottom conditions obtain. Thus in Lake Superior, for example, with its area of some 32,000 square miles, there are hundreds of miles of shore line where whitefish are practically unknown, and in over one-fourth its area there occurs no marketable species of fish. Yet, in spite of this, Governments on both sides of the international boundary expend money every year planting fish in virgin waters, in which, if the fish could find suitable conditions, they most probably would have flourished from the beginning.

Even if the Great Lakes were suited throughout their extent for all kinds of fish and were they ever so much larger than they are, the supply must nevertheless just as certainly be in danger of exhaustion if at any time the bulk of the species came within human control. In the Great Lakes this dangerous control may be exerted in the case of most species during the spawning season. The individuals of the more important species congregate to spawn near the shores where bottom conditions are favorable, usually within limits which, in comparison with the normal range of the fish, are extremely restricted. During the excitement of the mating act they not only approach the bottom, and thus come within the range of influence of the nets, but they appear also to lose there awareness of the netting,[9] a faculty which protects them to some extent from capture at other times, and they are taken in an abundance unknown at other seasons.

For the benefit of those, if any such there be, who believe that the practice of commercial fishing must necessarily, in itself, deplete any body of water, I present an abstract of an article written by Dr. J. Heuscher,[10] in which he gives the history of Lake Sempach, a Swiss lake of approximately 5½ square miles area, which, under judicious control, maintained a commercial fishery on a large scale for over 400 years and which was depleted only when fishing operations were allowed to go on uncontrolled.

The lake has a maximum depth of about 47 fathoms over an area of nearly 2 miles, and limnological conditions in this lake approximate those in the Great Lakes. At one time this body of water supported immense numbers of a whitefish, related to those in our lakes. Fishing rights in Lake Sempach were legally established as early as the tenth century. In 1394 these rights came into the possession of the city of Lucerne, which disposed of them in various ways at various times, mainly in the form of leases stipulating the cession to the city of a certain percentage of the fish caught. The city's documents record the number of fish thus taken annually from 1418 to 1853. The catches varied from year to year, chiefly between 100,000 and 600,000 fish.

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[9] It can not be doubted that the fish are aware of gill netting in the shallower waters. The principle of the pound net and all trap nets is based on the ability of the fish to perceive the lead, which is of a mesh large enough to permit them to swim through it uninjured. To reason further in the same strain, if they are aware of their food in deeper water they must likewise retain the capacity of sensing the presence of the netting.

[10] Swiss Fishery Journal, Vol. III, 1895.

There are still extant fishing regulations drafted in 1421 in which closed seasons, reserve zones, minimum mesh, and maximum equipment are fixed. Control over the waters relaxed, however, in 1798, and various abuses crept in. In 1825 improved apparatus supplanted the primitive gear, and in 1853, when the fishing leases were sold outright, the production was so enormous that fish were fed to the pigs. The last good year was 1856, and thereafter the supply dwindled. Drastic regulations were drafted to protect the fish, and fry were planted annually, but until about 1918 it had not been possible to restore the productivity of the lake. From 1918 to 1920, according to a letter from Dr. G. Surbeck, Swiss fish inspector at Berne, dated February 18, 1924, the production of whitefish in Lake Sempach increased considerably, and it is estimated that 35,000 to 45,000 pounds were taken annually during this period—a total probably about equal to the average annual yield of the nineteenth century. Doctor Surbeck and other investigators are of the opinion, however, that the whitefish now caught is not of the same species as that which originally inhabited the lake, but of a species which has replaced the original form. Latterly the catches have again declined markedly.

The history of the Sempach fish has more than a philosophical interest and teaches another lesson besides the obvious one. Our experience with the bluefin of Lake Superior, which has been undisturbed for from 10 to 20 years, and of the bloater of Lake Ontario, which has not been fished for in 25 years, both of which have apparently continued to decrease in abundance, closely parallels the case of this Swiss whitefish and emphasizes the danger of reducing a gregarious species below certain limits.

If, then, there is danger of exhausting the fish supply by overfishing, the production should be regulated in some manner. It is generally recognized that the taking of game must be controlled both by bag limits and closed seasons, and similar restrictions are considered necessary to preserve the game fishes. It can not, therefore, appear illogical to urge the application of the same kind of legislation to the commercial fisheries. What form such legislation should take the writer can not say. Over an area so extensive as that of the Great Lakes, which is influenced by such diverse climatic as well as physiographic conditions, no one may expect to apply a simple or uniform remedy; but, faced by the need of action, the dictates of common sense will point out a way, and these directions must not be ignored, even if they entail sacrifice on the part of some.

PROPAGATION

The work of hatching eggs of the important commercial species has been carried on more vigorously than ever in recent years. The output of species originally propagated has increased, and operations have been extended to include species previously ignored. In the stocking of streams and small lakes notable success has been achieved, and through making observations on conditions in such relatively limited areas positive evidence of the benefit of introducing fry and fingerlings has been gathered. Unfortunately there are no criteria by which we may judge the effect of propagation in the Great Lakes. There areas are so extensive and the migrations and interrelations of the species so little known that though fish increase, or appear to increase, after extensive plants it can not be positively stated that such increase is due to planting. Enemies of the species may have decreased or the increase may have been due to natural multiplication. The fact that there are areas where whitefish are said to have increased in recent years without the aid of artificial propagation, and the fact that the sucker, perch, sauger, blue pike, chubs, and herring, in spite of the persecution they have sustained, do not make a worse showing in the statistics than the carefully fostered whitefish and trout, at least justify an attitude of skepticism toward the enthusiastic claims of some of the propagationists.

At this point it is only fair to state that the leading fish-culturists now regard artificial propagation rather as a supplement to than an improved substitute for nature, but the rank and file of the conservationists of the Great Lakes area are still influenced by the exuberant optimism of the pioneer fish-culturists, who, inspired by the novel achievement of being able to hatch countless fry, entertained rosy visions of the possibilities of the new-found art. This optimism, first and last, arises out of the natural propensity of the human mind to be impressed by figures of inconceivable magnitude. If the hatching of a billion fish eggs is reported in a hatchery bulletin, certainly, one argues, that immense number can not fail to affect the fish supply advantageously; but no statistical bulletins can show what an insignificant fraction of nature's production of fish eggs this huge figure represents, after all, and nowhere is advertised nature's amazing prodigality in dealing with these eggs, though her stupendous carelessness in this particular can be demonstrated by anyone who is familiar with mathematical progressions.

Whatever the results of fish hatching on the Great Lakes may be, confidence in the effectiveness of propagation has had most important consequences, and the methods of propagation and the effects of this confidence ought to be carefully considered. In a vast section of the Great Lakes there is no closed season on any species of fish, and for some, commercial fishing is allowed as soon as 40 per cent of the fish, as shown by test nets, are ripe. The case of the whitefish will serve to illustrate the situation.

In the year 1919 one boat which set test nets on the "north grounds" at Alpena took 5,000 pounds of whitefish, practically all males, indicating that spawning had not yet begun, since the first run on the spawning grounds consists of males. These males are often so reduced in number by uncontrolled fishing that later on it is not possible to secure enough milt to fertilize the eggs that are collected. Let us assume, however, that half of these Alpena fish were females. Then there should have been produced by this boat, in one day, 2,500 × 10,000 (the average number of eggs estimated by fish-culturists to be produced by each pound of fish), or 25,000,000 eggs. The production of whitefish on the spawning grounds at Alpena in that year was over 50,000 pounds, or a potential 250,000,000 eggs, and the "north ground" off Alpena is only one of the many places in Lake Huron where whitefish spawn. On Lake Huron alone, then, the production of whitefish eggs might have far exceeded the entire collections by all the hatcheries on both sides of the boundary. It is not necessary to state that no such quantity of eggs was collected on Lake Huron.

Most of the eggs were wasted, nor could this destruction, under the circumstances, have been avoided.

No fisherman would assert that it is possible to save more than a fraction of the spawn, since many of the fish are green or dead when taken. If the nets are caught in a blow, and blows are the rule in the fall, most of the fish taken are dead. Even under favorable conditions the fishermen, where the collection of eggs is left entirely in their hands, give first attention to handling the fish and care for the spawn afterward. Many of them know well enough that the collection of a few hundred thousand eggs a trip is quite likely to satisfy the hatchery official to whom the spawn must be surrendered, and they act accordingly.

Since the taking of whitefish from the spawning grounds was permitted everywhere on all five of the Great Lakes, but since the entire collection of eggs was equal at most to the quantity which Lake Huron would have produced if the eggs of all the fish taken could have been saved, it may be assumed then that conservationists consider that the effectiveness of the output of one lake, handled by the hatcheries, equal to that of the other lakes left to natural conditions. Furthermore, since whitefish are liberated as fry, the practice of hatching must be based on the assumption that very few eggs hatch under natural conditions. Either they are not fertilized in nature or they are destroyed after fertilization by enemies or natural forces, or both. There are no other possibilities. It can not be stated too positively that any statements made with regard to the history of the whitefish egg, or of the egg of any other Great Lakes fish, for that matter, are purely theoretical. There is not a particle of evidence to show that the eggs are not fertilized in nature, notwithstanding assertions to the contrary, and all experience with fish breeding in nature indicates that they are fertilized. As for enemies, it must be remembered that the eggs of the whitefish are deposited at a time when other fish are least active and take the minimum of food or cease feeding entirely. The scale theory, which is now well established, is based on this assumption. Besides, the eggs are laid on rough bottom, so that many must fall into crevices where they would be comparatively safe.

While it is very desirable that as many eggs as possible should hatch, it can not be conceded that with the hatching of the egg the most dangerous stage in the development of the individual has passed. We have not yet the necessary knowledge of the life history of any Great Lakes fish to enable us to state which are the critical periods in the life history. It is apparent, however, to all field workers, and to fish-culturists in particular, that an immense percentage of the young fish die before they become an inch long and many more perish before they attain double that length, else the stocking of waters with fish would be a simple matter indeed. For this reason it is essential that the question of whether fry planted by the hatcheries have as much chance of surviving as those which are hatched naturally, or whether they have any chance at all, be given consideration.

Although there is no doubt that the distribution of fry in the Great Lakes has been carried out with the best of intentions, it is nevertheless true that no one is qualified to say what are the most favorable conditions for the planting of fry, and for safety's sake they should be planted on the natural spawning grounds. In many cases this has

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been done. However, there have come to my attention too many instances of careless distribution, when fry were dumped at random into waters of any depth or even into polluted rivers. Since the hatcheries frequently are forced to rely for distribution of their products on the charity of well-intentioned but often incompetent people, perhaps better results can not be expected, but the damage done by such an irresponsible procedure can not be mended nor can the practice be condoned by any excuse, however valid.

It is also a singular fact that many people who have distributed fry never knew, or had forgotten, that a sudden change of temperature is fatal even to an adult fish, and therefore made no provision for acclimatizing the fry to their new surroundings. In the case of whitefish and trout the water in the lakes at the time of planting is probably nearly at zero, and if the fry were iced in the cans they would be subjected to no great change in temperature, but when plants are made at other times abrupt changes of temperature should be most carefully guarded against.

A further consideration, which has been neglected, concerns the proper time for making plants. It is not practicable to feed the fry, but they can be retained without food without heavy mortality for some time after hatching, though it is not known what the consequences of such retention are. In some young animals feeding instincts atrophy if they are not exercised within a certain period, and it is not inconceivable that the withholding of food from fish fry for even a day at the critical time may be fatal.

To recapitulate, the practice of propagating whitefish or other Great Lakes species is not in itself condemned, but an effort has been made to show that the present system of permitting fishing during the spawning season is vastly wasteful. No one may safely affirm that the relatively few eggs that are artificially hatched—few in comparison with the numbers destroyed in the effort to collect them—can compensate for the benefits that might be derived if all the fish were allowed to spawn naturally. Particular force is lent to this argument by the fact that we now know absolutely nothing about the percentage of eggs hatched under natural conditions and nothing about the proper attention fry should receive after they have been hatched. It follows, then, that nature should not be interfered with blindly, lest more harm than good be done, a maxim the soundness of which, as applied to certain species, fish-culturists have already subscribed to. The closed season during spawning time should be restored at once, and studies into the effectiveness of propagation should be begun without delay. The collection of such spawn as is thereafter deemed necessary should be under the supervision of State and Federal authorities.

RECOMMENDATIONS

1. The needs of the Great Lakes fisheries should be studied, and in the light of the knowledge gained regulations having for their object the conserving of the fisheries should be created. We already have data to show that no single law can be devised to meet the varying conditions presented by one lake, to say nothing of applying one law to several of the lakes. The application of any laws found advisable must be independent of political boundaries. The present

division of authority over the fisheries among several States impedes the enactment and complicates the administration of any legislative provisions, and it is therefore urgently recommended that some definite and responsible organization, international in character, be provided through which a coordinated control of the fisheries may be secured.

2. The closed season to protect spawning fish should be restored wherever practicable, and no spawn should be collected if investigations and experiments fail to establish the desirability and effectiveness of propagation.

3. Investigations to determine the life histories of the important species already begun should be continued, and statistics reflecting the condition of the fisheries should be collected from year to year to supplement these studies. Only by means of such statistics, interpreted in the light of life-history facts, can the fishing industry be intelligently controlled.

SCIENTIFIC NAMES OF FISHES

The following are the scientific names of the species of fish mentioned in the text:

Alewife	*Pomolobus pseudoharengus.*
Black bass (largemouth)	*Micropterus salmoides.*
Black bass (smallmouth)	*Micropterus dolomieu.*
Bloater (of Lake Ontario only) Bluefin (of Lake Superior only) Blackfin (of Lakes Michigan and Huron)	*Leucichthys nigripinnis.*
Bowfin	*Amia calva.*
Buffalofish	Ictiobus (species).
Carp, German	*Cyprinus carpio.*
Catfish, including bullheads	Ameiurus (species). *Ictalurus punctatus.*
Chubs	Leucichthys (species).
Eel	*Anguilla rostrata.*
Gizzard shad	*Dorosoma cepedianum.*
Goldfish	*Carassius auratus.*
Herring, lake	*Leucichthys artedi.*
Longjaw	*Leucichthys alpenæ.*
Lawyer	*Lota maculosa.*
Menominee	*Prosopium quadrilaterale.*
Mooneye	*Hiodon tergisus.*
Pike	*Esox lucius.*
Rock bass	*Ambloplites rupestris.*
Salmon, Atlantic	*Salmo salar.*
Sauger	*Stizostedion canadense griseum.*
Shad	*Alosa sapidissima.*
Sheepshead	*Aplodinotus grunniens.*
Smelt	*Osmerus mordax.*
Sturgeon	*Acipenser fulvescens.*
Sucker, sturgeon-nosed	*Catostomus catostomus.*
Sucker, white	*Catostomus commersonii.*
Sunfishes	Centrarchidæ (species).
Trout, lake (ciscowet, fat trout)	*Cristivomer namaycush.*
Trout, steelhead	*Salmo irideus.*
Wall-eyed pike (blue pike, yellow pike)	*Stizostedion vitreum.*
White bass	*Roccus chrysops.*
Whitefish	*Coregonus clupeaformis.*
Yellow perch	*Perca flavescens.*

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