REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

United States Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., September 10, 1921.

Sir: I have the honor to transmit herewith a report of the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1921.

Respectfully,

E. W. Nelson,
Chief of Bureau.

Hon. Henry C. Wallace,
Secretary of Agriculture.

WORK AND ORGANIZATION OF THE BUREAU.

As in previous years, the work of the Biological Survey has to do with the wild life resources and liabilities of the country. The game and useful nongame mammals and birds form an asset of enormous value, and on the other hand the destructive predatory animals, such as wolves and mountain lions, and the harmful rodents, such as rats of many kinds, prairie dogs, and ground squirrels, coupled with certain birds in part or entirely harmful, form a distinct liability of no mean importance.

To deal with its various problems the bureau is organized under the following divisions:

1. Economic investigations, in charge of Dr. A. K. Fisher. Investigations cover the control of predatory animals and injurious rodents; experiments in fur farming; and the food habits of birds and methods of control of injurious species.

2. Biological investigations, in charge of E. A. Goldman. Conducts investigations of the distribution, habits, and migrations of North American birds; studies the food and other habits and the distribution of mammals; investigates and maps the life zones of the country; and conducts technical laboratory study of both birds and mammals.

3. National game and bird reservations, in charge of H. F. Stone. Administration involves warden patrol service, the building of fences, houses for wardens, and other improvements on reservations, and, on the Elk Refuge, hay farming on a considerable scale.

4. Migratory-bird treaty and Lacey Acts, in charge of G. A. Lawyer. Through a nation-wide warden service, administers the migratory-bird treaty and the Lacey Acts, the latter covering the unlawful interstate commerce in game and the importation of living foreign birds and mammals with a view to preventing the introduction of harmful species.

5. Alaska reindeer and fur bearers, in charge of E. W. Nelson and W. F. Bancroft. Covers investigations of the diseases, parasites, and grazing habits of reindeer; investigations of the grazing possibilities for reindeer and other stock of the Aleutian Islands; and administration of laws for the protection of land fur-bearing animals of Alaska and for the encouragement of fur farming in that Territory.

ECONOMIC INVESTIGATIONS.

Organized cooperative campaigns in most of the States west of the Mississippi River against predatory animals and injurious rodents have been continued vigorously with constantly increased thoroughness, despite a general depression in the farming and live-stock industries. Reduction in the amount of Federal funds available for this work, coupled with the financial condition of States, stockmen, and farmers, resulted in a decrease from the previous year in the amount of money expended in cooperative campaigns to clear Federal, State, and privately owned lands of the animal pests. This restriction in funds was offset in part by some reduction in cost of operations. The demonstrated value of this work, as shown by the large returns on money expended, which is reported by the cooperating farmers and stock growers, is responsible for its remarkable development, its substantial support, and the demand for its extension. During the year a saving of about $14,000,000 was effected at a cost of $1,345,220. Review of these operations for the last six years shows an estimated saving of crops and live stock amounting to more than $74,000,000 at a total cost to the Government, cooperating States, and landowners of about $6,080,000, an average of approximately $12 return on each dollar expended. These savings are cumulative, as the elimination of these pests automatically perpetuates the annual saving from the reduction in their depredations.

Progress has been made in research work having to do with the habits of injurious species and methods of combating them effectively and economically, and has resulted in great improvements in processes of preparing special poisons adapted to use in eradication operations.

In fur-farming investigations, marked advance has been made in the study of the causation and treatment of diseases to which black foxes and other fur bearers are subject when reared in captivity, and in feeding, handling, and housing practices favorable to securing good litters and maintaining a healthy and vigorous condition of the stock.

PREDATORY ANIMALS.

When, in 1916, the bureau first began organized operations to reduce the depredations on live stock by wolves, coyotes, and other predatory animals, the losses from this source were estimated at more than $20,000,000 annually. These operations include carefully planned trapping, shooting, den hunting, and poisoning campaigns covering the grazing States of the West and extending eastward to western Missouri and northern Michigan. The work done is in cooperation with State departments of agriculture, State live-stock commissions, stockmen's associations, and individuals, so that concerted action may be taken to clear large units of Federal, State,

and private lands of these pests. The Forest Service of the Department of Agriculture and the Office of Indian Affairs and the National Park Service of the Department of the Interior also cooperate on lands controlled by them. During the year skilled hunters and trappers, averaging 246 in number, were employed under bureau supervision. Part of these men were paid by the Federal Government and part by cooperating agencies, the latter having contributed $213,163 to the work.

The skins or scalps turned in by hunters as evidence of animals taken show a total destruction of 27,611 stock-destroying animals. These consisted of 694 timber or gray wolves, 24,234 coyotes, 2,466 bobcats and Canada lynxes, 129 mountain lions, and 88 bears. Exact returns of animals killed in poisoning campaigns are not obtainable, but, judging from the number of dead carcasses found and the marked reduction in the number of coyotes over large areas following poisoning operations, it may be conservatively estimated that from 25,000 to 30,000 coyotes were killed by this means in addition to the number whose skins or scalps were actually taken, making a total of more than 50,000 predatory animals destroyed during the year.

On the accepted basis of reckoning, the value of live stock saved by the destruction of these animals would amount to more than $3,000,000. The skins which have a market value become the property of the organization or individual paying the hunter's salary. Receipts from skins taken by Federal hunters and sold during the year amounted to $8,509.54.

The knowledge and experience gained in conducting operations against predatory animals have enabled the bureau to plan and direct the work with constantly increasing effectiveness. Through field investigation and through reports of hunters and stockmen, the inspectors learn in great detail the localities in which losses are most serious and the ranges and numbers of destructive animals in each district. Trapping and poisoning operations are organized according to carefully projected plans. Skilled trappers are detailed to take especially destructive individuals. Some hunters, working with motor cycle or automobile, can travel rapidly from point to point to eliminate unusually destructive animals which are reported by stockmen. Others, located on ranges where large numbers of predatory animals occur, systematically and relentlessly prosecute the campaign with rifle, trap, and poison.

In winter great poisoning campaigns are organized to distribute over the summer ranges the specially prepared and highly effective poisoned baits which have been devised by the bureau experts. These campaigns are launched in the fall as the stock begins to move out to the winter ranges, the flocks and herds being closely followed up to destroy animals trailing them. In spring, as the flocks and herds return to the summer ranges, trappers go ahead to catch any individuals that may have escaped poisoning. In similar fashion the important winter ranges and lambing grounds are being rid of these stock destroyers. In this way stock losses have been practically ended over great areas of the most valuable summer and winter sheep ranges and reduced in others to very small amounts compared with losses which occurred before these operations were organized, and with such losses as continue to occur in

regions which through limitation of funds it has not yet been possible to reach.

The clearly apparent results accomplished and the large savings effected have won the active support and cooperation of stockmen. Typical of the attitude expressed in a great number of letters received from stockmen the following may be quoted:

Your organization has done more in eradicating the wolf and the bobcat than all the other work that has been done here in the last 25 years.

I believe in the different outfits I am interested in we have saved during 1920 in loss of lambs at least 1,000 head. This is 100 head to the band and at $6 each would be $6,000. Then we have saved $2,000 in labor since a smaller number of men were employed on account of not having to watch the sheep so closely.

Every one of the ranchmen in our club is entirely satisfied with the progress that is being made in eradicating the wolves here. During the past three or four years the losses in sheep and goats from wolves had become so heavy that it was unprofitable to raise that class of stock even with the prevailing high prices. It had become necessary to employ more herders at higher prices and to reduce the number of animals in a herd to protect them against the wolves, and even then many were forced to sell their sheep because there was no relief from the wolves in sight. But I am glad to say that since you have taken charge of the situation and sent in a hunter, and the ranchmen saw the headway he was gaining on the wolves, confidence has been restored on the ranches, and at this time, with most of the old wolves caught, a good many flocks are ranging without herders. We were forced to pay amateur trappers $50 a wolf and at that they were able to catch only the young wolves; the old sly ones were left to raise the new crop for the next year. Your hunter has been especially successful against the old cunning ones, and I am glad to say that he has caught nearly every one of those that have been around here for over five years.

We feel that the task of controlling predatory animals is not of such a nature that it can be handled for specific areas such as States. It is a West-wide job and not one for any State by itself to tackle, and in handling it on a West-wide basis, it is essential that some uniform plan of operation, such as that now in force, be adopted and continued with coordination of efforts and practices in all sections in a uniform manner. This, in our opinion, makes it absolutely essential that some agency having authority much broader than State lines be in charge of the work, an agency which can forget State lines in its prosecution of the work. We feel in this connection that your bureau is the proper agency. The live-stock industry, particularly, is staggering under the burden of many handicaps. It is a fundamentally basic part of the agricultural industry of the Nation, the industry upon which more than any other the future welfare of the Nation depends. It must and should be relieved from every possible handicap if it is to survive without a terrific setback, and among its handicaps are losses from predatory animals.

Stockmen also maintain that inasmuch as they are paying grazing fees on the national forests they should have the protection of predatory-animal hunters thereon at Federal expense. Such grazing allotments on national forests for 1921 in districts where this work is organized provide leased pasturage for 2,322,180 head of cattle and horses, 36,480 swine, and 8,325,205 sheep and goats. Concrete evidence of the faith of the stockmen in this work is afforded by the fact that appropriations made by States where this cooperative work is in progress for the fiscal year 1922 total $211,700, while in addition the stockmen as individuals and in their organizations are contributing more and more largely toward the employment of hunters to operate under the direction of Biological Survey inspectors.

During the year predatory-animal work has been in progress in the following States:

Arizona.	Missouri.	Oregon.
Arkansas.	Montana.	South Dakota.
California.	Nevada.	Texas.
Colorado.	New Mexico.	Utah.
Idaho.	North Dakota.	Washington.
Michigan.	Oklahoma.	Wyoming.

On appeal of stockmen and State officials an expert was detailed for a short time to give assistance in Missouri and Michigan, where wolves and coyotes were destroying much live stock and game, and in the latter State were practically blocking efforts to utilize the great areas of cut-over lands for stock-raising purposes. The State Legislature of Michigan promptly enacted a measure which will provide from $35,000 to $40,000 a year for work organized under direction of a Survey expert. Requests for assistance in controlling losses due to predatory animals were also received from Minnesota, Wisconsin, Indiana, Iowa, and Louisiana, where serious damage from this source was reported. Investigations were begun to learn the conditions in these States and to devise measures for relief.

The practice followed of devoting special effort to the capture of notoriously destructive individuals and packs has resulted in many important kills, among which the following are typical examples:

The "Custer" wolf, mentioned in last year's report as having ranged for six or seven years in the vicinity of Custer, S. Dak., and during that period to have killed $25,000 worth of cattle, had escaped all efforts of sportsmen and stockmen to effect his capture, despite a bounty of $500 placed on his head. Early this year he succumbed to the skill and marksmanship of a bureau hunter.

A pack of eight wolves that had inflicted losses aggregating $20,000 on calves, pigs, and sheep in and around the Arkansas National Forest were all destroyed by a single bureau hunter between October 31 and November 19. In the worst-infested areas of Arkansas wolves take as much as 90 per cent of the calf crop, and pigs can not be raised at all on account of the combined attacks of wolves and bobcats.

In the vicinity of Splitrock, Wyo., a pack of nine wolves, that were killing about $10,000 worth of cattle each year, was trapped and poisoned.

All of a pack of five wolves that had ranged in the vicinity of Pueblo, Colo., for several years were taken. The last one to fall victim to the skillfully placed traps was an old renegade that had been known for at least 12 years and is reported to have killed $6,000 worth of cattle on a single ranch, besides making heavy inroads upon others, and during the last six weeks of his life to have destroyed nine yearling cattle.

In the six years that organized cooperative operations have been conducted under the leadership of the bureau not less than 300,000 predatory animals have been destroyed. Large numbers also have been killed by the unorganized work of private trappers stimulated by bounties and the prevailing high prices of furs. A great reduction in fur values during recent months has removed one of the chief incentives of private hunters. Especially vigorous prosecution of the systematic organized operations is therefore essential to prevent a reinfestation of cleared and partly cleared areas from the otherwise unchecked breeding and migration of these animals.

RABIES.

A few cases of rabies, of which coyotes serve as important carriers, have occurred in Nevada and other States within the original area of the great outbreak of this disease, but its spread has been effectually stopped. Where rabies formerly occurred as a highly dangerous and destructive epizootic, it has been reduced to isolated, sporadic cases by the prompt and vigorous measures employed by the bureau in cooperation with State commissions and health officials. Continuance of control measures is required to prevent the disease from again gaining headway in its original territory and spreading disastrously throughout the entire West.

RODENT PESTS.

Increased interest of farmers and stockmen and a more thorough organization in treating Federal, State, and private lands for the eradication of destructive rodents have been manifested during the year. This has resulted from the obvious benefits derived from the concerted drives under the leadership of the bureau specialists and from improved methods. In order that all Federal, State, and local agencies might be united into an effective working force, cooperation has been continued through the States Relations Service with the State extension organizations, including county agents and farm bureaus. State departments of agriculture and other agricultural and live-stock organizations have participated actively. Officials of the Forest Service of the Department of Agriculture, and of the Office of Indian Affairs and the Reclamation Service of the Department of the Interior also have cooperated effectively in localities involving Federal lands under their control. Cooperation with the U. S. Public Health Service and with State and municipal health organizations has been obtained where the directly economic problems merged with considerations of community health, as in bubonic and pneumonic plague, Rocky Mountain spotted fever, and kindred diseases where such agricultural pests as house rats, ground squirrels, and other rodents serve as carriers of disease-producing organisms. When such rodents occur commonly in cities and villages as well as in the adjacent rural sections, such cooperation is essential to a thorough coping with the situation.

The marked success which has attended the work of the bureau in correlating and guiding local organizations and uniting county and State movements into great inter-State organized campaigns for the control of rodent pests has resulted in demands for the extension of such service. The most pressing demands came originally from the Western States, where conspicuous damage to crops and range occurred, due to the larger native rodents, such as prairie dogs, ground squirrels, pocket gophers, and jack rabbits. More recent recognition of the serious losses caused by the introduced house rats and mice and by such small but abundant native species as pine mice and meadow mice has led to urgent appeals from all over the United States for assistance in organizing effective campaigns against these pests, employing the thoroughly tested methods which have been devised through the research work of the bureau.

PRAIRIE DOGS AND GROUND SQUIRRELS.

Organized campaigns against the highly destructive prairie dogs and ground squirrels were continued in the following States:

Arizona.	Nebraska.	Oregon.
California.	Nevada.	South Dakota.
Colorado.	New Mexico.	Utah.
Idaho.	North Dakota.	Washington.
Kansas.	Oklahoma.	Wyoming.
Montana.		

During the year 18,331,861 acres of Federal, State, and private lands were given a first poison treatment, and follow-up work was done on 4,402,662 acres. The bureau assumes the cost of operations on Federal lands, the State officials on State lands, and the farmers and stockmen pay the cost of work on their holdings. Cooperative funds contributed through State and county appropriations and funds expended by landowners amounted to $725,000. Poisoned grain prepared and distributed under supervision of the bureau amounted to 1,235 tons, and 104,523 farmers and stockmen took part in the work. Taking into consideration prevailing prices of farm and range products, a saving was effected estimated at more than $11,000,000. A total of 7,714,518 acres of Federal lands and 70,113,271 acres of State and private lands have been treated and largely cleared of these rodents up to the close of the fiscal year. The estimated value of crops and range grasses saved since the work was undertaken on a large scale in 1916 totals over $54,000,000.

Information from the Forest Service shows that as a direct result of this work, large areas of national forest land treated for the eradication of prairie dogs now carry 10 per cent more cattle and sheep with a corresponding increase in grazing fees. Stockmen who range their stock upon national forests where prairie dogs and ground squirrels have been destroyed are greatly pleased by the increased pasturage thus afforded as well as by the fact that this prevents their private holdings, when cleared of these pests, from being constantly reinfested by animals coming over from adjacent Government lands.

Through the cooperative plan of work great units of land, involving hundreds of thousands of acres each and previously heavily infested, have been cleared to a point where only an occasional animal can be seen; grass is growing luxuriantly on areas formerly largely or entirely denuded; and good crops are being produced where cropping was not attempted or where crops planted were entirely destroyed by pests. One farmer writes, "I have corn on the prairie-dog town this year as good as any I have seen. It is the first crop ever raised on this ground." The prairie dogs were destroyed during the spring. Another states, "From the bitter experience of previous years I can truthfully say if there had been no poisoning there would have been no crops or grass. Consequently, I consider this work worth the value of my whole crop, or about $1,000." The manager of a large cattle company writes, "Our entire range has been cleared of prairie dogs and we now consider this once serious question a past issue."

As the eradication campaigns reach a point where these rodents are no longer regarded as a menace, there is a strong tendency for

landowners to neglect complete extermination of the few animals that may remain. Definite effort is being made to have the work continued to completion in order to insure against the rodents again increasing to destructive numbers.

POCKET GOPHERS.

Important work was accomplished in Kansas, Nebraska, Oklahoma, Arizona, New Mexico, Idaho, Oregon, and Washington by demonstrating effective methods of combating pocket gophers and organizing campaigns to destroy them. Vigorous poisoning operations have been conducted in the great alfalfa-producing sections, where these animals cause damage commonly amounting to $2 or more an acre and frequently destroy the entire stand by cutting off the tap roots. Damage to harvesting machinery by the mounds of dirt thrown up is also a serious item of trouble and expense.

The protection of root crops and citrus orchards has been an important feature of the work of the year. In the irrigated citrus belt of the Salt River Valley in the vicinity of Phoenix, Ariz., and Yuma Valley, many thousands of dollars worth of trees were saved by organized campaigns against these pests. One orchardist writes, "Through continual use of poisoned grain and traps I have succeeded in keeping my 14-acre orange grove free of pocket gophers. Have not lost a tree since you started this work but others near me who have not cooperated have experienced a great deal of damage."

Among the most serious damage by these animals is that due to their burrowing in the banks of irrigation ditches, causing washouts and thus flooding and destroying crops with a consequent great loss of water and expense for repairs; in irrigated lands the burrows also divert the water, preventing its proper distribution to the growing crop. Such losses in the vicinity of the Elephant Butte Dam, in Dona Ana County, N. Mex., are typical of those prevailing widely in irrigated districts. Here pocket gophers caused seepage damage estimated at $60,000 a year. Irrigation farmers appealed for practical help and organized and provided funds to undertake the work under direction of a bureau specialist. Workmen who patrolled the banks would set strings of 50 traps at short intervals and, returning a little later, would commonly find pocket gophers in two-thirds of them. Where the ground was level, poisoned baits were placed in their holes. A careful survey taken during the spring indicated that 95 per cent of the pocket gophers had been destroyed in this brief intensive campaign, practically eliminating this $60,000 annual damage at a total cost to the farmers of about $3,500.

JACK RABBITS AND COTTONTAILS.

Campaigns for the destruction of jack rabbits were continued on a considerable scale in Idaho, Oregon, Washington, Nevada, Utah, and Arizona, being organized along cooperative lines under the leadership of the bureau. Damage was serious to alfalfa, cotton, hay, cantaloupe, lettuce, and other crops produced in the semiarid and irrigated regions. Jack rabbits sometimes occur in enormous numbers in sagebrush areas and cottontails are very plentiful. When feed becomes scarce, due to drought, they congregate about alfalfa,

wheat, and other growing crops, often clearing a field as clean as though it had been done with a mower. In winter when heavy snowfall occurs jack rabbits congregate about stacks of hay or grain, often completely undermining and destroying them. In one community in Arizona where rabbits last year destroyed $40,000 worth of long staple cotton, no losses occurred this year, due to effective rabbit drives organized in November in which over 300 persons took part. A farmer at Casa Grande writes, "Your poison saved my $1,000 cantaloupe crop from rabbits this year, and I know its value because I lost my cotton crop last year from rabbits."

In Lincoln County, Idaho, 168,166 jack rabbits (by actual count) were killed by the use of 845 ounces of strychnine applied to suitable bait. In other counties as many as 50,000 jack rabbits were killed by means of organized drives. In spite of unfavorable winter weather conditions for the poisoning campaigns planned in Oregon, 25,000 jack rabbits were killed and counted besides many others that were not found.

Damage to orchards, vineyards, gardens, and truck crops by cottontails was reported from many points throughout the Eastern and Southern States and practical methods of procedure were recommended.

MICE, WOOD RATS, COTTON RATS, AND KANGAROO RATS.

The less conspicuous but exceedingly abundant and widely distributed smaller rodents caused considerable losses locally throughout their respective ranges. Meadow mice and pine mice did much damage in orchards, gardens, and truck farms. Pine mice live mainly in underground tunnels and their destructive activities are usually not observed until irreparable injury has been done; they are probably the most destructive native animal pest in the Eastern States, witness their killing of 1,000 18-year-old apple trees as recently reported from a single orchard in West Virginia. Such trees are commonly valued at $50 each, and losses of this kind are constantly occurring. They are especially serious as the mice destroy during the productive period the results of long-time investments and cultivation. Damage to potatoes, bulbs, and root crops is also extensive.

Kangaroo rats, which occur in large numbers in sandy regions of the Southwest, interfering with natural reseeding of range areas by destroying great quantities of the seed of native forage grasses and by making frequent raids on fields of sprouting grain, greatly reduce the stand and the value of the crop harvested. Considerable assistance has been rendered in the control of these animals through demonstrations and advising as to practical procedure in combating them.

BEAVERS AND WOODCHUCKS.

The beaver, which has been protected because of its value as a fur bearer, has become an intolerable nuisance in some localities by damming streams and flooding valuable meadows and cultivated lands, cutting orchard and shade trees even in the farmer's dooryard, diverting natural watercourses through tunneling in creek banks, and by feeding upon and trampling down growing grain crops and

alfalfa. In cooperation with State game officials demonstrations were given as to methods of capturing these animals alive and transporting them to national parks or other places where they are welcome.

Demonstrations and advisory assistance were also given as required in preventing damage by mountain beavers in Oregon and Washington, and in destroying woodchucks in localities throughout the country where they were proving destructive to alfalfa, clover, and other field and garden crops.

HOUSE RATS AND MICE.

House rats, the most destructive mammal pest in the world, each year destroy food and other products in field, granary, warehouse, store, and home to the extent of more than $200,000,000, a sum equaling the economic output of 200,000 men working continuously. In addition to their destruction of food products, poultry, and other agricultural property, these pests are carriers of bubonic and pneumonic plague and other diseases communicable to man, and of trichinosis in swine; and since rats and mice may contract avian tuberculosis, both may have an influence on the spread of this infectious disease among domestic poultry.

The educational campaign has been continued to acquaint the public with the economic losses and menace to health due to the presence and destructiveness of these pests. Increased interest in effective measures to combat rats is manifest throughout the country, and the bureau has furnished to individuals and extensive State organizations practical, tested methods of poisoning and trapping them and effective means of excluding them from buildings by rat-proof construction. Emphasis has been placed on means of cutting off their food supply and eliminating favorable rat harborage. Wherever health questions have been directly involved, cooperation of Federal, State, and local health officers has been obtained. The economic work of the bureau in aiding in the destruction and exclusion of these pests at all times has an important, indirect effect upon the public health by reducing the numbers of these potential carriers of disease and by bringing about more sanitary conditions through the emphasis placed on proper disposal of garbage and other refuse.

Losses from rats have doubtless been exceptionally heavy during the past year because of the unusually large quantity of grain and other agricultural products that have been left in shocks in the fields, or kept in stacks and farm buildings, and in elevators and warehouses. The good shelter and the abundance of food thus afforded have given rats and mice opportunity to multiply rapidly.

There has resulted a constantly growing demand upon the bureau to provide skilled leaders to coordinate and direct the work of local organizations. Responding to an appeal from 20 organizations in Texas, following a series of local and State meetings, an experienced man was provided the latter part of January to head the work. Effort was concentrated on organized procedure. Campaigns were launched in counties where suitable organization could be effected, and as a result 670,000 rats, by actual count, were destroyed in about four months at a cost of less than $2,000 to the cooperators. Denton County conducted the most successful campaign, taking 253,000 rats

in six weeks. As the number of people living in this county is only 35,000, this catch is of interest as showing the ratio that may exist between the human and rat population. A two-weeks' campaign in another county netted 70,000 rats. In many other States, notably North Dakota, Oklahoma, New Mexico, Kansas, Nebraska, Oregon, and Washington, similarly organized work has been conducted under the leadership of experienced bureau representatives.

MOLES.

Many complaints of damage by moles to lawns, gardens, and field crops have been received, and in all such cases information as to practical methods of combating moles has been furnished through correspondence, published material, or demonstration.

PRODUCTION OF DOMESTIC RABBITS.

Interest in the production of domestic rabbits as a source of meat and fur has continued to develop in the United States, and the bureau has kept in close touch with leading rabbit producers and officials of State organizations of rabbit breeders. Information has been furnished regarding the care and management of rabbits, and, in cooperation with the Bureau of Markets, regarding practical procedure in developing a satisfactory market. Study of the diseases to which domestic rabbits are subject has been continued in testing the value of serums and bacterins in preventing or curing infectious diseases of these animals.

FUR-BEARING ANIMALS.

For centuries fur products have been an important factor in world trade and efforts to open up new sources of supply in America were the stimulus for important exploring expeditions which increased national territorial possessions. The fur trade, which was the forerunner of agricultural and other industrial developments, has now become one of the large and important industries in the business world, providing employment for thousands of skilled and unskilled workers and contributing to the comfort of people who wear fur garments. North America has been the leading continent in the natural production of furs and is also the greatest fur consuming region in the world. Imports of undressed furs into the United States during 1920 were valued at over $84,400,000, and of dressed furs and manufactured garments in which furs are used, at $9,131,000. Members of the national organization of fur dressers and dyers dressed during 1920 furs valued at $52,910,589. The revenue derived by the Federal Government from import duties on articles made of fur amounted to $15,311,214 in 1920. Exports of furs and manufactures thereof for this period were valued at $32,886,995. The approximate turnover in the fur industry of the United States during 1920 was $352,000,000.

Because of the enormous drain upon the natural source of supply, the maintenance and stability of the fur business is dependent upon a far-sighted, constructive program of conservation of native fur bearers and upon the propagation of certain kinds in captivity or

under control. Within a few years in the United States and Canada a growing industry has developed in rearing silver, black, and cross foxes. In a survey made during the spring of 1921 there were reported to be 340 fox ranchers in the United States having 4,350 breeding animals, their stock and equipment being valued at more than $4,280,000. The total number of breeding foxes in the United States will be materially increased by the young of the spring of 1921 which were not reported. Fox ranches were reported in the following States:

California.	Michigan.	Oregon.
Colorado.	Minnesota.	Pennsylvania.
Idaho.	Montana.	Virginia.
Illinois.	New Hampshire.	Washington.
Maine.	New York.	Wisconsin.
Massachusetts.	Ohio.	

A considerable number of people are also rearing skunks, raccoons, minks, muskrats, opossums, and beavers.

The bureau has continued its investigations designed to aid the development of the fur industry. These have included the study of the feeding, breeding, and management practices followed by those engaged in the business, and laboratory and other investigations at the Experimental Fur Farm, near Keeseville, N. Y. Important progress has been made in determining feeds suitable for maintaining health, growth, and reproduction among foxes, and in obtaining data regarding the physiology of these and of other fur bearers, such as the normal pulse and respiration rate, which are required as a basis for the detection and diagnosis of disease. Valuable information has been obtained regarding breeding periods, and the causes of mortality and the early growth and development of the young.

The most notable advance has been made in the investigation of diseases to which fur bearers, especially foxes, are subject; the conditions of pens and surroundings favoring contraction and dissemination of such diseases, and sanitary measures essential to their prevention; also in the determination of safe and effective remedies, dosage, and methods of administration in cases of disease.

Observations made indicate that the hookworm is one of the most serious parasites that fox ranchers have to contend with and that its occurrence is far more widespread than has heretofore been realized. The unexplained death of many foxes has unquestionably been due directly or indirectly to such infestation. Losses from this parasitic disease are not limited to death and impaired health of foxes but are measured also by reduced commercial value of the pelt produced and by lowered breeding capacity. There is little superficial evidence of light hookworm infestation either in appearance of health or quality of pelt. Foxes so infested, however, are a constant source of danger, for if kept in undesirable types of pens they will eventually acquire heavy infestation and be at all times a means of carrying infestation to all other pens and foxes on a ranch. This feature is brought to the serious attention of all fox ranchers and particularly those who are so fortunate as to have stock free of hookworms or are starting out with a new set of pens and foxes. With the view of bringing this feature forcefully to the attention of breeders and affording them much-needed protection, the department recently promulgated quarantine orders governing importation into the United States of

animals that are or may be infested with these parasites or are affected by other communicable diseases of parasitic or bacterial origin.

Especial emphasis is placed upon the careful selection of healthy, vigorous stock having high-pelt quality combined with good fertility and dependable breeding record. That certain breeding strains will prove of higher pelt quality and be more prolific than others is evident. As in other lines of live-stock production, the largest measure of success will be attained by judicious selection of breeding stock, proper sanitation, regularity and skill in feeding, and the adoption of other good-management practices.

A discussion of the fur bearers and of fur farming in Alaska is contained in the information on that Territory at the end of this report.

ECONOMIC ORNITHOLOGY.

Bird protection has been long established in the United States, and responding to it, certain species of birds are becoming overabundant from an economic point of view. In some cases changes in feeding habits or simply the multiplication of normal feeding effects due to increased numbers, have drawn attention in an emphatic way to a neglected aspect of economic ornithology, namely, the damage done by birds and the means of controlling it.

ROBINS.

In the last few annual reports mention has been made of investigations of depredations by birds protected by the migratory-bird treaty act and of orders of the Secretary of Agriculture permitting the destruction of certain birds when actually doing damage. During the fiscal year covered by this report investigations of the relation of robins to small fruits were extended to Indiana, Michigan, and Oregon. There is no question that robins are much more abundant than formerly and that they have been taking a heavy toll of small fruits, in many cases all of small crops; these depredations were intensified during the latter part of the year by a drought which reduced the supply of wild fruits. As a result, therefore, of special and general investigations of the food habits of the robin, and after consultation with State authorities to learn their attitude in the matter, an order was issued by the Secretary authorizing landholders and their bona fide agents in the States of New Hampshire, New York, Indiana, Wisconsin, Minnesota, and Oregon to kill robins by shooting when these birds are actually damaging small fruits.

DAMAGE BY OTHER BIRDS.

During the year the only order modifying the protected status of a bird under the migratory-bird treaty act was that issued in the case of the robin, but investigations were made of damage by other species, and it was found necessary to continue them in the hope of reaching satisfactory findings. These studies included investigations of damage by wild ducks and blackbirds to grain crops in the Imperial Valley, California, and by crows, chiefly to grain crops in Oregon and Oklahoma. In the case of the crow, work was carried to the stage of experiments in methods of control. In Oklahoma.

especially, the numbers of crows have increased greatly in recent years and their winter concentration in that State has resulted in great losses in grain. Progress was made in developing an efficient, slow-acting, poisonous bait. Such a bait seems essential in crow-control work because of the extreme wariness of this bird and its reluctance to continue feeding in a given area once it has become alarmed. It is of interest that a slow-acting bait is required for crows while greatest efficiency in poisoning mammal pests has been obtained by the most rapidly acting poisons. It is doubtful whether effective measures for the control of crows can be carried out during the fall and early winter when there is an abundance of food, but it is believed that successful control campaigns can be conducted in periods of severe winter weather. Work will be continued at that season during the coming fiscal year.

SURVEYS OF PLANT LIFE IN WILD-FOWL RESORTS.

Investigation of plant life on the feeding grounds of wild fowl was confined practically to the State of Missouri, a single hunting preserve in Illinois also being visited. About 250 lakes and ponds in Missouri were surveyed and a report upon them prepared for publication, which discusses in detail the present status of wild-fowl feeding places in the State and means of their improvement.

BIRDS IN RELATION TO INSECT PESTS.

In the course of spring and fall trips to Massachusetts, an effort was made to learn the relation of birds to the European corn borer, a comparatively recent importation which is rapidly developing into a most serious pest. These borers live in concealment during practically all the larval stage, and it was found that birds are either not adapted for feeding upon them or have not yet learned to find them. Only two species of birds were found to prey upon this pest, and both of them, like the insect, are introduced—the ring-necked pheasant and the starling.

In another case, however, it was found that native birds were doing good work against an introduced pest, the Japanese beetle, in New Jersey. The investigation of this case, begun the previous year, was completed. Birds were collected over the beetle-infested area through the period of adult existence of the insect, and field observations and stomach examinations show that birds play an important role in combating it. Thirty-one species of birds were collected, and the majority had fed upon Japanese beetles. The most important bird enemy proved to be the purple grackle; examination of the stomach content of all these birds which were collected showed the presence of these beetles, to an average extent of two-thirds of the total food. Other birds of importance as enemies of the Japanese beetle, and the percentage of beetles taken were: Meadowlark, 50.7; starling, 42.3; cardinal, 38.6; catbird, 14.8. Toads also eat the Japanese beetle, and in the specimens collected this beetle made up 22 per cent of the total stomach content.

Because birds were suspected of having an entirely different relation to a pest, namely, that of aiding in its spread, an investigation

was made at the request of the office of Cereal Investigations of the Bureau of Plant Industry of English sparrows as possible distributors of the wheat-gall nematode. The results indicate that when the sparrows are feeding on green galls only a very small proportion of the nematode larvae pass through the alimentary canal alive, and that these birds must be considered only a minor agent in the distribution of this nematode. During the early development of these galls English sparrows seem to have a special liking for them. At first it was suspected that these sparrows might spread the infestation in this way, but it was found that their active digestion sufficed to kill nearly all of the nematodes.

MISCELLANEOUS WORK ON THE FOOD HABITS OF BIRDS.

Laboratory study of the food habits of various groups of birds was carried on more effectively than ever, a larger number of stomachs being examined than in any previous year. Work was completed on the canvas-back, redhead, ring-necked, and scaup ducks, and work was begun on preparation of a report for publication. Examination of the stomachs of English sparrows, looking forward to a modern and thorough study of the birds' economic status, was continued. Nearly half of the more than 8,000 stomachs now on hand have been examined. The contents of nearly 600 stomachs of hawks and owls also were studied during the year, clearing up accumulations of hawk stomachs to date. Analyses were completed also of a number of shorebirds, including the willet, dowitchers, robin, snipe, and godwits. As in previous years examination of special collections for correspondents was conducted; a consignment of stomachs of nighthawks and pigmy owls from Oregon may be mentioned in this connection, and one of merganser stomachs from the Miramichi and other rivers in New Brunswick; examination of the latter indicates serious destruction of trout by mergansers of the region.

FOOD HABITS OF OTHER ANIMALS.

For many years the facilities of the stomach analysis laboratory and the experience of the analysts have been utilized incidentally to develop exact information on the food habits of various vertebrates other than birds. At the beginning of the year a definite project was established for the first time for the study of the economic relations of two of these groups—reptiles and amphibians. There is no question that through their destruction of insects these animals have a relation to agriculture concerning which we should have precise information as a guide to their rational treatment, for it need hardly be stated that public policy toward these animals in the past has been anything but rational.

The main accomplishment under this new project was the removal of the contents of approximately 2,400 stomachs of toads from specimens in museum collections. Nearly 2,000 of these were obtained from specimens in the United States National Museum and the remainder were presented by the University Museum, Ann Arbor, Mich., and the zoological department of the University of Wisconsin. Actual examination of the stomachs has been in progress for two months.

As an aid in replying to correspondence, two mimeographed forms have been prepared, one on the care of the American chameleon and the other on North American venomous snakes. The latter is a résumé of the subject, intended primarily to correct fallacies in popular beliefs and to have available in brief form the pertinent facts relating to these snakes; it covers such topics as poisons, poison apparatus, treatment, mortality, shedding of fangs, rattles, food habits, suggestions for destruction of the reptiles, snakes swallowing young, number of young and habits, and a key to venomous snakes.

The collections of both examined and unexamined mammal stomachs were thoroughly reorganized and catalogued, the collection of stomach analysis cards put in order, and a considerable number of new stomach examinations made. Among the latter were a number of Alaskan reindeer and mountain sheep. Considerable direct information on the forage of these animals was thus obtained which was desired in connection with investigations of the reindeer industry and of the food of game animals now being made by the bureau.

BIOLOGICAL INVESTIGATIONS.

Although the biological surveys of States have been somewhat curtailed during this year, notable progress has been made in several other directions. In general the activities of this division have continued along the lines previously followed, especially those which have proved to be of value in relation to various well-established duties with which the bureau is charged, such as the enforcement of the migratory-bird treaty act, the Lacey Act, the administration of mammal and bird reservations, the conservation of game birds and mammals, and those bearing upon the relations of birds and mammals to agriculture, stock raising, and forestry. The extent and value of the various files and card indexes on the distribution, abundance, and habits of North American birds and mammals, particularly regarding life histories, which have such an intimate and complex relation to the welfare of man, have continued to grow. These information files become increasingly useful from year to year and enable the bureau to respond satisfactorily to inquiries continually being received from individuals, scientific institutions, and State and Federal officials throughout the United States, as well as from foreign countries.

BIOLOGICAL SURVEYS OF STATES.

Field survey work was conducted in Washington and Wisconsin only, being necessarily confined through lack of funds to those States in which cooperative arrangements with State institutions were in effect.

In Washington a field party made an exploratory trip across the Cascade Mountains just south of the Canadian boundary from Glacier, Whatcom County, to Loomis, Okanogan County, which resulted in the acquisition of considerable valuable data on the fauna of this interesting and little-known region. Representatives of the State College of Washington and of the Bellingham State Normal School cooperated with the Survey party in this work, which continued from early in July to the end of September. During the

remainder of the year a representative of the bureau was engaged in similar work in various parts of the State, mainly in the northern and western counties.

In Wisconsin the field survey continued from July 1 to the middle of September, mainly in the southwestern part of the State. The Wisconsin Geological and Natural History Survey cooperated in this work, keeping one man in the field, under the direction of the bureau, during the entire period. Notable progress was thus made in the study of the distribution of birds and mammals within the State.

Reports based on field work of the survey completed, but not published, include "Mammals of New Mexico," "Mammals of North Dakota," "Mammals of Wyoming," "Birds of Alabama," "Birds of New Mexico," and "Birds of Texas." "A Biological Survey of Alabama," consisting of a report on the life zones and an annotated list of the mammals, is in press and will shortly appear as North American Fauna, No. 45. Progress has been made during the year in technical studies of mammals, especially the shrews and chipmunks.

DISTRIBUTION AND MIGRATION OF BIRDS.

Work on bird migration has progressed essentially the same as during previous years. Reports from about 275 observers were received, an increase over the number sent in last year. Progress has been made in abstracting records from published sources, in identifying, carding, and arranging specimens of birds lately obtained, and in copying the field notes of various members of the Survey. The number of record cards now in the bird files covering habits, distribution, and migration is nearly 1,450,000.

No general reports on migration have been issued during the year, but the following are practically completed: "Distribution and Migration of North American Terns and Their Allies," and "Distribution and Migration of North American Grebes, Loons, and Auks."

BIRD COUNTS.

Manuscript reports from the seventh annual series of bird counts received during the year numbered about 50, a substantial increase over the preceding year, a result of special efforts to reenlist the services of many of the collaborators whose work was interrupted by the war. Fortunately many of these reports were made on the same areas as in previous years, and thus will give continuity to an interesting and valuable series of observations that it is hoped will be maintained through a long period in order to establish facts as to average as well as varying conditions governing bird life in such areas. A third report on bird counts in the United States, covering the years that have elapsed since the second report, is being prepared.

BIRD BANDING.

The work of banding birds taken over by the bureau last year has been organized and the operations extended. At the close of the year the cooperators enlisted in the undertaking numbered 135, and this

number is steadily increasing as the work becomes better known and its value more appreciated. Accomplishments during the year included both the systematic trapping and banding of land birds and the banding of nestlings, as well as the banding of waterfowl, for the purpose of obtaining information concerning the migration of birds which is of special value in connection with the administration of the migratory-bird treaty act. Various State organizations, including State game commissions, are cooperating in this investigation. The number of birds banded under the direction of the bureau during the year was 2,845, and much valuable information was gathered from reports of "return" records (banded birds which were recaptured), in some cases at a point far distant from that where they were banded. Plans for the summer of 1921 contemplate the marking of waterfowl on their breeding grounds in North Dakota, and later it is hoped to extend operations to some of the more notable wintering grounds in the Southern States. One publication was issued during the year, a circular of instructions for bird banding.

INVESTIGATIONS OF MIGRATORY WILD FOWL.

Investigations of migratory wild fowl have been carried on by members of the Survey and in cooperation with State game officers and others.

The field party, headed by an assistant of the bureau, which was engaged at the close of the last fiscal year in studying ducks and other migratory game birds on their breeding grounds on the delta of the Athabaska River in central Canada, continued these studies until the departure of the bulk of the birds for the south early in October. This expedition resulted in the accumulation of a great quantity of very useful information on the breeding and migration of these valuable birds on one of the most extensive and important areas to which they resort, both during the nesting season and while on their seasonal journeys north and south.

Near the close of the last fiscal year an assistant of the Survey proceeded to southern South America to study the conditions governing the abundance of certain North American shorebirds which resort to that region to escape our winter. These investigations were undertaken in response to a demand for definite information regarding the status of these birds as affected by settlement in remote regions of the Southern Hemisphere, and its bearing on their lessening abundance in this country; also to provide data for the formulation of provisions of possible treaties which may be negotiated with countries lying south of the United States—treaties similar in character and object to that now in effect between our country and Great Britain, by which much-needed protection is given these valuable birds in the United States and Canada.

Our representative, who completed his studies and returned late in May, 1921, was very successful, having visited some of the more important areas most frequented by wild fowl in parts of Argentina, Paraguay, Uruguay, and Chile, and secured a mass of first-hand data of great interest. Besides the value of this information in relation to problems of conservation in this country, it will be of material assistance in formulating agreements to insure the most beneficial results in case migratory-bird treaties are consummated with any

South American country. In addition to the data secured on migratory shorebirds, it was found that some of our commoner insectivorous birds winter in those southern countries in considerable numbers. A report on the results of this very important expedition, the first of its kind in South America, is in course of preparation.

WILD LIFE IN NATIONAL PARKS AND NATIONAL FORESTS.

In the early part of July an investigation of the conditions affecting elk on the Sitgreaves National Forest, Ariz., the descendants of a small herd brought from the Yellowstone National Park, was made by an assistant of the bureau, in cooperation with the Forest Service. The elk, though widely scattered at this season, were found to be thriving. On the basis of various conditions bearing on the matter, carefully studied on the ground, boundaries for a proposed State game refuge were agreed upon which it is believed will admit of a considerable increase in the elk herd and other game without interfering with present arrangements relative to the grazing of domestic stock. The recommendations resulting from this work were submitted to the Governor of Arizona, who has expressed his approval of the plan and his desire to have the State elk refuge established as early as may be practicable.

The 1921 edition of the circulars of information concerning Yellowstone National Park and the Mount Rainier National Park, published in the spring of 1921, contain revised lists of the mammals and birds of these public recreation areas, contributed in part by naturalists of the Biological Survey. In addition, a more comprehensive treatise on the mammals of the Yellowstone National Park and a similar work on Mount Rainier National Park, the latter comprising the results of field studies of the life zones and extensively annotated lists of the birds and mammals, both by assistants of the bureau, are in the hands of the National Park Service for publication.

LIFE HABITS OF INJURIOUS ANIMALS.

During the year an assistant has been continuously engaged in studying the life habits of mammals, with special reference to the food habits of injurious rodents and their general relations to agriculture, grazing, and forestry, in North Dakota, Montana, Idaho, Oregon, California, and Arizona. In Minnesota and Wisconsin studies of beavers and muskrats were made to supply needed information in relation to rearing these animals on fur farms.

Field practice includes the observation of living animals under normal conditions, the excavation of burrows and dens to ascertain methods of storage and the kind of food preferred, observation and feeding of captive individuals, stomach examination of specimens taken under normal conditions, and studies of breeding habits. Studies in North Dakota were confined mainly to the two species of ground squirrel common there. In parts of the State the few thirteen-lined ground squirrels which had reinfested certain territory recently cleared of them were found to be feeding almost exclusively on the swarms of grasshoppers then doing extensive damage. Work in Oregon involved studies of such injurious rodents as ground squirrels, pocket gophers, rabbits, kangaroo rats, and pocket

mice. In Arizona about six months, including the winter season, were spent in studying the food habits of rodents, with special reference to their effect on native forage on stock ranges. Work in other States included the investigation of special problems—in the Bitterroot Valley, of the Columbia ground squirrel; in Idaho, of certain pocket gophers; and in California, of the wood rats.

The more information that is obtained concerning the habits of our native rodents, the more closely they are found to be related to the prevailing plant life. This gives these individually unimportant but enormously numerous animals a little-suspected although in the aggregate a very great economic importance. The occupation of the country for farming and other purposes has very generally destroyed the original checks and balances which held our wild birds and mammals at a more or less safe level as to numbers. The result is that without learning their habits and devising and enforcing methods for their control a number of species of predatory animals and rodents and even some birds would multiply until in considerable areas successful stock growing and agriculture would be carried on under severe handicaps and might be impossible.

GAME AND BIRD RESERVATIONS.

This has been one of the most successful years in the history of the Federal bird reservations. The increase of big game has been extremely satisfactory and no damage to the reservations or losses of moment have occurred. A small fire starting in the grass on the Montana National Bison Range, which might have developed into a serious menace, was promptly extinguished. The public is much interested in the reservations and is more and more respecting these wild life sanctuaries. Improvements have been made in various places by growing grain and cover for the use of birds, by the erection of new and the improvement of old buildings, and by the provision of new fences, signs, boundary marks, and added facilities for motor transportation. As a result of several extended inspection trips, during which most of the reservations were visited, the assistant in charge was able to suggest a number of improvements in administration which will undoubtedly be of much benefit. In addition, he represented the bureau at the national parks conference at Des Moines, Iowa, January 10 to 12, and inspected and reported upon a proposed migratory wild-fowl refuge and public shooting ground on the Bear River marshes, Utah.

Investigation of Federal bird reservations during the year developed the fact that the reservations covering irrigation reservoirs at East Park, Calif.; Keechelus, Kachess, Clealum, and Bumping Lake, Wash.; and Loch Katrine, Wyo., lack plant food and other requirements for useful bird reservations and are comparatively little visited by wild fowl. Recommendation was made accordingly and, by Executive order dated May 20, the President eliminated them from the list, and also San Francisco Bay Reservation, California, which is no longer useful as a bird reservation. This reduced the number of game and bird reservations under control of the Biological Survey from 74 to 67, but on June 30, 1921, the number was 70, the following three having been added during the year: Caloosahatchie, Fla., and Nine-Pipe and Pablo, Mont. Five of these are

fenced big-game reservations, three of which were also made bird reservations in order better to protect the wild bird-life frequenting them.

BIG-GAME PRESERVES.

Big game under fence on reservations controlled by the bureau, including buffalo, elk, antelope, and deer, have increased most satisfactorily during the year, particularly the antelope, which have at times suffered serious losses; in fact, at one time it was doubtful whether it would be possible to maintain antelope herds on the Federal game preserves. The critical period, however, appears to have been passed. The following table shows the game animals on inclosed preserves during the last six years:

Kind of game.	1916	1917	1918	1919	1920	1921
Buffalo	207	246	302	368	427	508
Elk	159	184	212	274	384	504
Antelope	40	49	49	54	69	92
Deer, mule	3	6	22	29	27	37
Deer, white-tail					6	5

For some years coyotes or other predatory animals, and possibly poachers, caused such serious losses among the antelope that their future within the Federal reservations was extremely doubtful. By increased vigilance of the wardens in charge and by detailing skilled predatory-animal hunters to trap and use poison about the reservations, a large number of predatory animals have been destroyed and the death rate among the game much decreased. No violent deaths appear to have occurred among any of the game animals during the year and only the few that might be expected from natural causes. A representative of the Biological Survey and one from the American Bison Society made a reconnaissance during the spring of an extensive unsurveyed area of country in southwestern Idaho to ascertain its value as a proposed antelope and sage-hen reservation. The few stockmen in this area favor such a reservation, which might be established without interfering with the grazing of the number of live stock now located there. This area is one of the few in the West still containing a considerable number of antelope.

National Bison Range, Mont.—This preserve has had a prosperous year. The buffalo have increased from 332 to about 388. One sick buffalo was found and it was necessary to destroy him; there have been only two other deaths. The elk now number 265 as compared with 200 a year ago. There were 45 antelope a year ago, 15 have been born, and none have died, which gives a total of 60 now in this band. The mule deer show about 35 as against 19 a year ago. There is one white-tailed deer on the range. In cooperation with the State, 24 ring-neck pheasants were turned out on the range in September, 1920.

Improvements have been made at the watering places and an unsatisfactory condition relating to an important spring within the reservation has been adjusted.

About 300 posts of the game fence have been replaced with new 10-foot posts. A new water system has been installed at the headquarters as additional fire protection and for domestic uses; this

includes a gasoline pump and water-storage tank. Improvements made on the warden's house include a kitchen extension and various fixtures which add to the comfort of the warden's family.

Wind Cave National Game Preserve, S. Dak.—The buffalo herd has increased from 60 a year ago to 71, the elk from 105 to about 150, the antelope from 20 to about 32, and there are still 2 mule deer. It is particularly gratifying to know that the antelope band has done extremely well, and the warden in charge is to be commended for his successful efforts to prevent losses by constant watchfulness and destruction of coyotes.

Through cooperation with the State wardens, convictions were obtained in the cases of illegal killing of elk in the vicinity of the preserve.

Concrete basins have been built at watering places to prevent the springs being tramped into boggy mudholes.

Niobrara Reservation, Nebr., now has 37 buffalo and 53 elk, as against 28 buffalo and 47 elk a year ago. A new game fence, greatly enlarging the inclosed range, is under construction, all the material for it having been received. The old military buildings have been removed, except those needed for reservation purposes. The State, with the aid of the Bureau of Public Roads, has completed a new road leading from Valentine to and through the reservation, and this should better conditions materially, as in bad weather the old road was frequently impassible.

Sullys Hill Game Preserve, N. Dak.—The six buffalo presented by the Portland City Park have become acclimated and one calf was born in 1919 and two this year, raising this to a herd numbering nine. The elk have increased here until it is desirable to dispose of some, as the preserve has only about 600 acres under fence. In addition to the buffalo and elk there are about three white-tailed deer. No losses have occurred among the animals during the year.

Construction work on the new buildings, roads, and recreation grounds was carried on through the spring, summer, and early autumn, but owing to the difficulty of securing mechanics and other labor and the exhaustion of available funds much yet remains to be done. The women's resthouse is nearly finished, the ornamental iron gates are on hand to be erected, and the new entrance road is ready for surfacing. This preserve continues to be a very popular resort for the people of the surrounding region and the improvements being made will add greatly to the comfort of the visitors.

Elk Refuge, Wyo.—The mild winter of 1920–21 was of great benefit to the elk herds. The southern, or Jackson Hole, herd, which winters south of the Yellowstone Park, suffered severely the winter before when thousands of elk died from starvation despite the fact that hay was bought in great quantities and fed to them in addition to the crop harvested on the refuge. Counts during the winter of 1920–21 show that only about 9,300 elk remained in that region. Approximately 3,500 was the largest number reported from the refuge at one time, as in some places the elk maintained themselves on the range all winter. Not over 75 are reported to have died in the Jackson Hole Valley during the winter and, with the favorable spring and summer which have followed, this herd should have begun to recuperate.

About 375 tons of hay are left over from last winter, and as the prospects point to a good crop this year there should be more than a thousand tons ready for next winter's feeding. A new set of haying machinery has been purchased to replace one of the old sets which became practically useless last summer.

BIRD RESERVATIONS.

During the year considerable progress was made in posting and defining boundaries of many of the bird refuges. This is important, since it facilitates the better guardianship of the refuges, strengthens the Government's cases in instances of violations, and is of particular benefit to sportsmen and others who are interested in maintaining the reservations. Orders have been placed for metal signs of a distinctive design, which will be more durable, easier to post, and cheaper in the end, and in every way an improvement over cloth signs.

The planting of grain to provide food and cover for sharp-tailed grouse and pheasants on the National Bison Range has been continued on a broader scale. The results have been most gratifying in increasing the number of grouse and maintaining both them and the pheasants on the reservation. No disease or unusual loss of birds, nests, or eggs has been reported and the year appears to have been a very favorable one for the birds on practically all the reservations.

An Executive order signed in June enlarges the Indian Key Reservation in Florida by the inclusion of Bush Key and three smaller keys; these are of considerable value to the nesting birds, which are increasing in this vicinity. It is especially notable that considerable numbers of roseate spoonbills are congregating about this reservation. These beautiful birds, among the most interesting and picturesque of all the avian inhabitants of Florida, were nearly exterminated years ago by plume hunters. Under protection they are gradually increasing in numbers and may again become one of the well-known inhabitants of the State.

The bureau for a number of years has been conducting investigations concerning the migratory wild fowl which breed in large numbers on the Bear River marshes near Great Salt Lake, Utah. In order that this splendid resort for wild fowl may be maintained for their benefit, it has been proposed to establish it as a breeding reservation to be utilized in fall as a public shooting ground. It is hoped that this plan may be carried out, since such favorable breeding grounds are becoming exceedingly scarce in the United States. A few interesting facts regarding some of the more important bird refuges follow:

Lake Malheur, Oreg.—In the spring an unusual quantity of water raised the level of Lake Malheur, flooding some of the nests, overflowing into Mud Lake, and partially filling the dry bed of Harney Lake. Migratory wild fowl nested in greater numbers than usual at Malheur, especially Canada geese.

Two extensive irrigation projects menace this great breeding ground, one in the Blitzen River valley and the other in the Silvies River drainage area. The latter is the more threatening, as it is planned to divert all the water of that stream to irrigate lands some distance from the lake. Every effort is being made to safeguard the

water supply in order that this reservation may continue as a breeding place for migratory wild fowl. It is one of the best, if not the best, remaining in the United States, and its loss would be a real calamity.

Klamath Lake, Oreg.—The exclusion of water from this reservation has greatly decreased its importance as a wild-fowl breeding place.

Clear Lake, Calif.—This is a Reclamation Service reservoir, the impounded waters of which have not yet been used for irrigation purposes. As a result there has been an increasing growth of tules, and the reservation is now the breeding resort for an abundance of wild fowl. Large numbers of the birds formerly breeding in Klamath Lake now resort to Clear Lake. The Reclamation Service watchman has been appointed a cooperative warden and keeps the lake posted and protected. Each spring sheep have done considerable damage to the nesting resort on a peninsula in the lake, and special effort will be made to prevent this in the future. Large numbers of geese nest here, in addition to other birds.

Deer Flat, Idaho.—The boundary of this reservation lies along section lines and it is extremely difficult for the wardens to regulate trespass. The high-water mark about the lake, however, is clearly defined along the willows and sage brush. During autumn the water is low and the gradually sloping land leaves a belt of from a quarter of a mile to a mile in width between the shore line and high-water mark. In the fall of 1920 the Secretary issued regulations to permit the shooting of migratory wild fowl on the reservation outside the high-water mark. The birds thus have the benefit of an undisturbed feeding and resting place, while sportsmen may have a certain amount of shooting on the surrounding lands.

Minidoka, Idaho.—Minidoka is another irrigation reservoir. In the spring of 1921, 16 acres on an island a few miles above the dam were planted with wheat, Japanese millet, sweet clover, and blue duck millet to provide food and cover for the nesting birds. The outcome of this experiment has not yet been determined.

Nine-Pipe and Pablo, Mont.—These two reservations, created by Executive order dated June 25, 1921, cover the Reclamation reservoirs of the same names and afford breeding places for a considerable number of wild fowl. Nine-Pipe includes 2,019 and Pablo 2,854 acres. In 1920 a pair of swans (probably trumpeters) raised a brood on Nine-Pipe Reservoir and a number of swans were seen about these waters this spring. These two refuges will be under the general supervision of the warden of the Montana National Bison Range, which is only 12 miles south of Nine-Pipe and 21 miles from Pablo.

Pishkun and Willow Creek, Mont., and Shoshone, Wyo.—Each of these reservations is an irrigation reservoir and will be safeguarded by men in the Reclamation Service, who are made cooperative wardens.

Chase Lake, N. Dak.—Warden service has been maintained at this reservation during the breeding and shooting season. A peninsula in the lake is a favorite breeding place for ducks. Special efforts will be made to protect this area from live stock during the breeding season in order that the birds may not be molested.

Mille Lacs (*Spirit Island*), *Minn.*, *Reservation*, enlarged by the addition of the small Hennepin Island, is a breeding place for gulls and similar birds. In the autumn considerable numbers of ducks congregate in the vicinity.

Big Lake, *Ark.*, has had an exceptionally good year. Trespassing on the reservation, which was formerly so common, is rapidly diminishing. The only serious depredation in 1921 resulted in one offender being sentenced by the Federal court to pay a fine of $500, his associate being fined $50 and sentenced to six months in jail. Wood ducks are breeding here in greater numbers than formerly and the reservation is a resting place and sanctuary for vast numbers of other ducks in autumn and winter. Geese rarely stop here.

Walker Lake, *Ark.*, is now under the supervision of the warden at Big Lake. A large rookery of egrets and other herons is established here, motion-picture films of which were made for educational purposes by a photographer from the department.

Reservations in the Gulf of Mexico.—These include Petit Bois, Breton, and Tern Islands and East Timbalier and Shell Keys, lying along the south shore of Alabama, Mississippi, and Louisiana, where countless thousands of sea birds and a few waders nest each spring and early summer.

The chief warden at Big Lake was detailed to patrol these gulf reservations during the spring of 1921 and among other interesting observations reported that two pairs of white pelicans were nesting on East Timbalier. This is a rare occurrence.

Key West and Tortugas, *Fla.*—Birds continue to nest in large numbers on Bird Key, of the Tortugas Keys Reservation, and a watchman was stationed there during the nesting season to protect it from being raided by egging parties.

MIGRATORY-BIRD TREATY AND LACEY ACTS.

Development of the administration of the migratory-bird treaty and Lacey Acts has been seriously impeded by lack of sufficient funds for their adequate enforcement. Nevertheless, substantial and gratifying progress has been made, as is evidenced by the remarkable increase in the numbers of wild ducks, wild geese, and practically all species of migratory birds. The increase among the migratory game birds is attributable almost solely to the elimination of spring shooting, the nonsale of migratory game birds, and the establishment of a uniform bag limit, the three fundamental restrictions made possible by the migratory-bird treaty act. Nearly all State game commissions and many organizations and individuals have cooperated actively with the bureau in creating an interest in the proper observance of the law, in checking violations, and in apprehending persistent violators.

The stopping of spring shooting has had a striking influence in encouraging the birds to remain within the States and to reoccupy parts of their former breeding range unfrequented by them for many years. Records are on file of birds nesting in some places on earlier dates than heretofore recorded. One noteworthy and unusual instance is the finding of four black ducks' nests—one with one, one with four, and two with six eggs—by a Federal game warden on

March 2, 1921, in New Jersey. The protection of the breeding grounds of the birds and the extension of their breeding ranges have greatly improved fall shooting and have more than compensated for the loss of spring shooting. During the last open season sportsmen enjoyed the best hunting for years, and in many sections the daily bag limit was easily obtained.

While the bureau has been unable to increase its warden force and expand the work to meet a widespread demand, the administration of the law has been systematized and perfected until now the warden force is operating in a highly efficient manner and increasingly commands the respect and confidence of the public.

The number of game wardens on duty has varied during the year from 27 to 31. These men were aided by 27 deputy wardens, who have rendered valuable services when placed on active duty at various times, and also by 326 deputy wardens located throughout the country, who receive the nominal salary of $1 per annum and cooperate in reporting violations and in bringing about a better observance of the law. Most of the Federal deputies are also State deputy game wardens. The volume of administrative work has increased so rapidly that it became necessary during the year to add to the force a deputy chief game warden.

The small number of Federal wardens allowed has made it necessary during the spring migration to continue the policy adopted several years ago of concentrating a number of them in the most troublesome sections. Many violators were thus apprehended and a check put on serious violations over large areas. This method of patrol, while expensive, appears to be the most effective way to conduct the work in sections where violations are numerous and generally distributed.

During the year 996 violations of the migratory-bird treaty act were reported and resulted in 492 convictions, in which fines were assessed ranging from $1 to $500 each, aggregating more than $9,500. In addition to fines imposed, a large majority of the violators convicted were compelled to pay costs, which in some instances equaled and in others far exceeded the amount of the fines. Federal judges dismissed 21 cases, while 56 cases were nolle prossed. Grand juries returned no bills in 17 cases, and trial juries acquitted 10 defendants. Prosecutions against 5 persons were terminated by the death of the accused; and 16 cases of a trivial or technical character were not reported by the bureau for prosecution. About 370 cases are awaiting action of the courts.

The convictions in Federal courts were distributed as follows: Alabama, 37; Alaska, 1; Arizona, 16; Arkansas, 17; California, 1; Delaware, 12; District of Columbia, 1; Florida, 24; Georgia, 36; Idaho, 7; Illinois, 44; Indiana, 1; Iowa, 43; Kansas, 8; Kentucky, 2; Louisiana, 4; Maine, 15; Maryland, 9; Massachusetts, 19; Minnesota, 3; Mississippi, 24; Missouri, 36: Montana, 7; Nebraska, 7; New Jersey, 2; New Mexico, 7; North Carolina, 5; Ohio, 7; Oklahoma, 6; Oregon, 2; Rhode Island, 2; South Dakota, 3; Tennessee, 8; Texas, 37; Virginia, 17; Washington, 21; and Wyoming, 1.

Numerous seizures were made of migratory game birds illegally killed or possessed, and most of these were disposed of by the bureau with consent of accused by gift to hospitals or charitable institutions

for use as food. Contraband plumes and mounted specimens of migratory birds of an estimated value of $5,000 were seized during the year. Most of these were released to the bureau by the accused, while others were turned over to it by court order.

Many substantial fines were imposed, but in some cases they were very small. The Federal judge for the eastern district of Arkansas imposed the maximum penalty of $500 on one persistent violator charged with selling wild ducks; in passing judgment on two other offenders similarly charged, the same judge fined one $250 and the other $50, in addition to which the latter was sentenced to six months in jail. Two of these offenders have been notorious violators of the game laws, particularly with respect to illegal traffic in wild ducks, and had previously been in Federal court on at least one occasion for violation of the Federal game laws. Each of two offenders arraigned in the western district of Missouri on charge of killing wild ducks in spring, was fined $200 and costs. One offender convicted in New Jersey on charge of killing wild geese during the close season served 10 days in jail, but the court remitted the fine of $200 also imposed. At Santa Fe, New Mexico, a violator was fined $350 and costs on charge of illegally possessing two wild ducks unlawfully killed; that he was a State deputy game warden may account for the substantial fine imposed. The illegal sale of wild ducks by a restaurant proprietor to his guests resulted in his conviction and the imposition of a fine of $100 in the Federal court at Beaumont, Tex. Many other cases netted fines ranging from $25 to $50 each.

The second conviction for hunting wild fowl from an airplane was obtained in the Federal court at Baltimore, Md., where the violator, charged with killing a swan, was fined $10. The concerted efforts of three Federal game wardens on the Missouri River in the latter part of 1920 resulted in the apprehension and conviction of approximately 25 violators charged with killing ducks and geese from motor boats; in most of these cases each offender was fined $25 and costs.

During the fiscal year 886 persons were authorized to collect and 160 to possess migratory birds for scientific purposes; 48 were authorized to capture migratory waterfowl to assist them in breeding wild fowl in domestication; and 2,139 were authorized to possess migratory waterfowl for propagating purposes. Only a small percentage of the persons to whom permits to propagate wild fowl were issued are engaged in breeding the birds for food purposes, many of the birds possessed being held merely for ornamental purposes or for use as decoys. Permits were issued to 150 responsible persons, authorizing them to trap, band, and release migratory birds in cooperation with the efforts of the bureau to obtain scientific data concerning the distribution, breeding habits, and times and lines of migratory flight of the birds.

On April 21, 1921, the Secretary issued an order permitting the destruction of nests and eggs of mergansers on the property of the Mad River Co., Oswego County, N. Y., to enable the company to protect trout and other valuable food fishes from depredations of the birds, but killing of the birds was not permitted.

Depredations of robins on cherries and other small fruits resulted in the issuance of an order by the Secretary on April 30, 1921, au-

thorizing fruit growers, under Federal permit valid when countersigned by the chief game official or his duly authorized representative in the State where effective, to kill robins when necessary to prevent the fruit from being destroyed, in New Hampshire, New York, Indiana, Wisconsin, Minnesota, and Oregon.

The order of January 17, 1919, permitting bobolinks, commonly known as reedbirds or ricebirds, to be killed in certain States from September 1 to October 30, was rendered ineffective in New Jersey, which passed a law affording these birds protection throughout the year.

The annual meeting of the Migratory-Bird Treaty Act Advisory Board, attended by practically all of its members, was held in Washington, on January 27. Most of those present were State game commissioners, and all commended the bureau for its efforts and gave it assurances of their hearty cooperation in the administration of the law.

Amendments of the Federal regulations suggested by the bureau were concurred in by the board, and these subsequently were adopted by the Secretary, approved by the President, and became effective on March 3, and May 17, 1921. The most important of the amendments provided that the daily bag limits obtained by one person shall include all birds taken by any other person who for hire accompanies or assists him in taking them; another amendment authorized limited as well as general privileges under permits issued for scientific purposes.

The effectiveness of the bureau's work has been greatly augmented by the hearty cooperation it has received from an ever-increasing number of State and local organizations of sportsmen and conservationists. In the important work of creating a healthful public sentiment to aid in the enforcement of the law, the bureau has enjoyed at all times the good will and cooperation of State game officials and of associations organized for the conservation of wild life. With this valuable aid it has succeeded in accomplishing gratifying results, not only through cooperation of such national organizations as the American Game Protective Association, the National Association of Audubon Societies, the Boone and Crockett Club, the Camp Fire Club of America, and the Camp Fire Club of Chicago, but of many of the State game protective associations.

INTERSTATE COMMERCE IN GAME.

A large number of investigations of interstate shipments of wild animals and parts thereof were made during the year, believed to have been in violation of sections 242, 243, and 244 of the Penal Code, commonly referred to as the Lacey Act. Many of these investigations have been practically completed, and 44 have been reported for prosecution. These involved mainly the shipment of beaver skins, although one shipment contained 994 muskrat skins illegally taken in Ohio and shipped to Michigan.

Eighteen convictions under the Lacey Act resulted in the imposition of fines and costs amounting to $580, five cases were nolle prossed, and two were terminated by the death of the accused. In cases involving 120 shipments, prosecution was deemed to be unwarranted or inadvisable either because they were found to be made by

parcel post or because of the fact that sufficient evidence could not be obtained: 100 shipments are still under investigation.

Investigations by Federal game wardens frequently reveal evidence of violation of State laws in the killing or shipment of animals or birds, which can not be prosecuted in Federal court, and during the year the bureau cooperated with State game authorities in turning over to them 291 cases of this character, which resulted in the States' receiving in fines and costs a total of $7,766.31.

Lacey Act cases reported for Federal prosecution originated in the following States: Arkansas, 2; Colorado, 2; Idaho, 8; Michigan, 1; Nebraska, 1; Nevada, 1; New Mexico, 1; Ohio, 1; Oregon, 11; Utah, 1; Washington, 7; Wisconsin, 3; Wyoming, 5.

Many important fur dealers, realizing the necessity of conserving the supply of fur-bearing animals, have continued to extend cooperation by republishing in their catalogues and in their advertising material information furnished by the bureau concerning State trapping and shipping laws and by omitting from their price lists quotations on furs of animals for which no open season is provided. The number of cases prosecuted under the Lacey Act is no indication of the widespread deterrent influence extended by the act against illegal killing and shipment of game and furs. This law is one of the most helpful conservation acts ever passed by Congress. It is of the greatest assistance to the State game officials in preventing the illicit destruction and shipment out of the States of their game and fur resources.

IMPORTATIONS OF FOREIGN BIRDS AND MAMMALS. 1921

The number of permits issued during the year for the importation of foreign birds and mammals showed an increase of more than 20 per cent, from 453 in 1920 to about 560 in 1921, and the number of shipments inspected increased in the same time from 89 to 155. At Honolulu, Hawaii, additional permits were issued for the entry of 1,190 miscellaneous birds, chiefly quail, doves, and pigeons. Altogether there were entered in the United States under permit 66,793 canaries, 22,209 quail, and various other miscellaneous birds, making a total of 182,052, of which 129,928 were inspected. In addition, there were entered at the port of San Francisco, chiefly as passengers' baggage without requirement of a permit, 875 parrots, 1,740 canaries, 1,989 miscellaneous birds, and 128 mammals. The permits for mammals authorizing the entry of 5,368 animals included 1,574 black or silver foxes from Canada. Some of the permits for foxes were probably not used and a few others covered the entry of animals brought in for exhibition and later returned. The number actually entered was probably much less, therefore, than the figures stated, although larger than the number reported last year, 805.

On April 7, 1921, new regulations for the entry of black foxes were issued, effective June 1, which limited the ports of entry to Boston, Mass.; Calais, Me.; New York and Rouses Point, N. Y.; Pembina, N. Dak.; Port Huron, Mich.; and Seattle, Wash.; and required a number of days' quarantine at the border before entry. Since these regulations went into effect comparatively few permits have been issued, and during the month of June no foxes were en-

tered. The object of this quarantine is to prevent the entry of black foxes suffering from diseases or parasites. Large numbers of these animals have been imported for fur-farming purposes, some of them afflicted to such an extent as seriously to endanger the fur farms where delivered.

Importation of birds from Europe and Australia included several large miscellaneous consignments for zoological parks including a number of rare and interesting species. Among these was a shipment from Australia which arrived in November at New York via the Panama Canal and included 2 blue birds of paradise (*Paradisornis rudolphi*), 4 Count Raggi birds of paradise (*Paradisea raggiana*), 21 satin bower birds (*Ptilonorhyncha violacea*), 2 New Guinea mynahs (*Mino dumonti*), and many other rare species.

During the year two Hawaiian geese (*Nesochen sandvicensis*) have been received, one at New York via Hamburg and one at San Francisco direct from Honolulu. This species, confined to the Hawaiian Islands, is seldom seen in captivity and has been imported previously on only one or two occasions. Several important shipments were received from South American ports and among them those from La Guaira, Venezuela, and Para, Brazil, included a number of rare toucans, parrots, and other species which deserve mention. The traffic in Tropical American parrots, which, prior to the war, had reached considerable proportions, has shown some increase, and during the spring several large shipments of parrots from Cuba arrived at New York.

IMPORTATION OF QUAIL FROM MEXICO.

Through the cooperation of the Bureau of Animal Industry, inspection and quarantine of quail from Mexico were provided as heretofore at Brownsville, Laredo, and Eagle Pass, Tex., from November 1 until April 20. Under date of March 3, 1921, the regulations admitting quail were modified to extend the open season 10 days, until April 20. After March 10 quail examined at the border and found free from disease were permitted to enter without quarantine. The number released from quarantine was 13,564 and the number admitted on inspection after March 10 without quarantine was 8,645, making a total of 22,209 admitted. Quail disease appeared at Brownsville in December and later at Laredo. The total number of birds lost from this or other diseases and not included in the above total was 7,359. Upon the first appearance of the disease at Brownsville entries at that port were suspended for a period of about six weeks.

The number of quail imported this year was exceeded only by the totals of 1917 and 1920 when 32,814 and 27,417, respectively, were brought in. In all, during the 10 years that quail have been shipped from Mexico, 119,717 have been imported, about two-thirds of which arrived during the seasons of 1917, 1920, and 1921. The birds were sold for $24 or more a dozen.

PROTECTION OF LAND FUR-BEARING ANIMALS IN ALASKA.

Under the appropriation act for the department for the fiscal year covered by this report, the Secretary of Agriculture was authorized to exercise jurisdiction heretofore exercised by the Secretary of Com-

merce over all land fur-bearing animals in Alaska. The work was assigned to the Biological Survey, and immediate steps were taken to carry out the provisions of section 1956 of the Revised Statutes, as amended, which provides that no otter, mink, marten, or other land fur-bearing animal shall be killed except under such regulations as the Secretary may prescribe. On July 1, 1920, regulations were accordingly promulgated in which open seasons were provided for killing land fur bearers in the Territory, with the exception of martens and beavers. On October 25, 1920, these regulations were amended extending the open season one month for trapping foxes in the southern part of the Territory.

A chief fur warden was appointed with headquarters at Juneau, and deputies were stationed at Akhiok, Atka, Fairbanks, Igloo, Killisnoo, Unalakleet, Unalaska, and Wrangell. Four employees of the Bureau of Education of the Department of the Interior on the Seward Peninsula were appointed as cooperating deputy fur wardens. In connection with the administration of this work, excellent cooperation has been extended by the Customs Division, Bureau of Education, Department of Justice agents in Alaska, the Coast Guard Service, and the Bureau of Fisheries. In addition to the fur wardens in Alaska, a warden and two deputies are stationed in the United States—at San Francisco, Seattle, and Tacoma—to investigate illegal shipments from Alaska of furs arriving at these ports. Although the funds available are inadequate to enforce the laws for the protection of the land fur bearers of Alaska, it has been possible to exercise a restraining influence in many parts of the Territory and thus to lessen greatly the illegal taking of furs.

A serious situation now exists as to the future fur supply of Alaska through the use of poison in many remote districts and through overtrapping. These conditions prevail not only because of the small appropriation available for enforcing the fur law and regulations, but because the law is inadequate to effect its purpose. It is hoped that a new law dealing with the fur bearers may be enacted in the near future.

Six seizures of contraband furs were made—one of which was later released. These included skins of 43 beavers, 13 martens, and 1 land otter. A trapper living near the Canadian boundary line on Fortymile River was convicted and fined $100 for killing 18 martens. There are now in possession of the fur warden stationed at Fairbanks, pending final disposition by the Federal court, 714 marten and 699 beaver skins, seized at Tanana and Eagle in 1919 by a United States deputy marshal. The Bureau of Fisheries turned over to the Biological Survey the proceeds from sales of furs seized by its agents prior to July 1, 1920, but not sold until after that date, amounting to $3,820.74.

Through cooperation of the Postmaster General, postmasters in Alaska were instructed to report to this Bureau all shipments of furs made by mail, and arrangements were also made with commercial transportation companies to report fur shipments made by express and freight. The value of the furs shipped out of Alaska, reported to the bureau for the period from November 16, 1919, to December 1, 1920, amounted to $1,079,668.86, exclusive of pelts of blue and white foxes from the Pribilof Islands, which are under the exclusive jurisdiction of the Bureau of Fisheries.

While the total number of furs shipped during the period stated exceeds that of the previous year by 27,680, the value is $299,678.80 less, because of a decrease in prices. The following table shows the number of the principal pelts shipped and their value:

Kinds of furs.	Number.	Value.	Kinds of furs.	Number.	Value.
Muskrat	138,443	$276,886	Land otter	3,017	$75,425
Mink	36,115	252,805	Blue fox	569	48,365
White fox	4,943	173,005	Cross fox	937	42,165
Red fox	6,469	97,035	Silver fox	328	41,000

FUR FARMING IN ALASKA.

The bureau has supervision of the leasing of 10 islands off the coast of southern Alaska for fox-farming purposes. Originally 12 islands were transferred from the Department of Commerce, but two of these—Little Naked (Storey) and Carlson (Grafton) Islands, being situated within the boundaries of the Chugach National Forest—were, with the approval of the Secretary, turned over to the Forest Service. The 10 islands remaining under the jurisdiction of the bureau are as follows:

Name of island.	Location.	Name of island.	Location.
Aghiuk	One of the Semidi Islands.	Long	In Chiniok Bay, east of Kodiak Island.
Chirikof	Southwest of Kodiak Island.	Marmot	East of Afognak Island.
Chowiet	One of the Semidi Islands.	Middleton	Gulf of Alaska.
Elizabeth	One of the Chugach Islands.	Pearl	One of the Chugach Islands.
Little Koniuji	One of the Shumagin Group.	Simeonof	One of the Shumagin Group.

All but the last named of these islands were leased during the year for fox-farming purposes—under the plan established by the Bureau of Fisheries prior to July 1, 1920—for periods of five years to the highest bidder, at about $200 a year. Through a cooperative arrangement between the Biological Survey and the Forest Service, a uniform policy has been adopted to cover the use for fur-farming purposes of islands in the Aleutian Chain and along the southern and southeastern coast of Alaska. Under this plan the rental will be $25 a year during the first three years of occupation, and at the expiration of this period the occupant of the island will be given the option of renewal, with a revision of the amount of rent to be paid according to the value of the location, but in no case to amount to enough to be burdensome to him. It is believed that the establishment of a uniform system of permits and rental rates covering the use of Alaskan islands for fur-farming purposes will greatly assist in developing the industry. The islands vary in area from 40 acres or less to several thousand acres. Blue foxes are the principal animals farmed on all these islands, although black-fox farming is also established on some of them. The blue foxes are practically running free on the islands, but most of the black or silver foxes are kept in pens.

In the Aleutian Chain the use of islands for fox-farming purposes is being granted to natives free of charge, owing to the lack of resources and to the difficulty they have in maintaining themselves, but the regular rental is charged for occupation by others.

More than 50 islands are occupied for fur-farming purposes in the Aleutian Chain. On some of the other islands foxes have been introduced for many years and are being trapped. During the winter trapping season of 1920 and 1921 the following fox skins of various kinds were taken in the Aleutian Chain:

Red foxes	755
Cross foxes	51
Silver foxes	43
Blue foxes	414
White foxes	10
Total	1,273

A new feature of the fur-farming industry in Alaska that is being observed with much interest is the propagation of martens. Four permits have been issued to residents of southeastern Alaska to capture a limited number of these important fur bearers for the purpose of stocking the forests on some of the islands.

It is estimated that at the present time about 225 Alaskans are engaged in the fur-farming industry in the Territory, with a considerable investment of capital. The industry is rapidly growing and gives indication of becoming an important one. One drawback to its development is the fact that many islands along the southern coast lie outside the national forests and the Aleutian Islands Bird Reservation and remain unoccupied because no legal authority exists by which they may be leased. It is hoped that legislation may be enacted shortly which will render these islands similarly available. This is particularly important in view of the fact that they are of little or no value for any other purpose.

THE REINDEER INDUSTRY.

From the introduction of the first reindeer in Alaska in 1892 to June 30, 1920, although these animals had increased to far in excess of 100,000, no definite expert investigation had been made concerning the grazing conditions under which the herds were living and the distribution and supply of available forage plants upon which they were dependent for both summer and winter feed. Furthermore, no investigations had been conducted to determine the diseases and parasites of the reindeer and methods for their control, and no investigations of methods of handling the herds in order to obtain the best results.

On July 1, 1920, funds became available for the Biological Survey to take up these matters. The chief of the bureau, accompanied by two grazing experts, a competent field naturalist, and a veterinarian skilled in the study of animal parasites and diseases and their control proceeded to Alaska in July and established a well-equipped reindeer investigational laboratory at Unalakleet. This has become the headquarters for the grazing and veterinary experts throughout the year. During the year the staff at this station covered several thousand miles by dog sled and boat travel. A grazing reconnais-

sance over thousands of square miles of territory was completed and substantial progress was made in ascertaining the parasites and diseases afflicting the reindeer, with experiments to develop methods for their control.

Great advance has also been made in devising improved methods of handling the reindeer herds. It is gratifying to know that both the natives and other herd owners showed from the outset a most wide-awake interest in the work of the experiment station, giving every possible cooperation, and before the year was over the herd owners in many instances began to put into effect recommendations given by the experts for the better handling of their herds, thus recognizing the practical value of the suggestions made. One of the most promising features of the situation has been this interest shown by the natives and their willingness to accept suggestions for improved methods of handling their herds. As a result, when the investigations are completed it is anticipated that the industry as a whole will receive a great impetus which will have a far-reaching effect.

A field naturalist stationed at Fairbanks spent the year investigating the caribou of that region, particularly the migratory herds, with a view not only to the conservation and perpetuation of this important game food supply for the interior, but also for the purpose of determining the most practicable locality and method to secure large caribou bulls to be used in grading up the size and vitality of the existing reindeer herds. These herds, through bad breeding practice, in various instances have shown signs of deterioration. This investigation has been most successful in developing the desired facts.

During the coming fiscal year it is planned to publish a bulletin giving the results of the reindeer investigations, with recommendations so far as the information obtained will warrant. This should provide the needed practical information for the development of the reindeer industry. In this connection it may be stated that the investigations into the grazing resources available for reindeer indicate that Alaska should provide forage for from 3,000,000 to 4,000,000 reindeer, the annual increase of which will furnish palatable meat for use both in Alaska and in the United States in such quantity as to form one of the greatest and most substantial of the Territorial products.

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