REPORT OF THE CHIEF OF THE BUREAU OF BIOLOGICAL SURVEY

1938

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UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 29, 1938.

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

DEAR MR. SECRETARY: I present herewith the report of the Bureau of Biological Survey for the fiscal year ended June 30, 1938.

Sincerely yours,

IRA N. GABRIELSON, *Chief.*

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INTRODUCTION

THE IMPORTANCE OF LAND FOR WILDLIFE

The wildlife-restoration program of the Bureau of Biological Survey, which was materially advanced during the past year, is fundamentally one of land utilization. In carrying out this program the

Bureau takes into account the fact that the major use of land in our present economy is agricultural. At the same time it is fully cognizant of the fact that the establishment of refuges for birds and other wild animals need not interfere with agricultural development. Fortunately, through the cooperation of those concerned with land use planning, it has been possible in the Government's purchases of submarginal lands to make provision for wildlife. When some other use of acquired lands is not primary, the Survey attempts to see that wildlife restoration is recognized as either the primary or a secondary, but still important, use. Fortunately also, the public generally is coming to realize that wildlife has a definite place in the land use program. As a consequence, in many sections game species especially are benefiting by the active cooperation of owners of submarginal acreage, who, in cooperation with the Bureau, are devoting large and small areas, particularly of marshland, to the welfare of waterfowl and other native forms of wildlife dispossessed by man of their primeval homes.

Necessary farming and industrial operations have justified economic uses of certain former wildlife habitat, but, unfortunately, unwise and unsuccessful drainage has ruined many extensive submarginal lands that had greater use to man in their natural state—teeming with the wild game and fur species thereby supported—than when unsuccessfully "reclaimed" for agriculture. Many such areas have been restored to wildlife during the year.

When an area has been acquired for refuge purposes, the first concern, as a rule, is to repair the natural hydraulic system and restore the original water levels, a measure that reverses the engineering program formerly in vogue of getting water off the land as completely and as expeditiously as possible. Following restoration of water levels, efforts are made to regenerate the native vegetative cover, by transplanting or, when necessary, introducing extirpated or other suitable species. Much of the vegetation of this type does not require a highly fertile soil. Hence, land too poor to yield an agricultural crop is being utilized for wildlife, and the development is being done in large part by employing relief labor.

The restoration of wildlife habitat is being aided by two important Federal laws, and work for the management of migratory species is undertaken under a third act of Congress with a view to providing an annual harvest for human enjoyment of the game and of the health-giving recreation to be found in the wildlife domain of forest, field, and stream. These three laws were enacted in furtherance of international treaty obligations for the conservation of species that live at different seasons in various parts of this country and also either in Canada or Mexico.

One of these laws is the Migratory Bird Hunting Stamp Act of 1934. This supplements the Migratory Bird Conservation Act of 1929, authorizing the acquisition of wildlife refuges, and provides part of the funds needed in the refuge program. As prescribed by its terms, every true sportsman over 16 years of age purchases a $1 stamp, validates it with his signature, and has it in possession while he hunts migratory waterfowl. The proceeds from the sale of the stamps, totaling more than $780,000 this year, are among the funds available for financing the refuge program and are supplemented by emergency relief allotments for restoration and development.

A second law, passed this year, known as the Pittman-Robertson Act, is designed to provide Federal aid to the States in their wildlife-restoration projects by authorizing annual appropriations of amounts equal to the revenue from the 10-percent tax on arms and ammunition, which has averaged about $3,250,000 annually. For the first year's operations the 1939 Agricultural Appropriation Act included an item of $1,000,000. The funds allotted therefrom to the States will be on a cooperative basis, each participating State paying one-fourth of the total cost of restoration projects approved by the Chief of the Biological Survey, acting for the Secretary. The projects thus aided by Federal contributions of three-fourths of the total cost will be supervised by the Biological Survey during development. With the States required and encouraged to acquire and develop land for wildlife purposes, many millions of acres will be gradually added to the total area being made available for wildlife under the national refuge program.

The third act referred to is the Migratory Bird Treaty Act of 1918, under which the Survey not only conducts research as a basis for adoption by the Secretary of regulations governing seasons and methods of hunting, bag limits, and possession of migratory birds, but also proceeds with their administration through educational work and law enforcement. For many years waterfowl have been in a precarious situation. Drainage of millions of acres has deprived the birds of large areas of their natural habitat, and improved roads and better means of transportation have made them easier to hunt. The birds each fall have had to run the gantlet of increasing numbers of hunters armed with ever-improved guns, and in addition throughout the year they have to withstand natural losses from predators, disease, and drought. Of all these limiting factors the one that can be most effectively controlled is the annual kill by hunters. Although drained areas are being restored and refuges are being established and maintained where waterfowl can breed, feed, and winter in safety, the success of any wildlife-conservation program depends on the adoption and observance of proper hunting regulations. Without this there would not be a sufficient return each spring of the breeding stock to occupy the nesting grounds dedicated to them and maintain the supply for succeeding years.

Regulations governing waterfowl hunting have had to be drastic for the past few years and have been as strictly enforced as possible. The result has been a noticeable increase of waterfowl, and this year the prospects are the best the birds have had since their recent precipitous decline. Some liberalization in the regulations, therefore, has been possible, so as to distribute more equitably such hunting as can be allowed, but there is still great need for restraint in hunting and for adopting somewhat drastic regulations and enforcing them effectively. The restrictions may seem unjust to some hunters, but it is to be remembered that an adequate game-law-enforcement program is necessary if waterfowl hunting is to be perpetuated.

Plans for wildlife restoration have been developed over a period of more than half a century of research and of field observations made by technicians of the Survey's staff. Facts slowly accumulated have been so brought together that when at last the means to proceed with a restoration program were provided the essential needs were known, as well as the methods by which they could be

met. The principal need, as already stated, is for land, and the minimum requirements for waterfowl were ascertained to be about 7,500,000 acres, distributed over marsh and water areas on the nesting grounds in the North, along the migration flyways, and on the southern wintering grounds. At the end of the year about half the total area required had been obtained or was in process of acquisition. The areas making up the remainder are known and can be acquired as the means are provided.

The second need is for more intensive and comprehensive research. The new national consciousness of the need for rededicating to wildlife some of the land and water areas that man has unwisely put to other uses places a great responsibility upon the Bureau of providing factual information regarding the animals that are to be benefited and the management of their environment. Fortunately, interest in the fauna and flora of the Nation has been manifest from the earliest days of settlement, and the constantly accelerated volume of contemporary literature shows that the interest each year is becoming more intensified. Gleaning data from a mass of published works and augmenting them by the original studies made by the regular personnel of the Survey and a selected corps of volunteer cooperators is a task of the first magnitude. During the year the study of the distribution and changing status of migratory birds has progressed in a most gratifying manner, and while the activities have continued to be concentrated to a large extent on migratory waterfowl, the results obtained have been of more than ordinary importance.

The third recognized need is for a personnel trained in wildlife management. There has long been a serious lack of men qualified to administer the country's resources in migratory and resident wildlife. Through recent cooperative undertakings, however, 11 of 15 prospective units for regional wildlife research have been established through the initiative of the Bureau with cooperating organizations at selected land-grant colleges, and these will offer to graduate students courses in wildlife administration similar in purpose to those offered in forestry. As the desideratum in wildlife management is the provision of an annual surplus for human enjoyment and utilization, it is essential that hunting shall not be permitted to an extent that will endanger the breeding stocks of any game species. The wildlife administrators developed for future work will have always to keep in view the objective of preventing the extermination of any species of wildlife and the desirability of increasing the numbers of all species to the greatest extent consistent with the land-use requirements of the human population. The work of the Biological Survey during the year has been motivated by this dual purpose.

CHIEF FEATURES OF THE YEAR

The outstanding features pertaining to the Bureau's work of the year may be summarized topically as follows:

National Wildlife Week.—That wildlife may be restored for the present generation and perpetuated for posterity, the President proclaimed the week beginning March 20, 1938, as National Wildlife Week, appealing to all citizens to recognize the importance of the

problem of conservation of the wildlife assets and to work with one accord for their proper protection and preservation.

Reorganization.—Bureau reorganization included establishment of the Division of Construction and C.C.C. Operations and the Division of Predator and Rodent Control by separation from other divisions; plans for the establishment of a new Division of Federal Aid in Wildlife Restoration; consolidation of all refuge-restoration and administration work in a single Division of Wildlife Refuges; and putting 6 of the 10 regional offices in full operation.

WILDLIFE RESEARCH

Waterfowl habitat.—The discovery of adequate habitat on the west coast of Mexico for waterfowl that formerly wintered in California and of the winter quarters of many ducks and geese of the Central flyway in the Mexican part of the Laguna Madre on the Gulf coast emphasized the importance to waterfowl-restoration programs of the treaty of 1937 with the neighboring Republic.

Research centers.—Completion of the laboratory at the Wichita Mountains (Okla.) Wildlife Refuge enabled the Bureau to institute a full program of study of wildlife relationships to forest and range; and progress of a construction program on the Patuxent (Md.) Research Refuge permitted the beginnings of systematic wildlife research there.

Research reports.—An extensive monograph on the ground squirrels was published as No. 56 of the Bureau's technical series, the North American Fauna, and a comprehensive report on the ecology and management of the blue-winged teal was issued by the Iowa cooperative research unit.

Aleutian Islands survey.—A biological reconnaissance was completed of the Aleutian Islands Bird Refuge, specimens of the fauna and flora were collected, animal life filmed, and data partly prepared for publication.

Farm wildlife management.—Completion of a survey in 48 States indicates that game management as a supplementary farm enterprise has varying degrees of success, the sociological aspects at present being more important than the economic.

Mourning dove studies.—A new approach to the problem of fixing open seasons on mourning doves was developed by studying the breeding cycle to learn when the majority of the adult birds have finished breeding and when the young have attained sporting size.

Drainage in wildlife habitat.—Quarterly quadrat counts were begun on nonmicroscopic faunas in adjacent ditched and natural marshes, to determine the actual biological effects of methods now employed in mosquito-control projects; and arrangements were made whereby the Survey will pass on drainage projects submitted to the Works Progress Administration.

Fur-research equipment.—A new fur-animal field station was established for muskrat investigations at the Blackwater (Md.) Migratory Bird Refuge; and through W. P. A. cooperation a new office and laboratory building was completed for the Fur Animal Experiment Station, N. Y., and nearly 500 experimental pens were constructed there for minks and foxes.

Reproduction in minks.—Financed by Bankhead-Jones research funds a cooperative study was begun of the reproductive cycle in the mink.

Fur-farming survey.—To assemble basic statistics on fur farming, including numbers of operators and value of stock and equipment, a Nation-wide inquiry was begun by means of questionnaires.

Waterfowl-disease research.—Studies of environmental conditions favorable to the development of botulism (duck sickness) in waterfowl disclosed the character of ooze, salinity, and organic disintegration most conducive to the inception of the malady.

NATIONAL WILDLIFE REFUGES

Refuges established.—Five national wildlife refuges were acquired, aggregating 13,676 acres and ranging in size from 100 to 6,800 acres; of these 1 was by purchase, at an average price of $26.15 an acre, and 4 were reserved from public domain by Executive orders; 17 new refuges were placed under administration.

Easement refuges.—The program of waterfowl restoration by establishing easement refuges was extended to South Dakota, and now in three States 81 projects are under construction or have been completed, involving refuge areas aggregating 135,113 acres.

W. P. A. cooperation.—Works Progress Administration allotments of $1,583,686 were used for developing 73 refuges in 21 States, chiefly on waterfowl flyways.

C. C. C. development work.—The Civilian Conservation Corps camps assigned to the Bureau for development work on wildlife refuges reached a total of 35.

LEGISLATION AND REGULATION

Federal aid to States.—Shortly after the approval on September 2, 1937, of the Federal Aid to Wildlife Restoration Act, organization plans were perfected and arrangements made for passing on wildlife-restoration projects and disbursing funds to States, beginning in the next fiscal year.

Law enforcement.—Successful prosecutions of violators commercializing game and conspiring to transport pelts illegally, increased enforcement of hunting regulations, and gratifying cooperation from State agencies combined to effect greater observance of wildlife conservation laws throughout the country.

Court decisions.—Circuit courts of appeal in Illinois and California affirmed lower-court decisions sustaining the power of the Secretary of Agriculture to make regulations that do not permit taking migratory waterfowl by means of feed or bait; and the United States Supreme Court denied applications for writs of certiorari in two of these cases.

Alaskan wildlife.—An amendment of the Alaska Game Law during the closing days of the last Congress will give more adequate protection to the wildlife resources of the Territory, and to the same end the regulations of the Secretary of Agriculture thereunder were revised; more intensive enforcement of the law and the regulations has brought an increased number of violators into court.

PREDATOR AND RODENT CONTROL

Predatory animals.—Greater protection to domestic livestock and game animals and birds and lessened possibilities of the outbreak and spread of rabies resulted from the destruction of 94,040 predatory animals in cooperative campaigns.

Rodents.—For the control of economically injurious rodents, 29,204,282 acres were treated under Bureau supervision, to protect farm crops, orchards, ranges, and water-diversion systems and to assist in checking soil erosion; in the New England States cooperation in the control of orchard mice was made more effective by the development of improved methods.

Sylvatic plague.—The Bureau inaugurated more intensive work in rodent control in areas reported by the United States Public Health Service as newly discovered plague centers in Nevada, Utah, Montana, Oregon, Idaho, and Washington.

Supply depot.—Enlargement of the supply depot at Pocatello, Idaho, will facilitate predator and rodent control by providing more ample storage space for bait materials and laboratory quarters for developing improvements in control products and equipment.

Selective control.—Laboratory and field studies resulted in further selectivity in controlling harmful wildlife by giving maximum protection to beneficial and harmless species in areas being covered for the control of injurious forms.

PUBLIC INFORMATIONAL WORK

The Bureau continued to make available to the public the results of its wildlife research and the progress of the wildlife-restoration program and of experiments in the propagation of economically useful species, as well as features of conservation-law enforcement and of necessary control of injurious forms of wildlife. Among the means employed were contributions to the various series of publications of the Department, including posters; the issuance of mimeographed leaflets to supplement correspondence, references to the several numbers of which are made under appropriate headings in the following pages; and preparation of press statements, radio and other addresses, and such visual information as motion pictures and exhibits. Through members of the technical staff the Bureau has been represented during the year at gatherings of scientists and educators, conservationists, sportsmen, wildlife managers, fur farmers, stockmen, and others interested in the protection, propagation, utilization, and control of the Nation's resources in wildlife and has thus had opportunity to present in detail to special groups much of the information summarized in this report. The first 99 issues of the mimeographed Wildlife Research and Management Leaflets were summarized in Leaflet BS–100.

FUNDS AVAILABLE

From regular and emergency appropriations a total of approximately $6,300,000 was available for the work of the Survey for the year. Of this sum, $2,002,840 was carried in the Agricultural Appropriation Act for regular activities; an estimated total of $780,000 has been collected from sales of Federal migratory-bird hunting stamps; and $19,700 was allocated to the Bureau from the Bankhead-Jones special research fund for an economic study of wildlife as a supplementary farm enterprise and for investigations of the reproductive cycle of the mink, silver fox, and muskrat. There was allocated from the Emergency Relief Appropriation Act of 1937, $1,583,646 to conserve water and wildlife, to check floods and erosion, to increase fur production, to provide stable water supplies, and to establish Federal waterfowl refuges in 22 States, and $45,300 was allocated for resulting administrative expenses. For expenditures in connection with work performed by the C. C. C. on national wildlife refuges, a total of $1,873,631 was made available to the Bureau.

ORGANIZATION

Effective February 1, further reorganization within the Bureau replaced the former Division of Migratory Waterfowl by the Division of Wildlife Refuges, in which are consolidated the administration of both bird refuges and big-game preserves; established the Division of Construction and C. C. C. Operations; and separated one unit from the Division of Game Management as the Division of Predator and Rodent Control. The change better coordinates related activities and provides competent individual administration for each natural unit of the work, and thus makes for increased efficiency. Arrangements were completed for the establishment of a Division of Federal Aid in Wildlife Restoration with the beginning of the new fiscal year to conduct the work authorized by the Pittman-Robertson Act.

At the close of the year there were in full operation 6 of the 10 regions into which the United States, including Alaska, has been divided for the purpose of decentralizing administration of field functions other than those involving wildlife research, land acquisition, and inspection of importations of foreign wild animals.

The present divisional and regional organization and the officers in charge are as follows:

Chief of Bureau	Ira N. Gabrielson
Associate Chief	W. C. Henderson
Division of Administration	W. R. Dillon
Division of Public Relations	H. P. Sheldon
Division of Wildlife Research	W. B. Bell
Division of Federal Aid in Wildlife Restoration [1]	A. M. Day
Division of Land Acquisition	Rudolph Dieffenbach
Division of Wildlife Refuges	J. C. Salyer, II
Division of Construction and C.C.C. Operations	H. W. Terhune
Division of Game Management	W. E. Crouch
Division of Predator and Rodent Control	Stanley P. Young
Regional organization (with directors and headquarters):	
Region 1 (Pacific), Portland, Oreg	Wm. M. Rush
Region 2 (Mountain), Denver, Colo	Leo L. Laythe
Region 3 (Southwestern), Albuquerque, N. Mex	Donald A. Gilchrist
Region 4 (West Central), Des Moines, Iowa	George Tonkin
Region 5 (Southern), New Orleans, La	Roy Moore
Region 6 (East Central), Milwaukee, Wis	Daniel H. Janzen
Region 7 (Southeastern), Atlanta, Ga	James Silver
Region 8 (Northeastern), Boston, Mass	S. B. Locke
Region 9 (Plains), Omaha, Nebr	Burnie Maurek
Region 10 (Alaska), Juneau, Alaska	Frank Dufresne

VETERAN RETIREMENTS

Automatic retirements of veteran workers were three in number, all from the Washington office and all on March 31, as follows: Jane S. Elliott, draftsman, after 27 years' service, all with the Bureau; Mary P. DeKnight, stenographer, after more than 20 years' service, the last 18 years with the Survey and earlier service with the War Department and the Forest Service; and Rosa E. J. Koch, file clerk, also after more than 20 years' service, nearly 14 of which were with the Bureau, following 7 years with the Treasury Department.

RESEARCH ON WILDLIFE STATUS AND MANAGEMENT

THE WATERFOWL SITUATION

INVESTIGATIONS IN CANADA

Under the leadership of the four flyway biologists of the Survey, parties were again this year sent to the waterfowl breeding grounds in Canada. Their reports are thrilling accounts of scientific exploration. The party on the Pacific flyway, the two on the Central, and that on the Mississippi flyway found that thousands of square miles of the great marshes of northern Canada are in excellent condition for waterfowl, and that, though these areas are still greatly underpopulated, there was a small but marked increase in the numbers of nesting birds over those observed in 1936. The party on the Atlantic flyway reported a definite increase in black ducks and Canada geese. At the close of the fiscal year, after investigations in the Southern States and Mexico, the

[1] Effective July 1, 1938.

four flyway biologists were again on the breeding grounds in Canada and Alaska.

In the Pacific flyway investigations were concentrated in British Columbia, which probably has never produced waterfowl in numbers comparable with areas of similar size in the Prairie Provinces. Nevertheless, this Province does make a notable contribution to the continental stock of birds. The breeding grounds there have not been materially affected either by climatic conditions or agricultural activities, the principal adverse factor being overshooting, as it is also in the Pacific Coast States. In British Columbia the survey investigators found the nesting habitat in good condition and the aggregate waterfowl population somewhat greater than in 1936.

In Canada the Central and Mississippi flyways converge and overlap, so they may be considered together. In the great central breeding grounds three parties took the field. The westernmost, operating in Alberta and western Saskatchewan, northward to Lake Athabaska, and west to Fort St. John, British Columbia, found little if any improvement over conditions of the preceding year. Drought throughout the southern half of Alberta and Saskatchewan was much worse than in 1936 and made great inroads also into the bush country. Fortunately, most of the parched area was dry or nearly so at the time of the spring migration and thus did not induce the waterfowl to begin nesting, as they sometimes do, only to lose their broods when the shallow waters later dry up. That this formerly valuable part of the breeding grounds may be permanently lost to the birds is indicated by the fact that the areas devoted to the four major cereal crops of Alberta alone (wheat, oats, barley, and rye) increased from about 600,000 acres in 1906 to more than 16,000,000 acres in 1935. Any water that may become available will undoubtedly have to be used to aid this greatly increased agricultural production.

The western party also investigated waterfowl botulism, which appeared on several small sloughs, and the seeming destruction of birds by leeches, which are abundant in some of the lakes. Studies of the common loon, a species that has been accused of destroying young waterfowl, indicate that it seldom if ever molests ducklings. It was rather surprising also to learn that little or no damage to young ducks is chargeable to the pike, or jackfish, so abundant in northern waters. It was found that some damage was done to birds by fires and also by Indians and their dogs.

The party working in eastern Saskatchewan and Manitoba found the situation much more satisfactory there than farther west, although unfavorable conditions were not lacking. High winds in Manitoba during the first week in June so raised the waters of the Netley and Delta marshes and at the south end of Lake Winnipegosis as to destroy large numbers of nests. The birds, however, nested again, and their second sets of eggs, while somewhat smaller, were successfully hatched. This party worked north in Manitoba to The Pas area and in Saskatchewan to Regina. Its general conclusion was that there should be a slightly increased crop of most species of ducks.

The biologist of the Mississippi flyway again began work in the delta of the Athabaska River and pushing northward along the Mackenzie by way of Great Slave Lake, Great Bear Lake, and the Barren Grounds south of Coronation Gulf, finally established summer headquarters at the Eskimo village of Aklavik in the Mackenzie delta. The spring break-up on the Mackenzie was followed by one of the worst floods in the history of the district, with water levels as much as 15 feet above normal. All nests then built were lost, and because of the shortness of the season the percentage of birds able to renest was small. A gratifying increase in waterfowl was noted in the Athabaska delta, a feature of particular satisfaction being the greater number of canvasbacks observed.

In the Atlantic flyway work was concentrated in the Maritime Provinces of Nova Scotia and New Brunswick. There, besides noting a definite increase in the numbers of black ducks and Canada geese, an important discovery was made of the presence of many breeding ring-necked ducks, heretofore considered as confined during the nesting season chiefly to the northern prairies.

Through the cooperation of the Newfoundland Government an aerial reconnaissance was made in that Colony as a basis for future work. The round trip extended about 400 miles within the island, affording an excellent idea of the waterfowl habitat, some of which looked promising but about which little is at present known, as it is remote from highways and railways. The black duck

seemed to be increasing slowly there, and the Canada goose is maintaining its numbers satisfactorily.

Returning to the United States late in June the Atlantic flyway biologist joined the MacMillan Arctic Expedition and accompanied it to northern Labrador and Baffin Island.

INVESTIGATIONS IN MEXICO

In western Mexico the biologist of the Pacific flyway conducted investigations as far south as Lakes Chapala, Patzcuaro, and Cuitzeo, covering the Valley of Mexico and all important areas west of the mountains. A mixed river, lagoon, and saline marsh area extends from Mazatlan to San Blas, a distance of 100 airline miles, and in this district the irrigation projects in the Yaqui, Mayo, Fuerte, Sinaloa, and Culiacan River Valleys form a most valuable wintering ground for migratory waterfowl, including Canada and white-fronted geese, as well as sand-hill cranes. In one section was observed a tremendous concentration of waterfowl, estimated at not less than 250,000 birds. The birds formed a continuous flock over a distance of 3 miles. In other sections estimates of 5,000 and 10,000 birds were commonly made. These facts demonstrate that the important wintering ground of the Pacific flyway is in western Mexico, rather than in California. While this had been surmised, it nevertheless is a satisfaction to know just where these birds have their winter quarters and that conditions are so favorable for them in our neighboring republic.

In eastern Mexico the biologist of the Central flyway worked as far south as Mexico City, but devoted most of his attention to the States of Vera Cruz and Tamaulipas, particularly to the Laguna Madre and other coastal waters south to Tampico. Early in February he made an aerial reconnaissance covering approximately 1,000 miles from Matamoros south to the Tamiahua Lagoon, in the State of Vera Cruz, flying almost the entire distance at the dangerously low altitude of 100 feet or even less. As most of that section is virtually inaccessible from the ground and its value to wintering waterfowl has only been surmised, his observations are particularly valuable. He estimated the waterfowl population of the area at 2,120,000, the list of birds being headed by the pintail, which outnumbered any other species 2 to 1. In the northern part of the Laguna Madre he saw a raft of about 129,000 redheads, the largest concentration of this species reported at any time during the season.

From this work it likewise appears that the principal wintering ground for the Central flyway is along the east coast of Mexico. Discovery of the great importance of wintering grounds in Mexico to the Central and Pacific flyways emphasizes the importance of conservation cooperation with that country.

INVESTIGATIONS IN THE UNITED STATES

The spring and fall migrations of the calendar year 1937 and the spring migration of 1938 were fully reported upon by a corps of carefully selected volunteer cooperators, who now number 522. These represent every State except Alabama and West Virginia, and their reports serve as a valuable supplement to the investigations of the official personnel.

During the winter of 1937–38 the biologists of the Mississippi and Atlantic flyways studied the concentration areas of the lower Mississippi Valley and the South Atlantic coast. All the evidence obtained indicated a substantial increase in the ducks and geese of these two flyways; in fact, the result of all investigations showed conditions in these flyways to be much better than in the Central and Pacific regions.

During the migration, nesting, and winter seasons reports were received regularly from officials in charge of Federal refuges, and these were carefully analyzed and collated with other reports.

The January inventory is the culmination of the Biological Survey's efforts to ascertain the numerical status of North American ducks, geese, and swans. Each year since 1934, when this investigation was inaugurated, the territory covered has been enlarged, but the coverage of all waterfowl wintering grounds is still far from complete. Inaccessible habitat and difficult terrain naturally make the survey less complete in some areas than in others, but the results, which are used for comparative purposes, have fully justified the efforts and funds expended.

The entire field personnel of the Bureau under nine regional directors participated, and this force was augmented by officers of the Forest Service, Soil Conservation Service, National Park Service, Naval Air Service, and the Coast Guard, and by cooperating State and county game and police officers, municipal officers, State forestry officers, assistants from State universities and colleges, superintendents and caretakers of gun clubs, and others. The Survey's fleet of patrol boats was reinforced by similar craft belonging to the State game departments, the Coast Guard, and other agencies. Special emphasis was again placed upon aerial coverage, and available aircraft included seaplanes, amphibians, autogiros, and dirigibles supplied by the Naval Air Service, the Coast Guard, a commercial tire and rubber company, and private citizens. Practically all areas along the Atlantic and Gulf coasts were surveyed from the air, some sections being covered by two or more observers as well as being checked by land or water. While exact figures are not available, it is believed that the total personnel participating exceeded 2,000.

As a result of this Nation-wide survey, and considering the numbers of ducks and geese known to be wintering in Alaska, Canada, Mexico, the West Indies, and other areas outside the United States, as well as those in parts of this country that could not be completely covered or were not covered at all, it is estimated that the continental waterfowl population is still less than 50,000,000. This year's statement on the waterfowl situation was contained in a leaflet (BS–111, mimeographed) issued in April. These annual statements have proved most useful in demonstrating to sportsmen and conservationists that the Biological Survey has essential data as a basis for prescribing regulations for taking ducks and geese.

BANDING GAME AND OTHER BIRDS

COOPERATORS

Physical limitations in handling the great mass of detailed bird-banding records, which must be maintained with a high degree of accuracy, make it necessary to decline many offers of cooperation. There has, however, been a slight increase in the number of stations—2,193 as against 2,129 a year ago. Of these, 110 are devoted to banding migratory waterfowl, 30 being located on Federal refuges. During the year a number of stations have each reported the banding of more than 5,000 birds. The cooperator heading the list banded 27,076, most of which were migratory waterfowl. Next on the list are two Survey men, one of whom banded 16,551 birds, and the other 7,436, most of which were tricolored redwings.

NEW BIRDS BANDED

The grand total of new birds banded and reported during the year is 346,056, an increase of more than 45,000 over the previous year. The number of bands purchased during the year was 565,000.

The birds banded represent 431 species, of which 16 are species (a few not native to the North American Continent) on which Biological Survey bands had never before been placed, as follows: Noddy tern, Laysan albatross, Pacific fulmar, wedge-tailed shearwater, Bulwer's petrel, blue-faced booby, Egyptian goose, masked bobwhite, white-crowned pigeon, ringed turtle dove, Harris's hawk, Sennett's white-tailed hawk, smooth-billed ani, golden-fronted woodpecker, black-whiskered vireo, and Lucy's warbler. This is a rather remarkable record, considering that such a large proportion of North American species have already been marked with bands.

The list of banded birds is again headed by the chimney swift, with 25,607, followed by the herring gull, with 18,805; the white-throated sparrow, 17,026; the pintail, 16,360; the junco, 14,701; and the mallard, with 13,587. More than 5,000 mourning doves were banded, and among the more unusual species of waterfowl marked were 280 blue geese and 9 immature black brant. These last were banded in the Mackenzie delta by the Mississippi flyway biologist, who also obtained excellent motion pictures of the operation, this probably being the first time that young black brant have ever been so photographed. The numbers of the different species of waterfowl banded during the fiscal years 1937 and 1938 are shown in table 1.

TABLE 1.—*Waterfowl banded during the fiscal years 1937 and 1938*

Species	1937	1938	Species	1937	1938
	Number	*Number*		*Number*	*Number*
American merganser	7	6	Greater scaup	66	165
Red-breasted merganser	10	15	Lesser scaup:		
Hooded merganser	7	9	Wild	919	5,295
Mallard:			Hand-reared	50	
Wild	14,319	11,519	Ring-necked duck	951	2,057
Hand-reared	1,434	2,068	Goldeneye	3	3
Black, cross		8	Bufflehead	43	29
Black duck:			Old squaw		7
Wild	3,613	6,319	American eider		4
Hand-reared	1,279	1,029	Pacific eider	2	
Florida duck	44	159	American scoter		2
Gadwall	[1] 738	694	White-winged scoter		4
European wigeon		5	Surf scoter		1
Baldpate	1,426	1,379	Ruddy duck	36	83
Green-winged teal	4,803	8,372	Snow goose	9	34
Blue-winged teal	4,740	5,353	Blue goose	96	280
Cinnamon teal	183	420	Ross's goose		3
Shoveler	349	495	White-fronted goose	1	39
Pintail:			Canada goose:		
Wild	11,248	16,060	Wild	386	458
Hand-reared	519	300	Hand-reared		15
Wood duck:			Black brant		9
Wild	458	405	Egyptian goose		1
Hand-reared	430	188	Fulvous tree-duck	[1] 7	15
Redhead:			Whistling swan		5
Wild	817	2,083			
Hand-reared	110	100	Total	49,329	66,235
Canvasback:					
Wild	185	644			
Hand-reared	41	96			

[1] Correction of figures printed in report for 1937.

RETURNS AND RECOVERIES

During the year there were reported 22,950 banded birds recovered either at the station where they were banded or elsewhere. This is an increase of about 5,000 over the previous year. Neither these record cards nor those received during the fiscal year 1937, in all, about 40,000, have yet been coded, punched, and distributed in the files, but it is planned to have this work done early in the ensuing year under a W. P. A. project.

The reports have included many of unusual interest either involving a new locality for a species or representing an unusual migration. At the close of the year an analysis was in progress of the migratory-waterfowl records received and punched since like data were analyzed in 1934. As these include data received during drought years, it is anticipated that interesting deductions will be possible as to the eastward and westward trends of waterfowl from the Central flyway.

For the first time, so far as known, colored bands were used this year on a large scale in studying bird migration, 5,000 herring gulls having been marked with brightly colored bands of red, blue, yellow, or black, supplied by the Survey to the Linnaean Society of New York, the National Association of Audubon Societies, and the Northeastern Bird Banding Association, in furthering a cooperative study. Young birds not yet able to fly were banded at 10 key stations along the Atlantic coast from Labrador to New York, each station having its own color combination. Protected under the Migratory Bird Treaty Act, herring gulls have greatly increased in numbers. Those that breed commonly along the coast from New England to Labrador winter farther south, to the Gulf of Mexico. Information on their fall and winter distribution, however, is rather limited and data obtained in recent years have been based largely on gulls marked with the Survey's aluminum bands. This information has been slow to accumulate because in most cases the recovery of bands had to await the death or injury of the gulls. Use of colored bands in obtaining "sight recoveries" is expected to speed up tracing the first-season movements of birds. During the year approximately 180 of these "sight returns" were reported from the vicinity of New York harbor.

One number of Bird Banding Notes was mimeographed in December and included the annual summary of banding work and other items useful to operators of banding stations.

RECORDS OF BIRD DISTRIBUTION

Data pertaining to the distribution and migration of birds continue to be added to the files. This year, these included 51,000 data cards, more than 1,700 locality cards, and 1,000 bibliography cards.

The number of migration observers is now 403. While it is not desirable indefinitely to increase their number, a few cooperators desirably located and able to contribute worth-while information have been added. A summary of their reports on the spring migration of 1937 was issued as Bird Migration Memorandum No. 3.

During the year distribution maps have been remade of four families—the cuckoos, kingfishers, woodpeckers, and parrots. The maps for the woodpeckers serve as a basis for the distribution and migration sections in a report on this family prepared for publication by the United States National Museum in its series of bulletins on Life Histories of North American Birds.

The series of maps showing the original and present breeding ranges of important game birds as well of game and fur mammals is now being corrected with a view to publication.

STUDIES OF WILDLIFE IN RELATION TO FORESTS AND RANGES

Studies of the animal factor in relation to pine reproduction at the California Forest and Range Experiment Station, at Berkeley, showed that the possibilities of success are best when reseeding closely follows a burn, a time when the rodent populations are at a low ebb. Experiments demonstrated that hastening germination by stratification may be of value in shortening the time the seeds are exposed to field mice and birds. Damage by rabbits to pine plantations continued to be a serious problem in northern California brush fields. Spraying nursery seedlings with strychnine-resylchloroform was somewhat successful in reducing clipping damage. Research on rodents of the range, including predation in relation to abundance, census methods, and the effects on range production, composition, and density, has been undertaken at the San Joaquin Experimental Range. In cooperation with the Forest Service, the study of predator-prey relationships on the Los Padres National Forest, Calif., yielded data also on wildlife populations and daily activities. The year's results on cooperative valley quail management have been prepared for publication by the State of California.

At the Pacific Northwest Forest Experiment Station, Portland, Oreg., studies of forest regeneration indicated that the present practice of slash burning following logging in the Douglas fir region, unless done lightly, removes sufficient seeds and second growth to restrict reproduction of the desired trees and that the success of subsequent planting or seeding is thwarted largely by rodents. On the other hand, intermittent second growth favors deer, grouse, and other game species, which react favorably to the openings created. Range studies in eastern Oregon on fenced plots from which pocket gophers were removed showed a gradual return to original forage conditions. Moderate grazing removed considerable surface vegetation, thus discouraging meadow mice, which destroy the crowns and roots of forage plants.

Research on white-tailed deer at the Lake States Forest Experiment Station, St. Paul, Minn., proved that the carrying capacity of winter ranges is rapidly declining and that the browse species now available do not have maximum nutritive value. Through overabundance locally, deer severely damage pine reproduction. Studies of beaver foraging yielded data showing that about 64 percent of the total food available in cut aspens was wasted. Tables have been prepared for publication that will enable wildlife managers, foresters, and others to estimate the quantity of food that can be expected from given stands of aspen available to beavers. In the same region work has been begun on the animal factor in coniferous reproduction, on management of sharp-tailed and pinnated grouse in the sand dunes of North Dakota, and on the value of coniferous cover plantings in burned areas to assist in breaking up heavy winter concentrations of deer.

At the Northeast Forest Experiment Station, New Haven, Conn., a detailed study of the values of native trees in wildlife management has been completed. A preliminary report on identification of animal damage to forest trees has been prepared as a practical aid to foresters. Observations on the Pillsbury State Reservation, N. H., show the use made by wildlife of artificial forest openings, food plantings, and specially manipulated cover.

Research at the Harrison branch, Southern Forest Experiment Station, near Gulfport, Miss., revealed a great consumption of the mast of longleaf pine in good seed years, and little damage in off years. Experiments are now under way to determine how much artificial seeding can be done without attracting undue numbers of birds. Before practical use can be made of this information, the best season for planting must be determined as well as means of hastening germination, so as to lessen the time of seed exposure.

Through cooperation with the Forest Service, experienced biologists, who have assisted in correlating forest-development programs with wildlife requirements, have visited national forests in the Lake States, Northeast, Appalachian, Southeast, Gulf States, and Mississippi Valley regions. This has resulted in better balanced programs, especially those proposed where silvicultural practices, road and recreational development, grazing, and other forest uses might have interfered with the desirable wildlife populations.

In the Rocky Mountain and Pacific Northwest regions field work has dealt with the ecology of fur animals, development of satisfactory wildlife-census methods in forest areas, determining breeding and feeding habits, and working out territorial requirements and yield data as important considerations in the management of fur species.

BIOLOGICAL INVESTIGATIONS ON WILDLIFE REFUGES

A complete grazing survey was made of big-game animals and long-horned cattle on the Wichita Mountains Wildlife Refuge, Okla., and the results will be used as a guide in regulating their numbers and distribution. Studies on wild turkey nesting showed that about 38 percent of the nests were successful. Two resident research men have been assigned to this refuge, and an extensive program is under way, including big-game range studies, preparation of a cover-type map, and collection of birds, mammals, reptiles, insects, and plants for laboratory study. Specific problems being investigated include life histories of wild turkeys, quails, prairie chickens, fox squirrels, and rabbits, predator relationships, and the biology of reptiles. A general wildlife survey also is being made of the refuge.

Development of the Patuxent Research Refuge, Md., has included the construction of a laboratory and a stock barn, remodeling of Snowden Hall as a headquarters building, repair of an old residence, and completion of the Cash Creek Dam. Since December 1937, 200 W. P. A. laborers and a C. C. C. side camp have greatly aided the development program. Little research will be undertaken until the construction work is completed.

At the Bear River Refuge, Utah, data were assembled for publication on an intensive waterfowl nesting study, work was completed on the development of census methods for adult and nesting waterfowl, and much information recorded on waterfowl sex ratios, on the life history of muskrats, and on migrations.

WILDLIFE-MANAGEMENT RESEARCH

COOPERATIVE RESEARCH UNITS

To extend research in wildlife management, 2 new units were organized this year, one in Missouri, the other in Pennsylvania, bringing the total number of units working chiefly in cooperation with land-grant colleges, State game departments, and the American Wildlife Institute to 11 (tables 2 and 3). The results in 3 years have included the assembling of many data of practical application for game administrators. The program includes specialized training of advanced students in the wildlife field and provides for demonstrations of the best management practices.

TABLE 2.—*Wildlife research and demonstration units cooperating with the Biological Survey, the areas involved, and the animal life studied*

Research units and headquarters	Trial demonstration areas		Areas involved in research		Major game species studied
	Number	Size	Size	Area in private lands	
		Acres	*Acres*	*Percent*	
Alabama (Polytechnic Institute, Auburn).	2	1,500	75,000	100	Mourning dove, deer, turkey, quail.
Connecticut (State College, Storrs).	2	6,200	6,200	90	Rabbit, pheasant, grouse.
Iowa (State College of Agriculture and Mechanic Arts, Ames).	2	11,460	19,960	100	Pheasant, quail, waterfowl.
Maine (State University, Orono)	2	6,400	27,480	20	Woodcock, grouse, heaver, deer, moose, waterfowl.
Missouri (State University, Columbia).	4	24,785	112,815	51	Deer, rahbit, wild turkey, quail, chukar partridge.
Ohio (State University, Columhus).	4	12,100	51,000	18	Deer, pheasant, waterfowl, squirrel, rahbit, raccoon.
Oregon (State Agricultural College, Corvallis).	2	20,000	1,820,000	10	Antelope, deer, grouse, pheasant, heaver.
Pennsylvania (State College, State College).	3	6,620	6,620	10	Deer, hear, pheasant, wild turkey.
Texas (Agricultural and Mechanical College, College Station).	15	100,000	2,921,760	95	Quail, wild turkey, prairie chicken, squirrel, deer.
Utah (State Agricultural College, Logan).	2	115,500	732,000	25	Deer, heaver, sage and sharptailed grouse, waterfowl.
Virginia (Polytechnic Institute, Blackshurg).	4	51,000	51,000	14	Quail, wild turkey, deer, grouse.
Total	42	355,565	5,823,835		

TABLE 3.—*Personnel engaged in research, demonstration, and training in cooperation between the Bureau of Biological Survey, land-grant colleges, State game commissions, and the American Wildlife Institute*

Research unit	Whole- or part-time workers	Graduate students	Students receiving advanced degrees, 1938	Enrolled undergraduates in wildlife management	Projects under way	Phases of research projects completed, 1938
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Alahama	10	4	1	0	7	2
Connecticut	6	2	1	14	4	3
Iowa	14	7	0	10	12	1
Maine	18	6	3	19	11	3
Missouri[1]	18	4	0	25	10	0
Ohio	25	5	3	35	9	3
Oregon[1]	25	4	2	157	11	2
Pennsylvania[1]	6	0	0	0	8	0
Texas	14	5	2	69	6	2
Utah[1]	14	4	1	53	7	1
Virginia[1]	16	7	2	50	14	4
Total	166	48	15	432	99	21

[1] Additional cooperation with the Forest Service.

A summary statement was mimeographed during the year (Leaflet BS–98), entitled "Colleges and Universities Offering Courses in Wildlife Management, 1937–38," with a list of all graduate and undergraduate wildlife courses offered by one or more colleges for preparing students for research, administration, and management. "The Status of Wildlife Research: 1937" was the title of another leaflet (BS–104) in the series, issued in February. To aid cooperators and others who are planning for wildlife management, an outline leaflet on this subject (BS–107) was issued in March.

Life history and management of the mourning dove continued to be the major project of the Alabama research unit. Records of the movements of some 1,800 banded birds and of the food contained in 1,083 stomachs have greatly augmented information valuable for the management of the species as regards breeding, nesting, growth, food habits, and migrations. Two reports of progress have been completed. In seven farming localities in the State, 510 experimental quail-food plots were planted, and data from these have been assembled on preferable planting dates, time of seed ripening, diseases and pests, rate of yield, time of shattering, and length of time that seed was available. More than 1,900 quail stomachs were collected for analysis. The importance of native deer foods was determined seasonally by examination of 194 stomachs and by observations on feeding and studies of browse plants. The relationship of foxes to quail was investigated by a study of the food in 70 fox stomachs and observations on the debris around 26 dens, with no indication so far that the fox is harmful to quail. A waterfowl food survey was made in the 5,000-acre Gulf Shores State Park.

The principal project at the Connecticut research unit was the life history and management of the cottontail rabbit. Home and seasonal ranges, growth, and food and cover preferences were subjects of research. Examination of more than 400 rabbits revealed the occurrence of two subspecies. The statistical study was completed as a basis for predicting population trends.

The major accomplishment at the Iowa research unit was the development of census methods for ring-necked pheasants and quail. A report on the ecology and management of the blue-winged teal was published in book form by the State. Progress has been made on studies of quail and pheasant management, nesting of diving ducks, management of muskrats, skunks, rabbits, raccoons, and mourning doves, and on mortality factors.

At the Maine research unit, through stomach examination of 59 woodcocks, it was found that earthworms comprised 87.4 percent of the diet. Of 143 birds dissected, 63 harbored endoparasites. Eighteen nests were located and 78 young banded. About two-thirds of the artificial singing grounds were used. Experiments with beavers in pens resulted in loss of weight and finally death from malnutrition, even though the animals were given plenty of natural foods. Research on Anasagunticook Lake was completed and definite plans for wildlife management recommended. Ten moose were examined for evidences of disease.

While work at the Missouri research unit began only this year, definite progress was made in studies on the chukar partridge, wild turkey, and quail, and on rabbit and deer management.

An intensive survey of pheasant management areas in northern Ohio has been nearly completed as part of the cooperative program of the Ohio research unit. The study has disclosed reasons for the high production of pheasants locally and for the success of the farmer-sportsmen associations. A report on investigations of parasites of gray and fox squirrels has been submitted. On Pymatuning Lake 357 waterfowl were banded to get information needed for managing the area. Management studies continue on fox and gray squirrels, deer, and raccoons.

At the Oregon research unit completion of a study of big-game sex and increase ratios revealed only slight unbalance in the huntable species. Possible beaver restocking areas of the State were mapped. A manuscript was prepared on investigations of small-game problems in the Willamette Valley. The antelope survey resulted in the game commission declaring a limited open season. Close observations on the 3,000-acre management area near Dallas showed upland bird population increases due to the changing of farm-crop rotations. As the results of field studies, recommendations were made for the reduction of deer herds in critical areas, regardless of sex, and for the provision of better areas for upland bird encouragement.

Due to findings of the Texas research unit, the season on Attwater's prairie chicken has been closed and steps taken to encourage natural increase. The outlook is also favorable for better quail management in Texas as a result of facts developed by research. Conditions necessary for gray and fox squirrel conservation have been determined. Five counties are involved in wildlife-research projects, almost 3,000,000 acres have been surveyed, and the work in Walker County has been completed. The major factors hindering quail production that are subject to control by man were found to be heavy hunting, overgrazing and undergrazing, maintenance of climax stands of pine, and early cropping practices that damage winter range. Through development of a satisfactory census method, Attwater's prairie chicken was estimated to include about 8,700 birds in Texas, occupying nearly 10 percent of the former range. A bulletin is being prepared

on prairie chicken management, recommending a 5-year close season as adopted recently by the State Game, Fish, and Oyster Commission. Progress has been made on studying wildlife-vegetative relationships.

At the Utah research unit particular attention has been given to problems confronting the State Game Department. Projects relate to the mule deer, sage grouse, sharp-tailed grouse, beavers, waterfowl-food resources, and wildlife diseases. Part of the sage grouse life-history and management study has been completed, but research on the effects of sheep on nesting mortality is still in progress. The beaver's role in soil and water conservation and the controversial beaver-trout relationship are being studied. Experimental work on deer-census methods, rate of increase, food preferences, conflicts in livestock-deer relationships, sex ratios, winter losses, migrations, and hunting removal has yielded considerable data for the management of this important game species.

The principal project at the Virginia research unit is the life history and management of the eastern wild turkey. Practical rearing technique has been worked out, and quantity production has been undertaken by the Virginia Commission of Game and Inland Fisheries. A wildlife-management plan has been completed for the Mountain Lakes demonstration area. Winter food habits of bobwhite quail have been determined through the examination of 559 stomachs. Food habits at other seasons are being learned from analysis of 249 other stomachs. Fifty-two wild turkeys were liberated on the North River demonstration area, George Washington National Forest, where studies to determine their wildness and survival are under way. Eighty-six deer were stocked in western Virginia counties and their progress studied. On the Blacksburg quail-demonstration area 55 food patches were established and their availability and utilization determined. Mass plantings were made of cover plants and shrubs adapted to pastures and wood lots. Progress was made on a survey of native plants of the State to determine potential wildlife food and cover resources. Studies are being continued on beavers, methods of crow control, and development of a nonpoisonous lead-alloy shot.

WILDLIFE EXTENSION WORK

In cooperation with the extension services of the various States, and as part of the cooperative research units' program, wildlife extension work was carried on in a number of States. This was summarized in a mimeographed leaflet (BS–106), Report on Extension Work in Wildlife Conservation to December 1937, issued by the Survey in March. Activities included the organization of game-management areas in farming districts, as in Texas, where 4,400 individuals banded together to establish 262 management areas, comprising 4,709,000 acres, on which 110 management associations were formed. In Texas, 138 counties have placed wildlife management in their extension programs for 1939.

In Iowa the wildlife program included holding 20 training camps for 4–H Club members and giving 25 radio talks, lectures, and demonstrations.

At the various research units attention was given to preparing publications of use to persons desiring to cooperate in wildlife conservation. 4–H Club conservation schools were held in several States. Radio programs, press releases, bulletins, and talks before farmers' organizations and civic groups were given in various States, supplementing the work done from the Washington office. The Biological Survey cooperated with the Extension Service in issuing a Miscellaneous Publication (No. 291) in March entitled "Teaching Conservation of Wildlife through 4–H Clubs." A leaflet (BS–108) entitled "History and Significance of American Wildlife" was issued for educational purposes, chiefly for use in schools.

WILDLIFE AS A SOURCE OF FARM INCOME

Investigations begun in May 1936, in cooperation with the Bureau of Agricultural Economics, on wildlife as a source of supplemental income on farm lands, were completed June 30. Through conferences and with the assistance of agricultural experiment station directors, farm-management specialists, county agents, foresters, and members of State conservation departments and planning boards, a good picture of prevailing conditions was obtained in all the States.

Following the reconnaissance survey last year, detailed studies were made of existing game-management areas on farms in Ohio, Iowa, Michigan, and Texas.

The results indicate that such areas, exceedingly variable in organization and administration, have been established on farm lands with varying degrees of success and that success depends largely upon the circumstances and personal interests under which they were instituted and operated. A report is being prepared for publication on the economics and social returns from farm wildlife.

STATE BIOLOGICAL SURVEYS AND FAUNAL REPORTS

Field studies on the mammals of Arizona and Florida have been completed, and reports on them are in preparation for issuance in the North American Fauna series. An extensive monograph was published as No. 56 of this series under the title "Revision of the North American Ground Squirrels, with a Classification of the North American Sciuridae." Work has progressed on the classification of the red squirrels (*Tamiasciurus*) and should be ready for publication in another year. A cooperative publication on the birds of Louisiana is now in press. Material on the birds of Texas will be assembled for a two-volume book for cooperative publication early next year. The work on the birds of Georgia requires about 2 months more of field work for completion.

REFERENCE COLLECTIONS AND RECORDS

The Bureau's reference collection of birds, mammals, and other vertebrates has been used as a basis for reports on classification, life histories, habits, and distribution. During the year, 1,232 mammal specimens were added to the collection, 553 were identified for 34 institutions and individuals in 26 States and 1 foreign country, and 261 were borrowed for study from 8 institutions, and 685 bird specimens were added to the collection, 1,735 were borrowed from 66 institutions, representing 29 States and Canada, and 392 were lent to 15 institutions in 15 States.

Scientists of the Bureau described 1 new bird of the genus *Penthestes;* 21 new mammals in the genera *Citellus, Cratogeomys, Dipodomys, Eutamias, Heterogeomys, Neotoma, Nyctomys, Peromyscus,* and *Thomomys;* and 2 new subgenera, *Poliocitellus* and *Notocitellus.*

The total number of mammal type specimens is now 1,253; a manuscript will be prepared for the North American Fauna series giving a list of them. The Bureau's mammal laboratory was used by 65 research workers from 19 States and 3 foreign countries. The aid of W. P. A. projects expedited the work of cleaning, rearranging, and bringing the mammal collection to date and of detailed cataloging and assembling the data on birds.

ECONOMIC RESEARCH ON WILDLIFE

That the mere provision of refuges is not sufficient to guarantee the increase of wild-animal populations is evident from the fact that many of the sanctuary areas consist of unimproved marginal and submarginal lands. One of the most important research jobs of the Biological Survey, therefore, is to learn about plants that may be used to improve the refuges. These should produce the foods preferred by the animals to be encouraged, and the conditions necessary to their growth should be made known. Special studies are being conducted on foods of the ruffed grouse, prairie chicken, bobwhite, valley quail, ring-necked pheasant, wild turkey, band-tailed pigeon, mourning dove, gray squirrel, and white-tailed deer.

The provision of adequate food and cover may not in itself entirely suffice, inasmuch as the competitor and predator populations of game areas may fluctuate and variably affect the managed species. Consequently many areas throughout the country are being carefully appraised to determine the maximum carrying capacity and to discover the causes for population fluctuations and how they may be held to a minimum. Aid in meeting the situation may come from studies now being actively carried on of the feeding habits of snakes, fish-eating birds, hawks, owls, foxes, coyotes, bobcats, feral house cats, weasels, skunks, and other predators.

That winter losses in wildlife, especially game and song birds, can be lessened by prompt and regular feeding during periods of food scarcity was emphasized in Farmers' Bulletin No. 1783, Feeding Wildlife in Winter, published this year.

WATERFOWL-FOOD INVESTIGATIONS

EELGRASS SITUATION

In the 7-year period since eelgrass (*Zostera marina*), formerly the principal food of the American brant, was decimated by a wasting disease, sporadic improvements in the stands have been observed at many places along the Atlantic coast. New growths approaching former abundance have been established only in some of the large bays and estuaries where the water is less saline than the ocean, including Shinnecock Bay, Long Island, N. Y., and Chesapeake Bay, in Maryland and Virginia. Several flourishing beds of eelgrass have been observed also extending from the mouths of rivers upstream to reaches where the salinity is only a half to a third that of normal sea water. Though the eelgrass crop this year was substantially larger than for several years past, the brant are still affected by the subnormal abundance of this important food. Observations on its status in February 1938 and notes on experimental plantings were summarized in a leaflet (BS–110) issued during the year.

As noted in last year's report, wigeongrass (*Ruppia maritima*), an excellent waterfowl food, continues to invade the areas formerly dominated by eelgrass. In a study area where wigeongrass once made up not more than a fifth of the bulk of the plant growth, it now constitutes approximately 80 percent of the submerged vegetation.

Reports of the decline of eelgrass on the Pacific coast were investigated. The findings do not seem, however, to substantiate claims that the grass has been affected. Every indication points to a normal crop of the plant in Pacific coast waters.

TRANSPLANTING AND PROPAGATING DUCK-FOOD PLANTS

The contents of 8,000 stomachs of game ducks, studied over a period of many years by past and present workers of the Bureau, were tabulated to serve as a basis for recommending propagation of the chief regional duck foods for each species. In a forthcoming bulletin (Technical Bulletin No. 634) entitled "Food of Game Ducks in the United States and Canada," which will be of interest to technicians concerned with the improvement of marsh and aquatic areas for waterfowl, each of the foods tabulated is described with respect to its abundance, habitat, propagation, and utilization. Most of them also are illustrated and their distribution mapped.

Several attempts to transplant healthy Atlantic coast eelgrass have been entirely unsuccessful, as have been repeated introductions of the unaffected Pacific coast form.

Plantings of eelgrass and wildcelery (*Vallisneria spiralis*) on the Bear River Migratory Bird Refuge, Utah, have not made a permanent stand, but the results of the transplanting of local waterfowl foods to the dikes and borrow pits have been gratifying.

To facilitate studies on the experimental propagation of waterfowl-food plants a battery of 24 ponds was excavated on the Patuxent Research Refuge, Md. In four of these, the bottoms of which were covered with desiccated muck from a natural swamp on the refuge, spatterdocks (*Nymphaea*) and burreeds (*Sparganium*) germinated abundantly. Tuber and rootstock material of three kinds of bulrushes (*Scirpus acutus*, *S. americanus*, and *S. robustus*), claspingleaf pondweed (*Potamogeton perfoliatus*), sago pondweed (*P. pectinatus*), wildcelery, marsh smartweed (*Polygonum muhlenbergii*), and arrowhead (*Sagittaria* sp.) also were transplanted and grown successfully.

To aid the work of three field stations newly established for experimental propagation of waterfowl foods, bibliographic research on the reproduction and growth of marsh and aquatic plants has been continued. At the same time intensive taxonomic studies of these food plants have been made to provide a basis for sound field observation.

Seeds of waterfowl-food plants not previously investigated were added to those of some 40 species stored in the fall of 1936, and samples of each were carried over winter in three ways: (1) Immersed in water at approximately 36° F.; (2) dry at approximately 36°; and (3) dry at room temperature. Sample seeds also were immersed in water at room temperature immediately after collection to ascertain whether they would germinate without undergoing after-ripening.

In the spring, germination tests were run with 41 species of waterfowl-food plants, including 9 pondweeds and 8 bulrushes. Germination experiments begun

in 1937 were continued to determine the longevity and viability of seed kept continuously in water at growing temperatures.

These experiments have confirmed the conclusion that cold storage in water is the most satisfactory method of handling seeds of most aquatic plants. Additional methods of storage and treatment will be investigated, since the results also indicate that a considerable number of species require special handling if the highest percentage of germination is to be obtained. It was further noted that a few species, including the dotted smartweed (*Polygonum punctatum*), pondweed (*Potamogeton panormitanus*), and wildrice (*Zizania aquatica*), will germinate after 4 or 5 months in dark cold storage, in water not colder than 36° F.

A number of plants have come to attention this year as being of special value locally as food for shoal-water ducks and geese in various sections of the country. In Louisiana, both seeds and tubers of the squarestem spikerush (*Eleocharis quadrangulata*) have proved to be important in the diet of ducks wintering in the Delta section as also is a slightly smaller form, the Gulf-coast spikerush (*E. cellulosa*). In the Bear River marshes, Utah, and at Malheur Lake, Oreg., Canada geese have been found to feed extensively on seedling squirreltail grass (*Hordeum jubatum*) in preference to other more abundant foods. An economic service is thus performed, as this grass is a troublesome weed and a predisposing cause of necrotic stomatitis in livestock and elk. Further study of stomach contents, coupled with field observation, indicates that sawgrass (*Cladium jamaicense*) is of considerable value to ducks as a regular dietary supplement.

FOOD RESOURCES OF WILDLIFE REFUGES

The food resources and general biological suitability of proposed migratory-waterfowl refuges in Maine, New Jersey, Maryland, Kentucky, Tennessee, Mississippi, Louisiana, Arkansas, Texas, and Colorado were investigated. Planting programs looking to improvement in food and cover conditions were suggested for some of these areas and for several existing wildlife refuges in Maine, New Jersey, Maryland. North Carolina, Tennessee, Louisiana, and Oregon; for sanctuary areas under the direction of the Forest Service in Virginia, of the Farm Security Administration in Maryland, of the Tennessee Valley Authority in Tennessee; as well as for the States of New York and Alabama and for the Muskingum Watershed Conservancy District in Ohio.

ECOLOGY OF WATERFOWL-FOOD PLANTS

Routine measurements of chemical and physical variations in the waters of duck-feeding grounds in the Southeast have been continued. The locks in the Chesapeake and Albemarle Canal, at Great Bridge, Va., formerly held open too much, have been normally operated for nearly 2 years, with a marked improvement in the aquatic flora of Currituck Sound, especially in the southern part, though the abundance of the plant life of the upper sound and of Back Bay nearer the mouth of the canal is still below normal. A marked increase in the duck population wintering in this area can be ascribed, in part at least, to this betterment of food conditions.

Work on the physicochemical optima for the growth of aquatic plants has been considerably advanced at the Delta Migratory Waterfowl Refuge, La., where extensive salinity tests, water-table determinations, and mechanical analyses of soils have been made.

SUPPRESSING OBJECTIONABLE MARSH AND AQUATIC VEGETATION

Alligatorweed (*Alternanthera philoxeroides*), an introduced species that tends to choke up waterways in subtropical areas, has continued to be a serious problem on the Delta Migratory Waterfowl Refuge. In a survey of natural enemies of the plant with regard to their possible usefulness in its control, several fungi were found, but none was pathogenic. A fungus (*Sphaceloma* sp.) that severely attacks the plant in South America is now being investigated cooperatively with the Bureau of Plant Industry under laboratory conditions. Another method of biological control tested was the making of numerous plantings of a wild millet (*Echinochloa polystachya*), which is an effective competitor of the alligatorweed in waterways on the refuge.

MOSQUITO CONTROL IN WILDLIFE HABITAT

In many States (Rhode Island, Massachusetts, Connecticut, New Jersey, Delaware, Maryland, Georgia, Tennessee, Michigan, and California) marsh areas have been surveyed to determine the effects of mosquito-control ditching on wildlife and on its habitat and food resources, in order to encourage the use of control measures least injurious to marsh-inhabiting species. When drainage has been undertaken without competent guidance and advice from entomologists and biologists, much of it has been unnecessarily destructive to game and fur mammals and birds and to their natural foods. Under adequate supervision the results have been far less detrimental. Cooperation with interested agencies has been furthered in attempts to have control operations proceed as far as reasonably possible along lines that have regard for conservation principles, so as to assure the fullest possible protection to wildlife, and thus serve the greatest public good.

Injury to wildlife habitats has been caused chiefly by altering natural water levels beyond the limits that most of the desirable plant and animal forms can tolerate and by lowering the level of water in ponds, thus destroying valuable submerged plants by subjecting them to injurious exposure or desiccation. In many instances altering the water levels has eliminated indigenous plant and animal forms and caused invasions of species that rapidly displace the food plants of waterfowl and other marsh denizens. An example will illustrate how ditching reduces the natural animal population of a marsh: Two areas, separated only by a small stream, and comparable as to plant and animal associations, elevation with respect to tide range and level, soil conditions, and location, were selected for study. One was ditched for mosquito control according to the usual methods, and the other was left undisturbed. A series of animal counts on plots 6 feet square on each was made throughout the year. Considering the unditched area as normal, the following reductions were revealed: After one season, in the saltmarsh cordgrass (*Spartina alterniflora*) association the reduction in invertebrate animals, primarily mollusks and crustaceans, was 43.5 percent; in saltmarsh bulrush (*Scirpus robustus*), 92.6 percent; in saltgrass (*Distichlis spicata*), 71.9 percent; and in saltmeadow cordgrass (*Spartina patens*), 84.2 percent.

Interested Federal and State agencies have cooperated with the Bureau in experiments concerned with studies of mosquito breeding in different types of marshes and of control measures not seriously injurious to the valuable fauna and flora. The results have led to recommendations that water levels be controlled where possible through the use of sluices, tide gates, and other means, and that mosquito breeding be checked by the use of killifishes, top minnows, and other predators of mosquito larvae. Similar cooperation has resulted in the preservation or partial restoration of considerable marshland valuable to wildlife. Amassing evidence that permanent ponds on saltmarshes rarely provide suitable breeding environment for mosquitoes, and as a rule need not be drained as a control measure, has resulted in saving for wildlife many marsh ponds along the North Atlantic coast and in the restoration of others by W. P. A. and C. C. C. workers through the installation of dams in the drainage ditches. In some instances wildlife habitat has been improved in connection with mosquito-control operations through the construction of ponds and lakes that serve both as reservoirs of natural predators of mosquito larvae and as homes for important species of wildlife.

Cooperating with the W. P. A., the Bureau has reviewed many applications for mosquito-control projects and other drainage operations throughout the country, with the result that some that would have been unnecessarily detrimental to wildlife have been disapproved or the proposed plans so modified as not to threaten injury to wildlife. In many cases, to the satisfaction of all concerned, such modification has resulted in the construction of artificial habitat to compensate for the unavoidable destruction of adjacent natural wildlife environment by necessary drainage. Wherever practicable, biological methods of mosquito reduction that involve water control and impoundment rather than the destructive measures of mechanical drainage have been recommended and prosecuted in the interests of the Nation's wildlife resources.

LABORATORY RESEARCH IN FOOD HABITS

Two of the Bureau's cooperative wildlife-research units detailed six students for work in the Washington laboratory for periods aggregating 18 months. One

full-time employee also was added to the staff. One temporary employee was made available by the Department of Conservation of New York for 8 months for special food-habits investigations of foxes, great horned owls, and ruffed grouse collected in that State. Through allocation of W. P. A. funds, 12 clerical assistants were available for a 6-month period to aid in indexing and tabulating accumulated examinations of the ruffed grouse, bobwhite, valley quail, ring-necked pheasant, mourning dove, and other game and nongame species, thus making the information on food habits more available for reference.

A total of 7,484 unit examinations, including stomachs, droppings, pellets, and nest samples, were made, representing 222 species of amphibians, reptiles, mammals, and birds. Stomachs were examined of 3,531 birds of 176 species, 1,004 mammals of 26 species, 18 lizards of 1 species, and 416 snakes of 12 species, in addition to 911 pellets of birds of 3 species, 78 droppings of birds of 4 species, 4 nest-debris samples of birds of 2 species, and 1,522 droppings of mammals of 8 species. Compared with last year's record of 4,072 examinations, this represents marked progress in determining the food habits of economically important species. Seed and plant identifications were incidentaliy made for a number of research workers engaged in wildlife studies and to aid game technicians on various Bureau refuges.

REPTILE COLLECTIONS

Additional reptile material from the George Washington National Forest was received through the cooperation of the Forest Service. During the year, 431 food-containing digestive tracts of 12 species of snakes were examined, making a total of 689 from this area, including representation of several species of potential importance to game management. Among them are the common black snake, pilot black snake, timber rattlesnake, and common water snake, species that prey to some extent on the contents of game-bird nests, the young of game mammals, or, in the case of the water snake, on fishes. The investigation of the relationship of the cottonmouth moccasin (*Agkistrodon mokasen*) to waterfowl and fur animals on the Delta Migratory Waterfowl Refuge, La., has been similarly advanced. Collection of bull snakes was initiated on the Valentine and Crescent Lake Refuges, Nebr., to obtain information on their general food habits and especially to ascertain the extent to which the species robs waterfowl nests. The abundance of bull snakes, coupled with the high losses of duck nestings on these areas, indicated the need of the study. A leaflet, Facts About Snakes (BS–103), which is of great value in answering voluminous correspondence, was revised.

MAMMAL STOMACHS

The findings of a food-habits study of 164 coyotes that had lost a leg, in a trap or otherwise, were presented in a paper entitled "Food Habits of Pegleg Coyotes," at the annual meeting of the American Society of Mammalogists, showing that such animals are somewhat handicapped in obtaining food and consequently, to the detriment of domestic stock production, their diet differs from normal to the extent that they tend to seek out the slow-moving animals as well as bait or even carrion.

As a part of a study to determine deer-food preferences and the effects of deer browsing on forest shrub and tree growth, analysis was made of the contents of 59 white-tailed deer stomachs collected on the Superior National Forest, Minn. The findings were summarized and presented as part of a paper delivered at the Third Annual North American Wildlife Conference in Baltimore.

In studying the contents of the stomachs of a series of 31 squirrels collected by the Texas cooperative research unit, it was found that identification of the foods was practically impossible without having available for reference plant material taken at the same time and place as the animal. Consequently a field reconnaissance was made of squirrel study areas in Texas to determine their principal plants and to collect samples.

FOOD OF BIRDS

The food of game birds continues to be of paramount interest, the need for accurate and detailed information on the subject having been increased by the great expansion in upland-game work throughout the country. The bobwhite was the subject of a special food-habits study by the cooperative wildlife-research units in Alabama and Virginia, States in which this species is the outstanding game bird. Two graduate student cooperators, assigned by these units

for temporary duty in the Washington laboratory, analyzed 456 quail stomachs from Virginia and 375 from Alabama. In the latter State special attention was paid to the soil province from which the bird was collected with a view to correlating the data obtained with soil types.

The food habits of the mourning dove continued to be investigated for a second year, and 751 stomachs were examined. A graduate research student from the Alabama unit increased knowledge of the dove foods of that State through analyses of 194 stomachs. A paper entitled "Some Important Foods of the Mourning Dove in the Southeast" was presented at the Third Annual North American Wildlife Conference.

Knowledge of food habits of prairie chickens was advanced through the joint efforts of the Bureau's Texas cooperative research unit and the Washington laboratory with a total of 24 unit examinations completed, including droppings and stomachs.

The movement to restore the wild turkey to a more important position as a game bird has continued, increasing interest being shown in efforts to improve its habitat on publicly owned lands. Studies to determine the prevalence of the choice foods utilized in the wild were continued, and 94 birds were examined. Of these, 26 were from the George Washington National Forest, 20 from other areas in Virginia, 3 from Alabama, and the remaining 45 from various sections of the United States. The Virginia research unit assigned a graduate student to the laboratory for 1 month to study some of the material collected in Virginia.

In cooperation with the Utah research unit, limited study involving 53 stomachs was made of the food habits of sage grouse.

In the course of the Bureau's economic studies of wildlife conducted during the past 53 years, stomachs of many extralimital species as well as of species now extinct or nearing extinction have been received. The results obtained from the study were reported at the 1937 meeting of the American Ornithologists' Union in a paper entitled "Food of Rare, Uncommon, and Extinct Species of North American Birds."

COOPERATIVE FOOD-HABITS RESEARCH

AID TO STATE AND OTHER AGENCIES

There were examined for the Michigan Department of Conservation 552 otter droppings and an aggregate of 35 droppings of bobcats, coyotes, foxes, minks, and skunks. The stomachs of 20 collared lizards were analyzed for the University of Michigan. Droppings of 816 foxes, pellets of 263 owls and of 2 hawks, and stomachs of 178 ruffed grouse were examined for the New York State Conservation Department.

For the Forest Service, stomachs of 89 bobcats, 14 cougars, and 1 gray fox were analyzed; for the National Park Service, 2 bobcats and 9 coyotes; and for the Soil Conservation Service, 74 mourning doves were analyzed and several seed and plant identifications made. Examinations and determinations were made for other organizations or individuals as follows: 342 horned owl pellets for the University of Wisconsin; 11 Mississippi kite stomachs for Cornell University; and 20 woodcock and 1 jacksnipe for a private research worker.

INVESTIGATIONS ON THE GEORGE WASHINGTON NATIONAL FOREST

A 2-year study of the early winter food habits of ruffed grouse on the George Washington National Forest was summarized and a report submitted for Department publication as a joint contribution of the Bureau of Biological Survey and the Forest Service. The investigation was continued into a third year to determine more completely the range of foods eaten and the variation in the use of important foods. Six additional black bear stomachs were studied, bringing the total to 22 for this species on this forest.

FIELD INVESTIGATIONS OF GAME BIRDS

MOURNING AND WHITE-WINGED DOVES

Repeated complaints that the open season on the mourning dove was too short and too early in the year led to detailing an observer to Mississippi for several weeks before, during, and after the dove season. His investigations demon-

strated that the open season in that State, as probably also in Tennessee, commences while a large number of birds are still nesting and before many of the immature doves have attained sufficient size or strength to be classed as huntable on a sporting basis. A similar investigation is now being made of the breeding period of the white-winged dove in Arizona. Much added information on the food of these birds has also been obtained.

BAND-TAILED PIGEONS

The study of the habits, distribution, and migration of the band-tailed pigeon in relation to agriculture was continued in Washington, Oregon, and California, and some 400 stomachs were obtained from hunters. It was observed that in northward migration these birds tended to follow the areas of newly planted fields of oats and peas, and that along the west coast flocks feeding extensively on wild berries changed to a diet of acorns following a protracted rainfall.

CANADA GEESE IN NORTH CAROLINA

The large numbers of geese concentrated at the Mattamuskeet Migratory Waterfowl Refuge, N. C., where insufficient grazing was available, foraged this year on the surrounding farm lands, with the result that there were numerous complaints of damage. Investigation traced much of the damage to the fact that farmers wishing to have the geese around during the open season had encouraged them during the 3 fall months, but objected to their continued presence when the crops began to grow in spring. In this district corn is planted early to avoid the destructive effect of a tassel pest, but this practice subjects it, along with oats, soybeans, and other truck crops, to attacks by the geese. It was found that satisfactory protection can be obtained at low cost by netting the fields with hard-twist cotton cords strung 50 feet apart and 8 or 9 feet above the ground.

WATERFOWL

Mortality studies of duck nestings were conducted at the Malheur Migratory Bird Refuge, Oreg., Bear River Migratory Bird Refuge, Utah, and Crescent Lake and Valentine Migratory Waterfowl Refuges, Nebr., to determine the factors that affect waterfowl adversely during the breeding period. At the Bear River marshes and on other refuges studies have shown that there is a direct correlation between the species and number of ducks breeding and the type and extent of nesting cover available. Consequently, it is possible by manipulation of cover planting to increase the breeding number of pairs of Canada geese, redheads, mallards, and other ducks that select various plant associations in which to nest. Such alteration of cover flora, however, would be pointless if there were insufficient feeding, molting, and brooding areas available. Some of the above studies have been reported in three papers published in The Journal of Wildlife Management. Large numbers of nests were kept under observation at these refuges, and details of the history of each recorded.

FIELD STUDIES OF INJURIOUS NONGAME SPECIES

WINTER CROW CONCENTRATIONS

The severe drought years 1934–35, succeeded by 2 dry years, were probably a factor in the shifting of large winter roosts of crows in a southwesterly direction across Oklahoma. Because of the many complaints received, an investigator was assigned to spend several months studying their distribution and behavior in the new areas. The investigation was made in cooperation with the Oklahoma Extension Service, which circulated and tabulated questionnaires for reporting information on crow damage to agriculture. After a preliminary survey, Grady County, in which six roosts harbored 97,000 to 190,000 birds each, was chosen for careful study. One accomplishment was the development of a formula for standardizing appraisals of crow damage to grain crops. It was found that where grain sorghums were seeded early, crow damage was negligible, but this practice will not be widely acceptable because of the poor forage value of early-seeded sorghums. Much of the crow damage to agricultural crops in Oklahoma is due to grain and cotton crops being grown at the same time, so that as soon as the grain has been cut and shocked, the farmers' attention is diverted to the cotton, and he leaves the grain shocks standing in the fields over

a protracted period, more or less exposed to crow attack. If the grain harvest could be advanced the damage would be much reduced. In some areas farmers have considerably decreased the loss to grain left in the fields by carefully roofing the larger shocks with smaller bundles, heads down. An interesting finding of this investigation was the indifference or opposition of many farmers to crow control in areas where wheat is the principal crop, since the crow is an effective enemy of a very destructive beetle pest (*Phyllophaga* sp.) of wheat.

EUROPEAN STARLINGS

The mild winter of 1937–38 in the East was not conducive to much progress in the work of starling control. Further effort was made, however, to perfect a flock trap, the large size of which had made it difficult to devise a suitable trigger for springing it. It is of interest that in the course of experimentation one bird afflicted with avian tuberculosis was trapped, for in England the starling has been convicted of spreading gapeworms and foot-and-mouth disease. Although scarcely recognized by the average person, a continued decrease of starling populations in metropolitan areas was noted.

FISH-EATING BIRDS

On Elephant Butte Lake, N. Mex., an artificial reservoir abundantly stocked with game fish by the State Fish and Game Commission, large rafts of American mergansers had long caused considerable concern for game-fish supply. In severe winters the mergansers concentrate in the lower end, where the fishes are more abundant. Examination of the stomachs of 124 birds, collected over the whole area, revealed that game fish formed 53.6 percent of the food, while in the stomachs of birds taken on the lower end they formed more than 80 percent.

An investigation of a great blue heron rookery near Lewiston, Mont., was made in connection with reports of damage to trout. An intensive study of the food habits of the birds over a 12-day period revealed no evidence to support the claims. The bulk of the food consumed by these birds was composed of nongame fishes and miscellaneous invertebrates.

A Bureau leaflet (BS–83) entitled "Birds in Relation to Fishes" continued to serve a useful purpose in supplying information on this much-discussed topic. In several instances the leaflet has been abstracted by feature writers, thus further disseminating the fundamental facts contained in it.

BLACKBIRDS AND RICE

Ever since rice was first introduced into the Gulf coast sections of Louisiana and Texas, blackbirds have been a source of loss to rice growers. A leaflet (BS–96) entitled "Blackbirds and the Rice Crop on the Gulf Coast" was issued in November, to present facts on the type of damage, protected status of blackbirds, their migrations, possibility of avoiding crop damage by the use of early maturing strains of rice, methods of crop protection, and other details.

CROP-DESTROYING BIRDS IN CALIFORNIA

Bird depredations in California continue to demand close attention, although there are variations from year to year in the extent of damage and in the kinds of birds causing it. Injury by sparrows, linnets, and blackbirds was considerably less than usual; horned larks made serious inroads on the sugar-beet crop as in the past; and crows, jays, and magpies attracted much attention by their depredations in almond orchards. The third part of a cooperative manual entitled "Procedure and Methods in Controlling Birds Injurious to Crops in California" was prepared for State publication. Banding injurious species, including the tricolored redwing and Gambel's sparrow, was continued to provide information as to their seasonal movements.

MAMMALS

Information obtained in previous years on the behavior of gray foxes in raiding dummy quail nests was summarized in an article published in July 1938 in The Journal of Wildlife Management. This contribution is intended to facilitate the study of quail-nest mortality in areas inhabited by foxes and is part

of a more comprehensive report now in preparation on the food habits and economic status of foxes in Virginia.

The report on an earlier study of the economic status of pocket mice (*Perognathus*) was issued under the title "Pocket Mice of Washington and Oregon in Relation to Agriculture" (Technical Bulletin No. 608).

RESEARCH IN FUR-ANIMAL CONSERVATION AND UTILIZATION

DEVELOPMENTS IN FUR PRODUCTION AND THE FUR TRADE

The past year has been exceedingly trying and difficult for both fur producers and fur tradesmen. High feed costs, low raw-fur prices, disease outbreaks, reciprocity agreements, tariffs, Social Security regulations, and strikes raised many disturbing problems earlier in the year. By June, however, there was a complete change. Strikes in the fur trade had ceased, the stock market showed an upward trend, raw-fur prices increased, manufacturers resumed work, and the outlook for fall and winter became much brighter.

INTERNATIONAL PHASES OF FOX-PELT PRODUCTION

The United States and Norway now lead all countries of the world in silver fox production. Reports on whelping from Norwegian fox farms indicate a production this year of about 350,000 pelts. Other foreign countries also have increased production to a greater or lesser degree. The crop of pelts in the United States will almost reach that of Norway.

With world production increasing, however, the average price received for fox pelts is decreasing. In the face of added competition fur farmers generally have been urged to give more serious attention to raising stock of better quality. For many years the Survey has been advising fox farmers that unless they improve the breeding stock they will experience considerable losses. That many fox farmers may even be compelled to retire from the business unless the average quality of their pelts is improved and the production cost is lessened is substantiated by questionnaires sent out by the Bureau in a Nation-wide survey of fur farming, and the replies show that many persons engaged in this industry have already discontinued operations through inability to produce at a profit.

PRODUCTION OF MINK PELTS

Mink breeders apparently have made better efforts to improve fur quality than have fox farmers, judging from the pelts offered in the raw fur markets. Mink raising is still on the increase and is continuing to be a popular phase of fur farming for beginners. The prospective production of ranch-raised mink pelts is about 150,000 in this country.

STATISTICS ON FUR PRODUCTION

The Bureau began the first attempt at a Nation-wide survey to assemble fur-farming statistics by sending questionnaires to individual fur farmers. State directors of extension, county agents, fur farmers, fur-trade organizations, feed companies, publishers, and others cooperated by furnishing approximately 12,000 names and addresses of known fur farmers. About 8,000 questionnaires have already been mailed, and more than 2,000 have been returned. The data will be assembled and tabulated with the assistance of W. P. A. workers, and while the results compiled will be made public, individual returns will be confidential.

COOPERATIVE INVESTIGATIONS

REPRODUCTION IN MINKS

A cooperative study of reproduction in minks, inaugurated by the Bureau and the Carnegie Institution of Washington and financed by Bankhead-Jones cooperative research funds, was undertaken at Johns Hopkins University, Baltimore, Md., through employment of a biologist and an adequate staff of assistants. Work was begun by collecting and studying a large number of adult male and female reproductive tracts. A small colony of minks was maintained in the laboratory to permit observations during the breeding season. To determine

the optimum period of breeding, daily vaginal smears were taken, and to check the ovarian conditions against these results, the females were operated on at various intervals. Further study is necessary before the cycle can be definitely understood. Vaginal smears taken after some observed matings revealed no live sperms. Studies in spermatogenesis indicate that some infertility is due to a testicular deficiency in which sperms do not mature.

Living eggs were recovered and studied and the relationship of ovulation to copulation and fertilization determined. Both gross and microscopic observations on changes in the ovary and uterus during pregnancy and pseudopregnancy have been recorded. Gestation periods were checked in several cases with considerable exactness by obtaining vaginal smears of sperm and then watching for the exact time of birth. Attempts to determine pregnancy by injecting urine into test animals gave negative results. Mink urine proved to be very toxic. Following experiments that involved removal of the gonads, great improvement in the fur was noted. The animals used are being kept to ascertain whether improvement is still apparent at pelting time.

BREEDING AND INHERITANCE IN FOXES

The breeding and sales records of a second large silver fox ranch were made available to Bureau representatives for a study of the relationship of the age of vixen and time of whelping to the prices received for pup pelts. Information is also being obtained on the inheritance of silvering in foxes. Department Circular 460, Silver Fox Pelt Prices as Affected by Time of Pelting, Sex, and Age, published during the year, was the result of an earlier study of prices realized from the sale of pelts produced by one of the largest fox farms in the United States.

STUDIES OF GUARD HAIRS AND UNDERFUR

Samples of guard hair and underfur obtained over a period of several years from individual foxes receiving different experimental rations are being measured by W. P. A. workers. Measurements are being recorded of the total length of the guard hair and of the white band, and also of the natural as well as the stretched length of the underfur. It is hoped that this information will be of value in determining the inheritance of silvering and the cause of possible changes in silvering that may be affected by age, feeding, and environmental and other factors. This study includes fur not only from adult foxes but also samples taken every 2 weeks from pups 4 weeks of age up to pelting time. The investigation will reveal the character and relative growth of the fur and furnish additional information regarding the fur produced by fox pups.

KARAKUL SHEEP PRODUCTION

For 7 years the Bureaus of Animal Industry and Biological Survey have been cooperating in Karakul sheep-raising studies, with special reference to fur production. The continued popularity of Persian lambskins for use in coats and in trimmings on cloth garments has accelerated Karakul sheep production in this country. All Karakul lambskins produced this past year at the Research Center, Beltsville, Md., were appraised by fur specialists of the Survey. The same skins were taken to the raw-fur market, where experienced handlers of this article classified and appraised them. Pelts from lambs representing the fifth generation from breeding purebred Karakul rams to Corriedale and Black-faced Highland ewes were considered by commercial fur dealers to be as valuable as many of the lamb pelts produced from purebred Karakuls.

BREEDING IN OTHER FUR ANIMALS

Toward the close of the year a supplemental project was approved for studying the reproductive cycle of the muskrat. Hundreds of muskrat ovaries and testes were collected on the Blackwater Migratory Bird Refuge, Md., for preliminary treatment, with a view to obtaining additional knowledge on reproduction in this important fur animal. Reproductive tracts of foxes, fishers, bobcats, mountain lions, beavers, and other fur animals were collected and preserved for future study, and at the close of the year a report was in press on the reproductive cycle of the coyote. Three papers, one technical and two semitechnical, were presented at special meetings by the Bureau representative conducting this

research. The Bureau's contribution to the 1937 Yearbook of Agriculture, The Breeding of Fur Animals, was reprinted as a separate (No. 1603) to supplement the correspondence on the subject.

INVESTIGATIONS ON DRESSING DUTIABLE ORIENTAL SKINS

Cooperating with the Treasury Department, a representative of this Bureau visited China to obtain information on methods employed in dressing dog, lamb, and kid skins. He appeared as an expert witness in proceedings before the Court of Customs and Patent Appeals, between the Federal Government and the fur importers. The question was whether the dog, lamb, and kid skins imported from China were dressed, partly dressed, or raw. Duties amounting to many millions of dollars are involved in these cases, which are still coming up for trial.

QUALITY OF TANNED SKINS

Cooperative work with the Bureau of Chemistry and Soils, to determine the influence of environmental factors on the quality of raw and tanned fur-animal skins, has been continued. Pelts taken from young and adult silver foxes fed experimental rations were supplied by the Survey for this study. In addition, a number of prairie dog skins collected by field representatives of the Bureau and guinea pig skins furnished by commercial breeders and the Bureau of Animal Industry were transferred to the Bureau of Chemistry and Soils for use in experimental tanning tests to determine their commercial value. Australian rabbit skins also were supplied.

FELTING STUDIES

The cooperative study to determine the value of various North American furs for felting was continued with the research department of one of the leading hat manufacturers. The fur of the mountain beaver and the hair of the guinea pig were found to have no felting properties. One hundred pelts from 60-day-old domestic rabbits were classified and graded for furriers' purposes. Doe skins produced 5 percent more usable blown fur suitable for hat making than an equal number of the same grade of buck skins and yielded 11 to 16 percent more usable fur than an equal weight of buck skins. Skins graded as No. 1 and No. 2 produced 16 to 27 percent more usable fur than those graded No. 3 and No. 4. The report on a cooperative study, mentioned last year, of the utility of jack rabbit and cottontail skins was issued in November as Miscellaneous Publication No. 289.

OTHER COOPERATIVE RESEARCH

Representatives of the Bureau have been cooperating with the Federal Trade Commission in the preparation of trade-practice rules for the fur industry, and a number of conferences were held in Washington and in New York. The rules promulgated were released June 17, 1938.

Results of analyses by specialists of the Meat Inspection Laboratory of the Bureau of Animal Industry of two composite samples of horse meat from eight carcasses, slaughtered for experimental feeding to fur animals, showed that muscle meat contained 75 percent of water, 20.2 of protein, 2.9 of fat, and 1.1 of ash; and that the viscera (blood included) contained 77.5 percent of water, 19.8 of protein, 1.25 of fat, and 1.1 of ash. The findings proved valuable to specialists in planning rations for experimental animals and also to fur farmers.

In cooperation with the foreign office of the Bureau of Agricultural Economics and the Committee for Reciprocity Information, representatives of this Bureau have been furnishing statistical data and other information pertaining to fur-farming developments in the United States and foreign countries. This was in connection with the import duty on silver fox pelts. A number of meetings were held in the offices of the Tariff Commission to give fur farmers an opportunity to present their views.

FUR ANIMAL EXPERIMENT STATION

The new office and laboratory building erected at the United States Fur Animal Experiment Station, at Saratoga Springs, N. Y., under W. P. A. funds, was occupied during October and provides facilities for better administrative

and experimental work. Through W. P. A. cooperation also additional pens for the animals were constructed, and there are now at the station 561 for minks, 369 for foxes, and 20 for martens. The building program, although planned some years ago, could not then be put into operation because until December 1936 the Federal Government did not own the land on which the station was located. It is hoped to complete construction during the coming year under W. P. A. grants, after which the experimental program can be resumed fully.

FOXES

A second year's feeding experiment corroborated previous findings that a ration containing 40 percent of raw meat (basis of added water) is as satisfactory as one having 60 percent when fed to vixens during gestation and lactation periods. One year's experimental work with summer and fall feeding of adult male foxes shows that beef meal alone is as satisfactory as the beef meal (4 parts) and liver meal (1 part) in a ration that is identical in other respects. This conclusion was based upon observations as to general health, fur shedding, food consumption, and average live weight. No information was obtained on the effect that such summer feeding has upon breeding performance the following spring.

Soybean oil meal produced by the hydraulic-pressure method was substituted for half the beef meal in the ration for summer and fall feeding of mature vixens. No raw meat was given. The normal trend of weights, general health as shown by appetite, and normal shedding of old fur indicate soybean oil meal to be a satisfactory substitute for some of the beef meal. A continuation of soybean oil meal as a substitute for some of the raw meat in the normal ration during breeding, gestation, and lactation seems to promise good results, though all production records of the vixens were poor because of disturbance incident to building operations at the station. It is interesting to note, however, that the adult vixens in the soybean oil meal group came in heat an average of 10 days earlier than those in other groups and produced more pups.

Ninety weaned pups of both sexes were fed until pelting time on rations planned to compare the relative value of 40 percent of raw meat (basis of added water) with beef meal (5 parts) and liver meal (1 part) and with soybean oil meal replacing half the beef meal. Though the group getting the raw meat weighed 0.75 pound more than the beef-meal group and 1.25 pounds more than the soybean oil meal group at the end of the experiment, the average length from nose to base of tail of the male pelts taken was not reduced. Fur-trade experts considered the pelts produced on the ration containing raw meat to have more tinge and less sheen, density, and length of guard hair, as well as less depth of underfur and life of pelt, than the other two groups. This problem is receiving further study. Preliminary data are still being gathered on the value of fish meal and peanut meal as substitutes for beef meal in the ration.

Further attempts were made during the year to produce foxes by artificial insemination through transfer of active semen from a vixen previously bred in the normal manner to one also determined to be in heat by observation and by testing with a male. Though one of the vixens appeared to be pregnant no young were born. Much information and improvement in technique were acquired for use in the continuation of this work.

Data on the most humane, efficient, and economical method of killing foxes for pelting are being gathered.

MINKS

Weaned mink kits were fed during the summer of 1937 on rations in which (1) canned fish and (2) a comparable quantity of fish meal on dry-matter basis were substituted for one-third of the raw-meat portion (45 percent on an added-water basis) of the ration. There was no apparent difference in any of the animals as to general health. Studies made during the last 8 weeks of the experiment failed to show any significant difference in color, quality, density, or primeness of the fur. Another year's experiments should be completed before definite conclusions are drawn.

Summer and fall experimental rations similar to those of the kits proved quite satisfactory when fed to adult minks. Experiments with tankage and liver meal as a summer feed for adult minks were reported on in a mimeographed leaflet (BS–112) as unsatisfactory.

Building-construction disturbances and an outbreak of distemper among the minks during the latter half of the year so affected production that no dependable information on this and other experimental feedings is available.

MARTENS

Despite the use of an especially nutritious ration only one litter of three young martens was produced this year. There are only seven male and nine female adult martens in captivity at the station, small numbers that handicap the research.

RABBIT EXPERIMENT STATION

Increasing requests for information from persons engaged in, or contemplating, rabbit raising tend to illustrate that the practical program of the research conducted at the United States Rabbit Experiment Station, Fontana, Calif., is becoming better understood and appreciated. Inquiries received increased 150 percent over those of the previous year, though the unemployed are in part responsible. About 200 4–H Club members visited the station to inspect its equipment and obtain first-hand information on production problems. The station is now equipped to handle in experimental work more than 4,000 rabbits a year. With this large number the element of error is greatly reduced and the value of the experiments enhanced.

Data resulting from a breeding experiment that involved 175 does divided into 25 lots of 7 each, mated first to sterile bucks and subsequently to normal bucks at intervals of 1 to 25 days, established the fact that more than 86 percent of the does failed to produce young after the normal gestation period when mated during the first 17 days after the sterile copulation. On being mated to a fertile buck, beginning on the eighteenth day and continuing through the twenty-fifth, 73 percent of the does, having passed through pseudopregnancy, later produced young. The definite knowledge that the false, or pseudopregnant, period lasts 17 days enables the rabbit breeder who has maintained his young does in groups for economy purposes, to separate them at least 17 days before attempting mating. It also gives him the assurance that test mating on the eighteenth day following mating will detect the largest number that failed to conceive.

A special lot of pseudopregnant does that were autopsied showed that activation of the mammary glands and the generative tract was most marked in the first 10 days of the period. At the 15-day stage these organs were involuting, and 18 days after the sterile mating the corpora lutea were disintegrating and the generative tract was approaching the size usual in nonpregnant does. The results of this research are being prepared for publication.

Twenty-six combinations of feeds were used in feeding experiments. Five generations of rabbits have been raised at lower cost on the whole-grain ration developed at the station and in use for 3½ years. An experiment to determine the relative value of various protein supplements in the diet was completed after 2½ years. A preliminary summary of the data indicates that self-fed does and their litters select a ration having a nutritive ratio (between digestible crude protein and the combined digestible carbohydrates and fat) from 1 : 2.8 to 1 : 4.5. It was found that protein meals must be pelleted in order to be satisfactorily fed with whole grain and that pea-size oil-meal cakes are satisfactory for balancing a ration. The experiments show that the addition of a good quality plant-protein supplement will increase the profit on a litter of seven rabbits by 80 cents at prevailing feed prices and market prices for live rabbits.

Because of the economical conversion of pounds of feed into pounds of rabbit meat, the self-feeding and full hand-feeding experiment is attracting more attention from commercial rabbit raisers than any other project. Butcher buyers are paying approximately 10 percent above market quotations for rabbits produced on the self-feeder because of the more uniform development and superior quality of the carcasses compared with those of the average fryer rabbits on the market.

An experiment is in progress to determine the effect of feeding combinations of a limited number of whole grains with pelleted peanut meal, so as to have information readily available on whole-grain rations adaptable to various sections of the United States. The protein level for all groups has been about the same. A preliminary summary shows that 3 to 3½ pounds of concentrates and

roughage combined are required to produce 1 pound of marketable fryer rabbit. Extensive data on all phases of rabbit production are being recorded to formulate a basis for developing a feeding standard.

Practically all the studies during the past 4 years in an effort to determine the factors that might be responsible for mucoid enteritis in rabbits have yielded negative results. Present information suggests that the trouble is nutritional and possibly due to vitamin deficiencies.

Several years of experimental study have shown that ¾-inch woven-wire-mesh floors cause sore hocks, that hardware cloth of ⅝-inch reduces this trouble materially, and that stamped metal floors eliminate it almost entirely. A cooling basket for young suckling rabbits was developed at the station and has been most favorably received by breeders. Details of its construction and use are set forth in a leaflet (BS–114) entitled "Care of Rabbits During Warm Weather." Another leaflet (BS–102), the Salt Requirements of Rabbits, was issued.

An address on various phases of experimental studies pertaining to the breeding of rabbits, given by the director of the station before the National Convention of Rabbit Breeders at Colorado Springs, was manifolded for correspondence uses as Leaflet BS–101, Principles of Rabbit Breeding. Other work relative to rabbit-production problems included discussions of experimental work with breeders in Kansas City, Mo., Memphis, Tenn., Birmingham, Ala., and Atlanta, Ga., and conferences with college officials in Mississippi and Alabama.

FUR ANIMAL FIELD STATION

The muskrat investigational work on the Blackwater Migratory Bird Refuge, Md., which was discontinued at the end of June 1934, was resumed this year. The 5,405 acres of marshland on this refuge produce annually 20,000 muskrat pelts. A preliminary report on the study was published in May as Circular No. 474, Muskrat Investigations in Dorchester County, Md., 1930–34.

An associate biologist and assistants were employed to conduct research work with muskrats in their natural habitat as well as in pens where feeding and breeding can be controlled. A careful count of all muskrat houses on the marsh was made this year in an effort to correlate pelt production and house density per acre. On 332 acres that produced 2,127 pelts, a count of old and new, large and small houses totaled 2,783. Other areas were less productive. The annual catch, segregated by color according to trapping areas, also was obtained from the entire refuge, thus providing comparable data for 6 consecutive years.

Several hundred reproductive tracts were removed from pelted muskrats to determine by microscopic study the period and processes of reproduction. Pelts were obtained every 10 days during the regular trapping season, January 1 to March 15, to demonstrate variations, if any, in the prime-fur period.

In a study, begun in June, of breeding activities on the marsh, weights and measurements of young were made and a total of 80 houses that indicated occupancy were opened but revealed only four litters. Under a cooperative understanding with the Bureau of Entomology and Plant Quarantine, collections of parasites have been made for identification, and more than 15,000 mites were obtained from one dead animal. The parasitic infestation is believed to be materially affecting the financial returns from the marsh. The color markings and odd colors (other than black and brown) have been given special study. Many unusually colored animals still alive in traps were put into pens for matings in order to develop information on the genetics of coat color. Colors varying from snow white to buff, gray fawn, and silver gray on different parts of the body have been observed, and also white tips on tails. These color variants are found more frequently in some marsh areas than others.

Though the Bureau does not consider that muskrat raising in pens would be a profitable undertaking, 52 animals are being kept enclosed for controlled research studies, including gestation period, inheritance of coat color, nutrition, periodical weights, and rate of growth. Through W. P. A. funds 61 pens of various types and sizes have been made available and some of these are fenced areas of the marsh itself.

A 5-acre plot has been planted to a variety of truck crops, which will be harvested and fed to the muskrats to determine their suitability for food. The experimental program will be materially enlarged during the coming year.

WILDLIFE-DISEASE CONTROL

FUR-ANIMAL DISEASES

A number of commercial silver fox farmers have enabled the Bureau to make practical tests of control measures designed to reduce losses from disease. On their fur farms large groups of animals were subjected to treatments with products prepared to prevent or cure sickness caused by organisms associated with canine distemper. In each trial three test groups of foxes were used and checked against a fourth lot of untreated animals, all the various sets being closely related.

It was shown that those receiving adequate doses of a properly prepared homologous serum were temporarily protected. Others receiving chemotherapy and bacterin treatments also showed resistance slightly above that of an untreated check group. Unfortunately the protection afforded by the homologous serum was largely lost within a period of 3 to 5 weeks. The immunization, however, was of sufficient duration to permit development of pelts much superior in quality to those of foxes affected earlier in the furring season. Urgent need is evident for additional research on the development of a more lasting or permanent immunity to the infections of foxes.

Increasing production of minks on fur farms also calls for extended research on the diseases of these animals.

For the benefit of producers of domestic rabbits a mimeographed leaflet (BS–116) Suggestions for Control of Coccidiosis in Rabbits, was issued, giving condensed practical information for use in handling this disease. A manual for fur farmers in general was issued in the Farmers' Bulletin series (No. 1777) under the title "Diseases of Fur Animals."

DUCK-SICKNESS CONTROL

At the Bear River Migratory Bird Refuge, Utah, inteusive research on the cause of western duck sickness, or botulism, has disclosed the type of area most conducive to its incidence. For some time it has been known that not all feeding places in the alkaline mud flats are favorable to the disease-causing factor and that decaying organic matter, such as decomposing dead birds on the shore liue, was a prolific source of the trouble. Extensive outbreaks have recently been shown to have their source in natural culture media consisting of combinations of organic matter, earth, and water, forming a characteristic ooze in which under suitable temperature rapid growth of the toxin-forming organism (*Clostridium botulinum*) ensues. A mimeographed leaflet (BS–99) on Disease as a Factor in Game Fluctuation was issued.

MALADIES OF PROPAGATED GAME BIRDS

Through cooperative field studies as well as laboratory examinations information has been developed on the diseases to which game birds are subject under artificial propagation. Farmers' Bulletin No. 1781, Diseases of Upland Game Birds, was issued to give game managers and others interested in game conservation general information on infectious, parasitic, and nutritional maladies affecting various species of propagated wild birds.

Special attention was given to incubation, brooding, and nutritional difficulties on game farms. It has been demonstrated in recent tests that pullorum disease, an infection widely distributed among domestic poultry, is seldom if ever important in captive quail. Observations also demonstrated the need for a carefully controlled brooding temperature and well-regulated rations. Many propagation plants were found to have achieved better results by maintaining incubators at slightly lower temperatures than formerly. Rations containing too high a percentage of protein, especially during hot weather, are known to cause losses.

Progress has been made in a study of the normal blood corpuscle count in both young and adult quail and in wild ducks. These investigations are of importance as a basis for understanding disease manifestations in the blood of sick birds.

FEDERAL AID IN WILDLIFE RESTORATION

With the approval on September 2, 1937, of the Pittman-Robertson Act, known also as the Federal Aid to Wildlife Restoration Act (50 Stat. 917), there was initiated a program that promises to become one of the most potent influences in

the history of American wildlife conservation. Under its authorization of annual appropriations not to exceed the excise tax on arms and ammunition, which amount to about $3,250,000 a year, Congress on June 16, 1938, appropriated $1,000,000 for the first year's program, beginning July 1, 1938.

Emphasis is placed on the selection, restoration, rehabilitation, and improvement of land and water areas for wildlife purposes, and on research into problems of wildlife management. Areas unsuited for other economic uses are to be restored to game and fur production, thus providing additional sport for hunters and an increase in the income from the land.

Federal funds are apportioned to the States on the basis of land area and hunting licenses sold, and each State must contribute 25 percent of the cost of projects from its own resources. The State fish and game departments are named as the cooperating State agencies, and provision is made that all areas purchased are to be owned and maintained by the State departments. Federal funds will be expended on the basis of individual projects approved by the Chief of the Biological Survey, acting for the Secretary, in conformity with prescribed standards.

Although the act did not become effective until July 1, 1938, meetings were scheduled as early as November 1937 to discuss plans with representatives of the State game departments, and an explanatory leaflet (BS–105), The Federal Aid to Wildlife Restoration Act, was mimeographed and the public also informed by press statements and radio addresses. Regional conferences were held at Albuquerque, N. Mex.; Portland, Oreg.; Pocatello, Idaho; Omaha, Nebr.; Pierre, S. Dak.; Boston, Mass.; Jacksonville, Fla.; and New York, N. Y.; and two national conferences, one at Baltimore, Md., in connection with the Third Annual North American Wildlife Conference, and the other at Asheville, N. C., during the meeting of the International Association of Game, Fish, and Conservation Commissioners, afforded excellent opportunities to draft rules, regulations, and general policies after full discussions with representatives of the States.

Plans for the organization of a new Division of Federal Aid in Wildlife Restoration had been perfected and arrangements made for the approval of projects and disbursal of funds shortly after the close of this fiscal year.

ACQUISITION OF LANDS FOR REFUGES

Refuge-land acquisition was concerned principally with consolidating and extending the ownership of areas in existing refuges. Five new refuges, however, were acquired: The Back Bay Migratory Waterfowl Refuge, Va., 3,926 acres, through purchase; and the following four refuges, containing a total of 9,750 acres, by Executive orders: Hazen Bay Migratory Waterfowl Refuge, Alaska; Apache Migratory Waterfowl Refuge, Ariz.; Tybee Migratory Bird Refuge, Ga.; and Snake River Migratory Waterfowl Refuge, Idaho.

For rounding out 23 national wildlife refuges, the Migratory Bird Conservation Commission approved the purchase of 15,440 acres of land at a total cost of $314,581, or an average of $20.38 per acre. Many of the tracts involved are being taken by judicial proceedings because agreements on prices deemed equitable by the Bureau could not be reached with the owners or because legal entanglements in certain titles made it impossible to prepare contracts that would be binding.

The Survey's activities in land acquisition were unusual because of increased time taken up with suits in the Federal courts, instituted for the condemnation of lands that could not be otherwise acquired. There had also been transferred to the Bureau the responsibility for getting abstracts of titles and material to perfect titles and for taking the final steps looking to the closure of acquisition cases and making the payments for the lands purchased. This departure from the old practice is too recent to permit a definite statement that it has quickened the closure of purchase cases, but it is the general consensus that, without reflecting upon the agencies heretofore responsible for the work, there has been a marked improvement in this direction. The advantages grow out of the fact that representatives of the Biological Survey are more closely associated with the landowners who agreed to sell, and consequently, through personal contacts, can more rapidly close the transactions.

The Bureau's work in the acquisition of refuge lands by purchase is probably unique by reason of the purposes for which the lands are being acquired. Wildlife refuges cannot be wholly effective unless all of the lands within their exterior boundaries are under Survey jurisdiction and ownership. As a consequence, it

becomes necessary to obtain titles to the lands as quickly as possible by every legitimate means. Having once launched upon a refuge-acquisition program within a given unit of purchase, the negotiations for the acquisitions must be vigorously prosecuted and eulminated within a minimum time. For this reason the Biological Survey usually finds itself confronted with a purchase problem that resolves itself into what is generally spoken of as a "seller's market."

Approximately 91 percent of all lands within the refuges being acquired by purchase are now in Government ownership and practically all the remainder are in more or less advanced stages of progress leading to the vesting of title in the United States. The residue are lands that within a very recent period have been found necessary to the refuge, and consequently the acquisition work has been under way only a short time.

It is also necessary promptly to define accurately on the ground the boundaries of refuges. The boundary surveys, which are made as rapidly as conditions warrant, involve the retracement of the original property lines. In many localities these were first laid down in pre-Revolutionary days. In most instances, except for lands in the far West, where the surveys are more recent, most of the original boundary lines and corners have been lost or obliterated. The problem of restoring these lines to their original locations involves a tedious and technical procedure, time-consuming and relatively costly, but nevertheless necessary to avoid boundary-line disputes, to facilitate administration, and to determine correctly the acreage of the lands being acquired, so as to make compensation to the vendors.

Approximately 75 percent of the Ruby Lake Migratory Waterfowl Refuge, Nev., has been paid for, and the remainder is now in the final stages of conveyance.

The titles to all lands within the Moosehorn Migratory Bird Refuge, Maine, have vested in the United States during the current year.

The original Bombay Hook Migratory Waterfowl Refuge, Del., has been completely acquired. Additional lands are now needed for administrative and development purposes, and the negotiation and acquisition work is now in process.

Acquisition was completed on the Savannah River Wildlife Refuge, Ga. and S. C., and on the Cape Romain Migratory Bird Refuge, S. C.

The Montezuma Migratory Waterfowl Refuge, N. Y., is about 50 percent acquired, and the titles to the remaining lands are being vested as rapidly as the difficult title situations permit.

Practically all the Aransas Migratory Waterfowl Refuge, Tex., has been acquired, except a few small parcels being taken by purchase and by condemnation.

In addition, miscellaneous parcels are being taken in other refuges to round out the program. Numerous special appraisals were made of small parcels needed for inclusion in existing refuges.

Besides 346 miles of refuge boundary lines surveyed, it was necessary to survey 290 additional miles of interior or contiguous lines by reason of lost and obliterated corners; 24 miles of level lines were surveyed, and to define the boundaries of existing refuges 277 miles were marked. Preliminary to fence construction, 166 miles of boundary lines were staked.

Survey descriptions necessary for title examinations and preparing deeds of conveyance for 268 tracts were completed for approximately 132,000 acres, of which 86,594 acres with irregular boundaries were surveyed preliminary to the preparation of descriptions to properly define the lands. More than 6,000 acres were surveyed for topography, and topographic maps therefrom were compiled.

The President signed 26 Executive orders prepared for the reservation of refuge lands, embracing 36,271 acres of the public domain and 276,185 acres acquired by purchase.

Details of the accomplishments in refuge acquisition are shown in table 4.

TABLE 4.—*Land for refuges and related uses acquired or in process of acquisition during the fiscal year 1938 under the Migratory Bird Conservation Act, with emergency and other funds, by gifts, and by Executive order*

State and county	Refuge	Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	Acquired in previous years
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pending title conveyance	Total			
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Alaska: Fourth judicial division	Hazen Bay							[1] 6,800	6,800	
Arizona: Apache	Apache							[1] 2,514	2,514	
Arkansas: Arkansas, Desha, Monroe, and Phillips.	White River		529	529	1,482	6,715	[2 3 4] 8,197		8,726	94,932
Delaware: Kent	Bombay Hook	6,886	659	7,545				•	7,545	5,120
Florida: Jefferson, Taylor, and Wakulla	St. Marks	2,879	6,918	9,797		1,181	[2] 1,181	[1 5] 9,179	20,157	47,145
Georgia:										
Charlton, Clinch, and Ware	Okefenokee		833	833				[5] 11	844	292,982
Chatam	Savannah River (see also South Carolina).	31		31		1,462	[2] 1,462		1,493	3,921
Do	Tybee							[1] 100	100	
Idaho:										
Jefferson	Camas	200	3,350	3,550					3,550	6,692
Canyon	Deer Flat							[1 6] (2,121)	(2,121)	12,373
Bannock	Pocatello	1		1					1	1
Canyon	Snake River							[1] 336	336	
Illinois:										
Mason	Chautauqua				1,760	496	[3 4] 2,256		2,256	2,220
Carroll, Jo Daviess, Rock Island, and Whiteside.	Upper Mississippi (see also Iowa, Minnesota, and Wisconsin).									[7] 19,630
Iowa:										
Kossuth	Union Slough	430	231	661					661	200
Allamakee, Clayton, Clinton, Dubuque, Jackson, and Scott.	Upper Mississippi (see also Illinois, Minnesota, and Wisconsin).									[7] 29,827
Louisiana:										
Cameron	Lacassine	5,468	2,649	8,117	22,992		[2] 22,992	[1] 227	31,336	17
Do	Sabine				138,987		[2] 138,987		138,987	
Maine: Washington	Moosehorn	10,610	10	10,620					10,620	684
Michigan:										
Marquette	Huron							[1] 64	64	83
Schoolcraft	Seney	196	37,364	37,560	11,735	3,043	[2 3 4] 14,778		52,338	33,614

[1] Set aside by Executive order or proclamation.
[2] Federal Emergency Relief Administration and Resettlement Administration funds.
[3] $1,000,000 fund provided through Executive Order No. 6724, of May 28, 1934.
[4] $950,000 fund, a substitute for Executive Order No. 6724.
[5] Acquired by gift.
[6] Numbers in parentheses represent deductions and should be subtracted.
[7] Upper Mississippi River Wildlife and Fish Refuge fund.

TABLE 4.—*Land for refuges and related uses acquired or in process of acquisition during the fiscal year 1938 under the Migratory Bird Conservation Act, with emergency and other funds, by gifts, and by Executive order*—Continued

State and county	Refuge	Under Migratory Bird Conservation Act			With emergency and other funds			Acquired other than by purchase	Total	Acquired in previous years
		Acquired by purchase	Pending title conveyance	Total	Acquired by purchase	Pending title conveyance	Total			
		Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Minnesota:										
Aitkin	Rice Lake		1,423	1,423	2,935	4,854	[2] 7,789		9,212	661
Cottonwood	Talcot Lake					920	[3] 920		920	80
Becker	Tamarac	505	1,414	1,919					1,919	21,158
Houston, Wahasha, and Winona	Upper Mississippi (see also Illinois, Iowa, and Wisconsin).					1,874	[7] 1,874		1,874	[7] 22,370
Missouri:										
Holt	Squaw Creek				365	120	[2 3 4] 485		485	6,163
Chariton	Swan Lake		2,900	2,900	3	180	[2] 183		3,083	7,608
Montana:										
Phillips	Hewitt Lake							[1] 400	400	
Do	Lake Bowdoin				640		[2] 640		640	[8] 10,671
Hill	Lake Thibadeau							[1] 192	192	
Roosevelt and Sheridan	Medicine Lake				3,614		[2 3 4] 3,614	[5 4]	3,618	[8] 16,614
Beaverhead	Red Rock Lakes	231	771	1,002	590	8,503	[2] 9,093		10,095	16,526
Nebraska: Cherry	Valentine				1,159	276	[2 3 4] 1,435		1,435	64,373
Nevada:										
Humboldt and Washoe	Charles Sheldon (see also Oregon)	17,509	5,304	22,813					22,813	559,235
Elko and White Pine	Ruby Lake	20,745	7,667	28,412					28,412	
New Mexico:										
Chaves	Bitter Lake	120	6,935	7,055				[1] 11,316	18,371	3,193
Socorro	Bosque del Apache		2,926	2,926					2,926	52,843
New York: Seneca	Montezuma	2,564	3,656	6,220					6,220	
North Carolina:										
Hyde	Lake Mattamuskeet		541	541					541	49,925
Dare	Pea Island	1,605	2,702	4,307				[1] 32	4,339	1,539
North Dakota:										
Foster and Stutsman	Arrowwood				943	80	[3] 1,023		1,023	12,293
Burke and Ward	Des Lacs	2		2	837	608	[3 4] 1,445		1,447	12,359
Ramsey	Lake Alice		10	10					10	
Burke and Mountrail	Lostwood		373	373	480	1,208	[3] 1,688		2,061	21,723
Bottineau and McHenry	Lower Souris	5,618	1,243	6,861	803	2,144	[3 4] 2,947		9,808	44,016
Renville and Ward	Upper Souris	317	708	1,025	809	409	[3] 1,218		2,243	29,359
Oklahoma: Alfalfa	Salt Plains							[1] 6	6	19,453

Oregon:										
Lake	Charles Sheldon (see also Nevada).		627	627					627	
Do	Hart Mountain	1,811	2,421	4,232					4,232	212,004
Harney	Malheur:									
	Blitzen Unit		320	320					320	65,722
	Malheur Unit		317	317	141		[3] [4] 141		458	93,346
Marion	Willamette		343	343					343	
South Carolina:										
Charleston	Cape Romain	3		3					3	62,907
Jasper	Savannah River (see also Georgia).		617	617	530		[2] [3] [4] 530		1,147	6,078
South Dakota:										
Brown	Sand Lake				340	458	[2] 798		798	19,157
Day	Waubay		29	29					29	2,557
Tennessee: Lake and Obion	Lake Isom					1,517	[2] 1,517		1,517	20
Texas:										
Aransas and Refugio	Aransas	45,597	903	46,500					46,500	
Bailey	Muleshoe	1,417	738	2,155		1,440	[2] 1,440		3,595	2,214
Utah: Box Elder	Bear River	2	39	41	3,144		[3] [4] 3,144		3,185	53,979
Virginia: Princess Anne	Back Bay	3,926	663	4,589					4,589	
Washington:										
Spokane	Turnbull	1,925	4,866	6,791					6,791	5,412
Pacific	Willapa Harbor	40	660	700					700	2,230
Wisconsin: Buffalo, Crawford, Grant, La Crosse, Trempealeau, and Vernon.	Upper Mississippi (see also Illinois, Iowa, and Minnesota).					321	[7] 321		321	[7] 71,103
Wyoming:										
Teton	Elk Refuge	1,557	641	2,198				[1] 618	2,816	[9] 17,621
Do	Flat Creek							[1] [6] [10](40)	(40)	40
Total		132,195	104,300	236,495	194,289	37,809	232,098	29,638	498,231	[11]

[1] Set aside by Executive order or proclamation.
[2] Federal Emergency Relief Administration and Resettlement Administration funds.
[3] $1,000,000 fund provided through Executive Order No. 6724, of May 28, 1934.
[4] $950,000 fund, a substitute for Executive Order No. 6724.
[5] Acquired by gift.
[6] Numbers in parentheses represent deductions and should be subtracted.
[7] Upper Mississippi River Wildlife and Fish Refuge fund.
[8] Revised acreage.
[9] In addition to the acreage shown, 3,858 acres are held under lease.
[10] The Flat Creek Refuge was merged by Executive order, and is now a part of the Elk Refuge, which it adjoined.
[11] Total omitted, as entries in column are for only those refuges on which acquisition work was involved during the year.

NOTE.—1-acre items range from a fraction of an acre to 1.49 acres.

RESTORATION OF WILDLIFE HABITAT BY THE REFUGE PROGRAM

The continued program of wildlife restoration has resulted in the provision of additional areas where various forms of wildlife, especially waterfowl, are given protection and a chance to increase their numbers. Conditions for wildlife have been improved on the Federal refuges by stabilizing impounded waters, planting wildfowl foods and food-producing trees and shrubs, constructing nesting islands and upland game shelters, and providing other facilities tending to make the areas better serve their purpose. Waterfowl have increased in numbers on the refuges and are beginning to spread from them over the adjacent country.

Although many of the areas acquired by the Bureau for wildlife conservation needed only protection to make them attract large numbers of birds, it has been definitely proved that their drawing power can be greatly enhanced. Through the use of labor provided by emergency funds the development of refuge lands has gone forward rapidly.

REFUGE DEVELOPMENT BY C. C. C. CAMPS

Thirty-five C. C. C. camps and three side camps were engaged during parts or all of the year in the development of 32 national wildlife refuges. The type of work and the objectives have been discussed in previous reports, so that here only the twofold objective need be stated: To make such improvements on the refuges as will (1) increase their attractiveness to wildlife and (2) facilitate their administration. The camps in operation this year were as follows—the six starred (*) were at new locations:

White River Migratory Waterfowl Refuge: Arkansas Camps BF–1, 2, and 3.
Tule Lake and adjacent Migratory Waterfowl Refuges: California Camp BF–1.
Sacramento Migratory Waterfowl Refuge: California Camp BF–2.
*Bombay Hook Migratory Waterfowl Refuge: Delaware Camp BF–1.
St. Marks Migratory Bird Refuge: Florida Camp BF–1.
Okefenokee Migratory Waterfowl Refuge: Georgia Camp BF–1.
Seney Migratory Waterfowl Refuge: Michigan Camp BF–1.
Mud Lake Migratory Waterfowl Refuge: Minnesota Camp BF–1.
Tamarac Migratory Waterfowl Refuge: Minnesota Camp BF–2.
*Swan Lake Migratory Waterfowl Refuge: Missouri Camp BF–2.
Medicine Lake Migratory Waterfowl Refuge:: Montana Camp BF–2.
Valentine Migratory Waterfowl Refuge: Nebraska Camp BF–1.
Charles Sheldon Antelope Refuge: Nevada Camp BF–2.
*Montezuma Migratory Bird Refuge: New York Camp BF–1.
Pea Island Migratory Waterfowl Refuge: North Carolina Camp BF–2.
Mattamuskeet Migratory Waterfowl Refuge: North Carolina Camp BF–3.
Upper Souris Migratory Waterfowl Refuge: North Dakota Camps BF–1 and 5.
Arrowwood Migratory Waterfowl Refuge: North Dakota Camp BF–2.
Des Lacs Migratory Waterfowl Refuge: North Dakota Camp BF–3.
Lower Souris Migratory Waterfowl Refugee: North Dakota Camp BF–4.
Wichita Mountains Wildlife Refuge: Oklahoma Camps BF–1 and 2.
Malheur Migratory Waterfowl Refuge: Oregon Camps BF–1, 2, and 3.
*Hart Mountain Antelope Refuge: Oregon Camp BF–4.
Savannah River Migratory Waterfowl Refuge: South Carolina Camp BF–1.
*Cape Romain Migratory Waterfowl Refuge: South Carolina Camp BF–2.
Sand Lake Migratory Waterfowl Refuge: South Dakota Camp BF–2.
Lacreek Migratory Waterfowl Refuge: South Dakota Camp BF–3.
Bear River Migratory Bird Refuge: Utah Camp BF–1.
*Back Bay Migratory Waterfowl Refuge: Virginia Camp BF–1.

With the exception of State-owned areas at Ogden Bay, Utah, and Howland Island, N. Y., all work was on Federal land.

TYPICAL C. C. C. WORK—VALENTINE REFUGE

Differences in topography, water supply, climate, and rainfall, and in the wildlife species primarily served, make the development problems at each refuge different in some respects from those at all others. The C. C. C. work accomplished under the technical supervision of the Bureau at the 69,000-acre Valentine Migratory Waterfowl Refuge, Nebr., however, is typical of that at other refuges, and as an illustrative example may be discussed in some detail.

When acquired in 1935 for development as a refuge, this area, which is favorably situated in the Central waterfowl flyway and includes 15 important lakes, in the heart of the sand hills of Cherry County, Nebr., had been hard hit by drought, erosion, and uncontrolled grazing. As a consequence it had deteriorated biologically. The progressive lowering of the water tables during the past 15 or 20 years was sharply accentuated by drought in the early 1930's. The general lack of moisture greatly lowered the levels of the lakes early each

summer, and many of the marshes dried up completely during late summer and early fall.

C. C. C. boys were used on projects designed to impound sufficient water to carry the birds through the breeding season. A dam across Gordon Creek stores the spring run-off, which is drawn upon and conveyed 4 miles by ditch to Hackberry Lake so as to maintain optimum levels during the critical breeding season. Dikes were built to hold the water in many of the lakes, 15 wells were dug, and as a further protection against losses by drought, a large number of pot holes were excavated in and adjacent to the marshes. These holes are about 150 to 200 feet long, 60 to 90 feet wide, and 5 to 6 feet deep. Because of their depth, they will provide insurance against complete drought even in the driest years. In excavating them, 55,400 cubic yards of earth were removed. In addition, 140 man days were used in creating open-water areas throughout the marshes so as to provide a better breeding and feeding habitat for migratory birds.

A project of direct and important benefit to wildlife was the propagation of food- and cover-producing plants and shrubs. Here was an opportunity for biological rehabilitation on a large scale. The drought and scorching winds had denuded the sand hills of almost all vegetation. Even plants indigenous to the area could not withstand the drought. After improvements, with water levels protected, the marshes and lakes were planted with many varieties of aquatic plants. Species were selected that would provide food and also shelter from natural enemies and storms. A seed and tuber cellar was constructed for storing planting stocks until they can be set out to best advantage, and 1,850 pounds of seeds, including wildrice and other food-producing plants, were gathered and stored. In addition to the marsh and water areas, 260 acres of upland, in plots ranging in size from ½ to 2 acres and distributed throughout the refuge, were planted to food and cover vegetation.

In the nursery at Valentine approximately 1,000,000 tree seedlings were grown. Most of these were planted in the food and cover plots on the refuge, but many were shipped to other refuges. During the winter months 366 junipers and ponderosa pines, ranging in height from 6 to 8 feet, were planted. A pump house was built from which to supply water to the nursery.

One of the first projects was the fencing of the boundary line. This involved construction of more than 100 miles of fence, with steel and wood posts placed alternately, and required several hundred miles of wire and about 30,000 wood posts, which were peeled and treated with creosote. At points where needed, 20 automobile gates were constructed, and 35 directional or warning signs were made and erected.

As the refuge comprises more than 100 square miles, there has been the problem of furnishing trails for fire-protection patrol and for giving access to recreational areas. Forty-seven and one-half miles of truck trails were made and surfaced either with clay or with black topsoil, and to check erosion hundreds of tons of hay and rushes, cut from the roadsides, were used as mulch.

When the great drought of recent years ended, range grasses, protected from overgrazing, again began to cover the sand hills. Because of the constant danger of disastrous prairie fires, it was necessary to make more than 120 miles of firebreaks. These consist of two parallel plowed strips spaced 30 to 50 feet apart. In cutting vegetation between these strips and along the truck trails, 490 man-days of enrollee labor were used.

At two of the highest points on the refuge 100-foot lookout towers were erected as observation posts for the detection of fire and trespassers. About 18½ miles of telephone line were constructed to provide communication facilities between headquarters and patrol stations.

The headquarters buildings were all erected with the aid of the C. C. C.; that is, enrollees were used as assistants to the carpenters, masons, and other skilled mechanics. The refuge is situated on a very poor road approximately 35 miles from Valentine, Nebr., and a permanent headquarters for the management and supervision of the refuge is, therefore, essential. Six cinder-block buildings—a residence, office and laboratory, pump house, service building, machine shop, and bird house—were constructed. As a secondary headquarters, from which the activities in the southeastern part of the refuge will be directed, the C. C. C. has constructed cabins for the use of patrolmen and barns that may be used to house either automobiles or horses. Materials salvaged from buildings razed by the enrollees were largely used.

The recreational facilities provided by the C. C. C. are extremely important in this semiarid country. On one of the lakes, noted for fine fishing, these

included such necessities as overnight cabins, wells, picnic grounds, and toilets. This area is open to the public, but its use is so supervised as to avoid interference with the wildlife.

JOB-TRAINING AND EDUCATIONAL PROGRAMS

Special mention should be made of the educational program in Biological Survey C. C. C. camps. The development of a refuge involves the application of a diversity of sciences—hydraulics, structural and mechanical engineering, biology, botany, agriculture, and forestry—and many kinds of mechanical equipment are used. There are, therefore, unusual opportunities for the correlation of classroom instruction with everyday field operations.

At each camp there was an average each month of 31 classroom meetings, with an average of more than 15 enrollees attending. Prominent among courses offered were those in automobile mechanics, cabinetmaking and carpentry, dragline operation and maintenance, surveying, stone masonry, bricklaying, and office filing.

Much of the classroom instruction was put to immediate use and was supplemented on the job. At every camp enrollees assisted skilled mechanics and foremen in the construction of camp buildings, offices, shops, garages, seed and tuber cellars, lookout towers, warehouses, and bridges of timber and steel and concrete. For example, enrollees were taught to make concrete both by hand and by machinery, to build the necessary forms for pouring, to set the steel, and to finish the concrete.

As dam and dike construction, the excavation of diversion ditches, and other large earth-moving jobs require a variety of heavy equipment, those enrollees who in classrooms showed an aptitude for mechanical work were given opportunity to learn how to operate and repair trucks, draglines, power shovels, elevating and road graders, and tractors. Enrollee truck and tractor drivers were taught to care for and make minor repairs to the machines, and those with exceptional mechanical ability were assigned to the repair shops to assist the regular mechanics.

At the end of the year 75, or more than 1 of every 5, of the auxiliary personnel regularly employed by the Biological Survey in its C. C. C. camps were former enrollees. Among these 75 ex-enrollees were 5 dragline operators, 5 machine operators, 11 mechanics, 18 clerks, 19 squad foremen, and 5 junior foremen. In 80 percent of these cases the individual became qualified for the particular job as a direct result of instruction received as a part of the C. C. C. educational program. This demonstrates the practicability of achieving a close correlation between the training program and employment opportunities. The Survey leads all other organizations in percentage of employments from the enrollee ranks.

SAFETY PROGRAM

Efforts were made to provide safe working conditions for the enrollees and to enforce safety regulations. This resulted in a marked decrease in both the frequency and severity of accidents. In the first half of the year, 450,033 man days of enrollee labor were used on Biological Survey projects, and during that period 119 lost-time accidents were reported, whereas in the second half of the year only 81 such accidents occurred in 496,267 enrollee man days of work. Two camps had no lost-time accidents, and there were no fatal accidents in any of the 35.

COOPERATION OF THE WORKS PROGRESS ADMINISTRATION

Allotments totaling $1,583,646 were made to the Biological Survey by the W. P. A., under the E. R. A. Act of 1937 for the purpose of carrying on refuge projects designed to provide employment for those in need of relief and at the same time improve conditions for wildlife. These funds have enabled the Bureau to continue the development of water- and wildlife-conservation projects by means of dams, dikes, spillways, diversion ditches, and other water-controlling and water-saving structures; by planting erosion-resisting and food-producing grasses, shrubs, and trees; constructing trails, nesting islands, and game shelters; building and repairing fences, buildings, and other structures; developing recreational and other public facilities; and marking and posting refuge boundaries. It has been possible, through the use of these funds also

to initiate development on many of the newly acquired refuges and in the Great Plains States to continue improvement of the easement refuges that have proved so successful in supplementing the major refuge system. The easement refuges are of great value for flood control, stock watering, and public recreation, as well as for wildlife.

The W. P. A. program of the Bureau has met with the approval of the communities in which the projects are located, not only because they have afforded work to those in need, but also because they are in themselves of distinct public advantage. Work was done through this medium on 73 refuges in the following States: North Dakota, South Dakota, Nebraska, Montana, Wyoming, Idaho, Minnesota, Wisconsin, Michigan, Illinois, Missouri, Arkansas, Oklahoma, Texas, Louisiana, Georgia, South Carolina, Maryland, Delaware, New York, and Maine.

Through an understanding with the W. P. A., all project applications submitted to that organization involving drainage are now referred to the Biological Survey for review to determine their effect on wildlife. Many projects involving drainage operations have in the past resulted in the unwarranted destruction of valuable wildlife habitat, but since project applications have been submitted to the Bureau, many wildlife marshes have been saved. Very often it has been found possible to preserve the wildlife values of an area through modification of the plans and operating procedures and still accomplish the results desired by sponsors of a project. In addition to the W. P. A. field allotment, the Biological Survey received $7,166.88 to employ 18 statistical and clerical relief workers for a period of 6 months in the Washington office.

COOPERATION OF NATIONAL YOUTH ADMINISTRATION

National Youth Administration labor also was utilized, chiefly on refuges in the Great Plains States, particularly on the easement refuges in North Dakota. The duties of the young men consist of observing wildlife, making nest and brood studies, repairing fences and signs, cleaning out ditches, gathering and planting seeds, and caring for thousands of newly planted trees. It would be difficult to accomplish this kind of work without this type of help. The comprehensive reports submitted by the young men each week keep the Biological Survey personnel in charge of the refuges constantly informed as to the varying conditions of water and wildlife.

ENGINEERING WORK FOR REFUGE DEVELOPMENT

The Bureau of Agricultural Engineering has continued its cooperation with the Bureau of Biological Survey in the supervision and execution of engineering work on the refuges. The assistance rendered included reconnaissance surveys for determining developmental possibilities, preparation of contour maps to facilitate the control of water so as to produce conditions favorable for wildlife, studies of underground water to determine existing water-table elevations and their fluctuations, and preparation of designs for structures on both existing and proposed refuges. With this cooperation, investigational and constructional work was accomplished on 60 areas.

Hydraulic engineers of the Biological Survey attended to the filing of water rights, protecting water supplies, and negotiating with various Government and State agencies on matters involving the use of the water on or affecting the refuges.

BIOLOGICAL DEVELOPMENT OF REFUGE AREAS

FOOD AND COVER PLANTINGS

The establishment of adequate food and cover for all forms of wildlife is an important phase of the biological development of proposed and existing refuges. Toward that end, more than 2,000,000 trees and shrubs were planted. This work was materially aided by transfer of large quantities of stock from the Forest Service and Soil Conservation Service. Part of the stock was set in lining-out plots pending sufficient development for use in the permanent locations selected.

As a measure of economy, refuge nurseries, with two exceptions, are being eliminated; one of these is on the Lower Souris Refuge, N. Dak., and the other on the Valentine Refuge, Nebr. Hereafter the refuge personnel will collect

seeds of desirable species and turn them over to a Forest Service or Soil Conservation Service nursery for the production of planting stock.

It was determined, through tests conducted on the Valentine Refuge, that the seeds of duckpotato (*Sagittaria*) have a high germinating capacity (up to 92 percent). They are readily collected, stored, transported, and planted, and at a much lower cost than the planting of tubers. It is hoped by their use to establish this species over larger areas. The duckpotato is an important food of swans and geese on the Mattamuskeet Refuge, N. C., and of the rare trumpeter swan on the Red Rock Lakes Refuge, Mont. In view of the shortage of the local food supply for these birds, extensive shoal-water areas will be sown with duckpotato seed. This should not only increase the food for the larger waterfowl but also control wave erosion, which tends to keep the water roily, thus inhibiting the development of desirable submerged aquatic vegetation. The successful introduction of saltmarsh bulrush (*Scirpus robustus*) far north of its present range indicates that this species may be important in augmenting the wildfowl food supply on the prairie sloughs.

Despite the fact that comparatively little propagating material of desirable species was available for collecting or planting last year, more than 50,000 pounds of seeds and tubers were sown. About 10,000 pounds of Muhlenberg's smartweed and wild millet were planted on earth-fill dikes to protect these structures from wave erosion and also to produce additional food. Hardstem bulrushes (*Scirpus acutus*) were extensively planted in many of the shoal-water areas, as well as along the dikes. These rushes are effective wave breakers and also supply excellent cover and some food for waterfowl.

About 4,600 acres of grain, mostly corn, barley, and winter wheat, were sown to furnish food during critical periods when natural supplies are either exhausted or unavailable. Well over 200,000 pounds of grain were harvested to use for feeding upland game birds and waterfowl and in reseeding. Rye and oats are now known to be of secondary importance in attracting birds, and extensive plantings of these species will be discontinued.

IMPROVED FACILITIES FOR NESTING AND SHELTER

The excavation of pot holes and the impoundment of water behind small coulee dams have created additional nesting habitats more acceptable to many species of ducks than the larger water areas. Together with further construction of nesting islands, they have favored substantially increased nesting populations. In some instances the increase has been more than 100 percent, and on the nesting islands, where predation is at a minimum, as many as 13 nests per acre have been found.

Many nesting boxes have been constructed and set up for tree-nesting ducks. Made to resemble a hollow trunk or natural cavity in the bole of a tree, these boxes have substantially increased the number of goldeneyes and wood ducks nesting on the refuges. In the absence of more desirable dens several nesting boxes have been appropriated also by raccoons, opossums, and squirrels.

The upland game shelters previously established were carefully studied to determine their value. On the basis of these observations additional winter shelters and feeding stations were constructed at favorable locations. Frequently 30 to 50 birds visited a single feeder in 1 day during inclement weather. The following were reported using the shelters during the winter: Sharp-tailed grouse, prairie chickens, ruffed grouse, bobwhites, Hungarian partridges, and ring-necked pheasants. During the course of a winter thousands of game birds seek food and cover in the shelters provided.

CONTROL OF PREDATORS AND PESTS

Concurrent with improvement of environmental conditions, it has been necessary to control predators attracted by concentrations of waterfowl and other game birds. Within its range the skunk continues to be a major predator, while in other areas the bull snake is of ranking importance. Other common predators are coyotes, weasels, turtles, crows, and magpies. Control campaigns on nesting refuges, based on careful study and field observation, have reduced the predation on duck eggs from 50 percent to 10 percent.

In several areas, hordes of grasshoppers threatened to destroy plantings newly established in the interests of wildlife conservation. Field crops grown to supply winter food were consumed. Hundreds of trees and shrubs were stripped of their

leaves, and often the tender bark of the smaller trees was completely removed. In an effort to check the damage the field personnel entered into an extensive control campaign in cooperation with local officials and met with a measure of success in protecting the vegetation on the refuges, as well as farm crops on adjacent lands.

ADMINISTRATION OF NATIONAL WILDLIFE REFUGES

At the beginning of the year 231 national wildlife refuges, aggregating 11,482,374 acres were under administration, and by the end of the year the number had been increased to 248, and the acreage to 11,650,358. Of these refuges, 232 are in the United States (7,557,221 acres) and 16 are in Alaska, Hawaii, and Puerto Rico (acreage estimated as 4,093,137). In addition, the Survey administers 14 smaller experimental and administrative units totaling 9,791 acres, on which also wildlife is protected. The classification of the 248 refuges and their acreage are shown in table 5.

TABLE 5.—*Number and extent of national wildlife refuges administered by the Bureau of Biological Survey*

Classification	Number	Acres
Migratory-waterfowl refuges (including easement refuges)	140	1,537,298
Refuges for other migratory birds	60	917,332
Wildlife refuges (for birds, mammals, and others forms)	10	4,062,894
Refuges chiefly for nongame birds	28	105,537
Big-game preserves and ranges [1]	10	5,027,297
Total	248	11,650,358

[1] The 2 Charles Sheldon antelope preserves, Nev., are now combined under a single administration.

PATROL AND MAINTENANCE

Patrol and maintenance have become items of major importance in the administration of the continental system of wildlife refuges. With the completion of the major development on many of the refuges and the consequent withdrawal of C. C. C. and W. P. A. forces, the administering personnel has been increased to protect the refuges properly against trespass and vandalism, and additional employees have been required to handle the enormous problems of predator control and grazing, haying, and other farming operations. Initiation of sharecropping agreements, by which local people may participate in the benefits derived from proper land use, again has increased responsibilities on the refuges.

Recreational use of the refuges also has gained rapidly as a result of the creation of lakes and ponds and the establishment of small picnic and other areas where local people may enjoy the out of doors and see something of the wildlife that is being protected by the Bureau.

Maintenance of the extensive water-impoundment structures is in itself a major undertaking and requires a staff of trained men and much specialized equipment to insure against damage by wind, water, ground-burrowing mammals, and other causes.

The laws and regulations for the administration of national wildlife refuges were published in the Service and Regulatory Announcement series (B. S. 90).

BIRD REFUGES

INCREASING VALUE TO WILDLIFE

There is no doubt that wildlife populations are benefited by the refuge system controlled by the Biological Survey. Each year sees an increase in the number of birds frequenting the refuges, and each year a few species never before seen in the vicinity of a particular refuge occur there. That the year just closed was no exception may be noted from the following comments on general conditions and on the results obtained from the Bureau's program of protection, establishment of additional water areas, construction of nesting islands, and other developments for the conservation of the important re-

source in bird life, under which even better results have been produced in many cases than anticipated. In addition to the general observations, some of the more important details are given for a few representative refuges, both bird and big game.

A total population of about 1,500,000 birds used the Sand Lake Refuge, S. Dak. Of this number about 441,500 were ducks and geese, 444,000 Franklin's gulls, 75,500 other water and shore birds,. 5,000 upland game birds, and the remainder songbirds. A total of 220 species of birds was identified on the refuge, of which 86 nested and 27 were seen there for the first time. Two nests of the white pelican were found on one of the artificial nesting islands—the only nesting record of this species in the State for many years.

Canvasback ducks, first reported as nesting on the Malheur Refuge, Oreg., in 1937, increased in 1938, when 11 nests and 2 broods of young were found prior to June 30. Birds now known to nest on this refuge number 117 species, including 13 kinds of ducks.

At the peak of the fall migration, 1,250,000 waterfowl were estimated to be using the Bear River Refuge, Utah. This represents a decided increase over the number present during the fall migration of the year before. Canada geese were unusually abundant during the spring migration. Several nests of the black-crowned night heron were found there as early as March 21, with the eggs hatched and the young birds in a healthy condition, while a fresh fall of snow covered the edge of the nests.

A decided increase was reported in the number of baldpates, blue-winged teals, redheads, and ruddy ducks using the Lake Bowdoin Refuge, Mont., during migration periods. The largest flight for years was reported for the Crescent Lake Refuge, Nebr., and the Boulder Canyon Refuge, Ariz. and Nev.

The nesting season on the Lower Souris Refuge, N. Dak., was not complete at the time of this writing, but an increase of a third to a half in the number of young ducks produced is reported. Five pairs of captive Canada geese nested and produced 18 young. These captives are the first birds of this species to nest on the area since it became a refuge, although they nested in large numbers locally before the Souris Valley was drained in the early 1900's. To prevent fighting, the birds were released during the nesting period, but all were driven back into the pen afterward. With these geese scattered over the marshes, migrating Canada geese should be induced to stop and nest.

Three water birds new to the Lower Souris Refuge nested, namely, Franklin's gull, horned grebe, and western grebe; and the first nests of Cooper's hawk, sharp-shinned hawk, bluebird, and phoebe were noted. These bring the total of birds observed nesting on this important refuge to 112 species, including 14 of ducks. White-tailed deer have increased at least 100 percent since 1935 and are now common over the refuge.

The largest spring run-off since the establishment of the Des Lacs Refuge, N. Dak., greatly improved waterfowl conditions there. During the spring and summer of 1938, 10,000 ducks used the refuge, as compared with 2,000 in 1937. About 2,500 young ducks have been produced up to the time of this report, principally pintails, shovelers, mallards, gadwalls, and blue-winged teals. A few horned grebes nested there for the first time. At least 100,000 shore birds were noted about Upper Des Lacs Lake in July.

Waterfowl conditions are also much improved on the nearby Lostwood Refuge, N. Dak., where the horned grebe, eared grebe, green-winged teal, and black tern nested for the first time since its establishment.

On the Mattamuskeet Refuge, N. C., geese increased from 15,000 in the winter of 1934–35 to 60,000 in 1937–38, and whistling swans from 5,000 to 16,000.

The trumpeter swan, which is now found only on the Red Rock Lakes Refuge, Mont., and the nearby Yellowstone National Park, is just about holding its own. Two years ago only 115 of these birds were counted in the United States; last year the number increased to 158; and this year, while only 148 were counted, an apparent decrease of 10, it is thought that not all the cygnets (young birds) were seen when the count was made. Of the 55 cygnets thus far seen, 51 were on the refuge (same number last year) and 4 in the park (last year 26). Last year there were 81 adults, and this year 93, of which 47 were in the park and 46 on the refuge.

EASEMENT REFUGES

The easement-refuge program, which was begun in North Dakota in 1935 and under which landowners grant to the Federal Government perpetual easements

that permit the development and operation of areas as waterfowl refuges, was extended into Montana and South Dakota. It now includes a total of 81 units, aggregating 135,113 acres, as compared with 75 in 1937, covering 118,777 acres. North Dakota has 71 of these, comprising 111,580 acres; Montana, 8, with 22,931 acres; and South Dakota, 2, with 602 acres.

The program in North Dakota is well on the way to completion, and results are apparent in the increased use of refuges by birds. The winter of 1937–38 saw the completion of the major water-impoundment structures on all projects in the State, and in the spring the areas were for the first time in condition to catch the run-off. Before the close of the year 35 of the 71 impoundments had reached spillway elevations. Others were from half to three-fourths full, and all had enough water to take care of young birds hatched within or near their boundaries.

Seven of the eight cabins planned for the largest of the North Dakota easement areas were completed and their grounds leveled and planted to grasses, trees, and shrubs. Three additional lookout towers were completed and several wells dug. W. P. A. carpenters constructed all the furniture used in the cabins, as well as several boats, large refuge signs, and desks, filing cabinets, and other office equipment. All fencing of cabin sites and water-impounding structures was completed, and small areas in which plants are being propagated were fenced for protection against livestock. All major dams and spillways and several roads were completed and all areas posted. In all, 280,480 trees and shrubs were planted on the areas that needed them most; and 8,829 pounds of seeds, including those of shrubs, cover plants, and aquatics, were collected on certain of the refuges where they grew in abundance and planted on others.

The spring of 1938 saw a noticeable increase in the number of birds using the North Dakota easement areas. In one marsh on the Long Lake Refuge it was estimated that there were more than 10,000 nests of Franklin's gulls. Since these birds feed their young almost entirely on grasshoppers, the quantity of these insects destroyed by this colony alone was enormous and their destruction a great boon to nearby farmers. The Chase Lake Refuge, the only breeding place in the State for pelicans, cormorants, and ring-billed and California gulls, produced larger numbers of these species than for many seasons past. One of the largest flights of geese seen in the State in recent years visited the easement refuges, and an exceptionally large flight of lesser scaups and ruddy ducks also stopped on them during spring migration.

The permanent recreational areas developed on several of the easement refuges were visited by several thousand people. On one Sunday more than 1,200 people picnicked on the recreational area on the Lake Ilo Refuge, near Dunn Center. The regard in which the people of North Dakota hold the Bureau's easement program is evidenced not only by the fact that the landowners and other residents have granted the perpetual easements but also by the letters and verbal comments of landowners, sportsmen, and businessmen and by the fact that various county and other political subdivisions have lent their facilities and equipment and have otherwise given their support and assistance. Particularly noteworthy is the fact that in spite of an exceptionally large flight of waterfowl this spring, not one instance of law violation on the easement refuges came to the attention of the Biological Survey.

Although the easement program in South Dakota and Montana is younger than that in North Dakota, progress has been made there in the establishment and development of several refuges, and a few areas, which were near enough completion to impound water, attracted waterfowl and other wildlife in sufficient numbers to indicate their future value in wildlife conservation. Easement refuges established during the year are listed in table 6.

TABLE 6.—*Bird refuges established during the fiscal year 1938, by gratuitous easements to the Federal Government*

State and refuge	County	Area	State and refuge	County	Area
Montana:		*Acres*	North Dakota:		*Acres*
Greedmans Coulee	Hill	3,360	Brumba	Towner	1,977
Hailstone	Stillwater	2,266	South Dakota:		
Halfbreed Lake	do	3,080	Twin Lakes	Miner	277
Lamesteer Reservoir	Wibaux	800			
			Total		11,760

OKEFENOKEE WILDLIFE REFUGE, GA.

The end of the fiscal year was also the conclusion of the first full year's administration of the Okefenokee Wildlife Refuge, in Charlton, Clinch, and Ware Counties, Ga., which at present comprises 293,826 acres of the vast Okefenokee Swamp. It extends from about 4 miles north of the Florida-Georgia line to within 10 miles of Waycross.

In administering this great wilderness area the Biological Survey is keeping it in as nearly a natural condition as possible. The C. C. C. camp there is engaged only in the necessary work of constructing a few trails on the edge of the swamp and in clearing out a canal 12 miles long to facilitate patrol. All travel within the swamp proper will be by boat runs and foot trails. The outside boundaries of the refuge are being posted, and for the purpose of administration, a group of headquarters buildings are being constructed on adjacent high ground. Most of the improvements undertaken by the C. C. C. camp are being done outside rather than in the swamp.

The complete protection given the area even during only 1 year has resulted in noteworthy increases in the numbers of many species of wildlife. Although the ducks congregating there had dwindled in recent years from hundreds of thousands to less than 12,000, an upward trend to about 25,000 was noted. The increase of wood ducks is particularly outstanding. Before the acquisition of the swamp by the Survey, these birds were hunted before the young could fly, and many were killed at their roosting places. The stopping of this slaughter has resulted in great increase.

Among the interesting birds making their home on the Okefenokee Refuge, many of which are badly in need of protection, are Florida crane, definitely on the increase; water turkey; swallow-tailed kite; great blue, Louisiana, little blue, Ward's and eastern green herons, the latter two of which nest on the refuge; and wood and white ibises.

Because of requests from wildlife lovers, naturalists, and others for permission to observe the unique wildlife of the area, access to the swamp is being allowed under permit. Nonsalaried, licensed guides conduct the visitors, thus preventing undue disturbance of the wildlife. Fishing, allowed only under permit and in restricted areas, has been unusually good. During a total of 5,606 man-days of fishing, 99,371 fishes were taken, principally perch, although a few bass, jackfish, catfish, and mudfish also were caught.

The fact that two or three Florida cranes, the wildest of wildlife, have become sufficiently unafraid to spend part of nearly every day within 50 yards of the canal through which boat traffic passes, eloquently shows what protection means to the wildlife of the swamp.

Supplementary regulations for the administration of the Okefenokee Refuge as approved in August were published in the series of Service and Regulatory Announcements (B. S. 89).

MEDICINE LAKE MIGRATORY WATERFOWL REFUGE, MONT.

Two full years of administration have seen the Medicine Lake Migratory Waterfowl Refuge, in Roosevelt and Sheridan Counties, Mont., change from a badly overgrazed and drought-stricken area to one in which newly created water-impoundment areas are within reasonable distance of the spill stage and where nesting cover has made a remarkable come-back. The spring run-off and summer rains have started the refuge well on its way to restoration.

Through the aid of the C. C. C. camp, which began work on the area May 21, 1937, and of W. P. A. labor, which has been utilized on the project since April 16, 1938, development has been outstanding; it includes the completion of a secondary headquarters building, construction of approximately 11 miles of refuge boundary, and 1 mile of inside fence, 20 acres of shelterbelt, and 90 acres of aquatic planting; construction of an overnight cabin and camp garage; riprapping of roads and dikes; and the building of 26 miles of roads and 29 miles of firebreaks. Widening the Muddy Creek diversion ditch entailed the excavation of about 47,550 cubic yards of earth. Lake and pond development, nest and brood studies, landscaping, general clean-up, the razing of undesirable structures, seed collection, and the construction of upland-game-bird shelters and feeders were other projects on which men from these two sources were engaged.

The refuge was a concentration point for numerous waterfowl during migration, particularly mallards, pintails, blue-winged teals, shovelers, redheads, ruddy

ducks, goldeneyes, and buffleheads. Goldeneyes, buffleheads, and redheads were present in much larger numbers than in 1937. A great many waterfowl nested, and broods of mallards, pintails, and blue-winged teals could be observed on all parts of the refuge. Gulls and terns bred on Gull Island, near the northeast corner of Medicine Lake, in such abundance that it was difficult to walk over the island without stepping on their eggs or young. Willets, avocets, and other shore birds also nested in abundance.

About 437 acres were planted to field crops for the use of the birds during the spring of 1938. Several hundred pounds of seeds and 1,200 tubers of aquatic plants, as well as some 78,000 trees and shrubs, also were planted.

During fall and early winter a number of upland-game-bird shelters were constructed of willow brush and marsh grass. Thirty-seven such shelters were placed at favorable locations over the refuge and supplied with self-feeders for use when natural food shortages or adverse weather conditions prevail. Pheasants and sharp-tailed grouse used these shelters and feeders extensively during the winter, but Hungarian partridges seemed to prefer to eat what they could find on the outside and except on one or two occasions did not enter the shelters. No noticeable losses occurred in any of the upland game birds during the winter.

Emergency grazing was permitted on the refuge for a month in the summer of 1937, during which time 89 cattle were carried on designated areas. A number of special-use permits were issued for cutting hay between August 1 and 15, and a total of 175 tons was harvested.

CAMAS MIGRATORY WATERFOWL REFUGE, IDAHO

The Camas Migratory Waterfowl Refuge, in Jefferson County, Idaho, is another of the Federal waterfowl sanctuaries placed under administration. Although a refuge manager was assigned to the area on August 1, it was not closed to hunting until October 8, when the Executive order establishing the refuge was issued. It is strategically situated on the important Snake River migration route and is an excellent nesting and resting place for ducks, coots, shore birds, and grebes.

Relatively few ducks stopped there during the fall, but at the height of the 1938 spring migration approximately 75,000 ducks, 300 Canada geese, and 400 whistling swans were noted. About 30,000 of the ducks were pintails and 20,000 mallards.

It was estimated that 10,000 ducks nested on the refuge in 1938, including mallards, gadwalls, baldpates, blue-winged and cinnamon teals, shovelers, pintails, redheads, canvasbacks, and ruddies. Coots, great blue and black-crowned night herons, American bitterns, white pelicans, long-billed curlews, avocets, willets, and killdeers also nested in numbers on the area.

About 40 antelope that ranged on the refuge until December returned in April. Their numbers will probably increase and they should eventually winter on the refuge. Pheasants were numerous during the fall, many remained all winter, and large numbers also nested. At least 600 sage hens were present until the first of December.

To get as much water as possible into existing sloughs and pot holes, necessary dikes were built, and these, together with a number of ditches, have produced excellent nesting conditions. The topography of the refuge is such that very little development is necessary to obtain almost ideal environment. A W. P. A. crew at work from December 1 to June 30 performed a variety of work, including the construction of 2 rock and earth diversion structures (with head gates), 75 small spill boxes, 50 ditch head gates, and 6 dikes (partially completed); cleaning out and repairing 13 miles of ditch and excavating 2 miles of new ditch; constructing 6 miles and graveling 1 mile of patrol road; peeling 2,100 fence posts; repairing 2,400 rods of fence; and razing 12 useless buildings. About 1,500 tons of hay were harvested and a maximum of 800 cattle were grazed on the refuge under special-use permits.

DELTA MIGRATORY WATERFOWL REFUGE, LA.

One of the Bureau's most important wintering sanctuaries for waterfowl is the Delta Migratory Waterfowl Refuge, in Plaquemines Parish, La., at the mouth of the Mississippi River, where almost a million ducks spent the past winter. An increase of at least 20 percent was noted in the numbers of wintering ducks, most common of which was the wigeon, closely followed by the pintail. Approximately 300,000 blue geese, 30,000 lesser snow geese, 5,000 Canada geese, and a few white-fronted and Hutchins's geese also wintered on the refuge. Food conditions

were excellent, and the geese remained all winter, to the exclusion of surrounding territory.

Among the other migrant birds noted on the refuge, most of them in great numbers, were greater and lesser yellowlegs, willets, and sandpipers. Gulls, terns, white pelicans, ibises, gallinules, ospreys, and coots also were common. Snowy and American egrets and six other species of herons remained all year in almost inestimable numbers.

An appreciable increase in all forms of wildlife on the refuge was noted, exceptional increments being observed in the populations of otters and white-tailed deer.

The use of W. P. A. labor was continued, with noteworthy results. Eight permanent buildings were completed, and other work, including repairs, painting, plumbing, roofing, and electrical wiring, was done on several others. Concrete walks and a splendid system of drainage ditches connecting with a large sump were constructed, and a levee was built around three sides of the headquarters site. Seven small boats, some now in use on other refuges, were constructed; and a number of wooden observation towers were built along the coast where needed. These towers have proved of great value both in the observation of wildlife and in the prevention of trespass. Ditches, bayous, and passes were cleaned out by the W. P. A. workers, thus opening them up to a steady flow of fresh clear water, which has effected a marked decrease in the growth of the troublesome alligatorweed.

BOMBAY HOOK MIGRATORY WATERFOWL REFUGE, DEL.

The Bombay Hook Migratory Waterfowl Refuge, in Kent County, Del., was established by Executive order of June 22, 1937. Before title to the lands was actually vested in the United States, however, with the approval of the former owners, it was possible to close the area to hunting during the season of 1936. As a consequence, waterfowl congregating on the refuge have received absolute protection for 2 years, and definite increases were noted this year in many species. During the height of the fall migration, an average of 36,000 ducks and 1,700 greater snow geese used the refuge; and a maximum of 25,000 ducks and 10,000 greater snow geese were noted during spring migration. Upland-game species, including rabbits, quails, pheasants, and doves, also showed great increases, not only because of the protection received, but also because of the mildness of the last two winters and the availability of natural food.

The natural salt marsh is attracting more and more breeding birds each year; and the fact that the area is so completely broken up by tidal streams reduces depredations to such an extent as greatly to increase the percentage of hatch. The shoveler, 8 broods of which were observed on the refuge in 1937 for the first time in its history, bred again this year, 18 broods being recorded. Other nesting ducks were the blue-winged teal, black duck, and mallard. Willets also nested on the refuge for the first time.

In the fall, a small group of W. P. A. laborers began work on the refuge, first devoting their time to improvements to facilitate transportation, since a large part of the development program planned will involve work in the marshes. Roads were graded and graveled, a dock was rebuilt, and a gunner's cabin converted into a patrol cabin. Five sets of undesirable farm buildings were razed, and a marine railway constructed. Late in the spring a C. C. C. camp was established on the refuge.

Four acres were prepared by C. C. C. and W. P. A. labor for lining out 53,775 seedlings to be transplanted to permanent locations next year. Fifty-two acres were planted to barley and rye, a part of which will be harvested for seed and feeding, and the remainder left standing for the birds. In addition, 38 acres were planted to corn.

During the year, 7,063 muskrats were taken under permits issued to trappers, and 120 tons of salt hay were removed.

MONTEZUMA MIGRATORY BIRD REFUGE, N. Y.

Although the Montezuma Migratory Bird Refuge, in Seneca, Wayne, and Cayuga Counties, N. Y., in the important Finger Lakes migratory-bird flyway, has been under administration less than a year, it is already proving its worth. During the fall migration the main duck concentration was of black ducks, but

a few mallards, teals, and wood ducks congregated in the sloughs. Great blue herons also were noted on the refuge at that time. During the winter, from 5,000 to 10,000 ducks, about 75 percent of which were canvasbacks and the rest lesser scaups, mallards, baldpates, teals, and mergansers, concentrated in the vicinity of the refuge and fed along the shallow coves, where there is an abundance of pondweeds. When the water development planned for the area is completed even larger numbers should be attracted. In the spring several whistling swans were observed in the vicinity of the refuge, the first, it is said, for 6 or 8 years.

The burned marsh areas, grown up with nightshade, goldenrod, smartweed, and various grasses, together with the upland within the refuge boundary, provided excellent food and cover for the pheasants, which were common. Forty or fifty deer were estimated to be on the area.

C. C. C. labor used on the refuge since October 1937 made great progress in development work, which included constructing levees, jetties, water-control structures, and a series of dikes to form lakes and ponds; fencing and marking boundaries; building roads and trails; razing undesirable buildings; and erecting headquarters buildings and a lookout tower. A total of 22,650 seedlings were received and lined out, to be planted later in permanent locations on this refuge or distributed to others as needed.

MOOSEHORN MIGRATORY BIRD REFUGE, MAINE

Established principally for the protection and preservation of the woodcock, the Moosehorn Migratory Bird Refuge, near the town of Calais, Washington County, Maine, was placed under administration. Observations made throughout the year of its wildlife disclosed that the principal species of waterfowl present were black ducks, ring-necked ducks, scaups, American and hooded mergansers, goldeneyes, and blue-winged teals. Black ducks, ring-necked ducks, and hooded mergansers nested. Woodcock were abundant breeders, and, with the freeze-up delayed, many remained until the latter part of December. Ruffed grouse, while scarce farther south in Maine, were abundant on the refuge; deer were numerous; and five black bears were reported.

Improvements were accomplished mainly by W. P. A. labor, beginning late in January, although the refuge was posted earlier by the refuge personnel. Work began with 36 men, but this quota was increased until at the end of the year 210 men were employed, principally in road, fire-line, and fence construction, deer-yard improvement, and general clean-up.

Two hundred and thirteen fishing permits were issued, and approximately 1,200 man-days were spent in fishing.

BITTER LAKES MIGRATORY WATERFOWL REFUGE, N. MEX.

The 21,524-acre Bitter Lakes Migratory Waterfowl Refuge, in the northern Pecos Valley, one of the most important winter concentration points for waterfowl in New Mexico, is one of the newer Federal refuges. In conjunction with the Carlsbad Refuge, 50 miles to the south, it will provide excellent resting and feeding facilities for waterfowl. In its original state it offered desirable feeding and resting areas, but it had also excellent possibilities for improvement. W. P. A. construction work began in December 1937, and though development has been under way for only 6 months, an enormous amount of work was accomplished. Approximately 13,100 lineal feet of ditch to conduct water on the area and 10,200 lineal feet of dikes to impound it were completed; 18,000 fence posts were cut, 12,000 of which were hauled to the refuge; 27 miles of boundary fence were built; and 9 miles of road partly completed. For the headquarters buildings, construction of which has been begun, approximately 17,000 adobe bricks were made by the W. P. A. workers. More than 15,000 seedlings of cover- and food-producing shrubs were planted. Bulrush transplanting was completed in some of the newly created ponds.

During the winter the refuge harbored approximately 7,000 ducks, including mallards, gadwalls, wigeons, lesser scaups, blue-winged, green-winged, and cinnamon teals, and shovelers, and several thousand geese also stopped for a few days to several weeks at various times during the fall and spring migrations. Scaled quail are common on the upland areas, although cover is at present limited, a result of years of overgrazing by cattle, sheep, and goats before the refuge was established.

BOULDER CANYON WILDLIFE REFUGE, ARIZ. AND NEV.

Development of the Boulder Canyon Wildlife Refuge, in Mohave County, Ariz., and Clark County, Nev., was begun after December 15, on which date arrangements were completed with the National Park Service for the services of 20 men from its C. C. C. camps at Kaolin, Nev. Early in spring, before the heavy migration started, five small feeding ponds were completed, covering an area of approximately 240 acres. Adjacent to these, 600 acres of abandoned wheatfields were flooded, thus providing excellent feeding grounds. Other work undertaken by the side camp and more or less completed included the construction of 3 miles of graveled road, clearing land preparatory to building a water-control structure, building dikes and a small diversion dam, and developing a 3-acre experimental aquatic food plot.

The number of waterfowl in the vicinity of the Boulder Canyon Refuge was the largest for many years. Outstanding among them were Canada geese, but large flocks of mallards, scaups, redheads, cinnamon teals, ruddy ducks, coots, grebes, and mergansers also were noted. Several species of waterfowl wintered on the refuge in fair numbers, principally Canada geese, mallards, scaups, redheads, and cinnamon teals. The upland-game-bird population consisted of Chinese pheasants and Gambel's quail, the latter nesting in fair abundance.

Since more water is now available, conditions are greatly improved for Nelson's bighorn sheep, which occur both on the refuge and in the surrounding ranges, it having been estimated that at least 100 were present during the year.

The fishing season on the Nevada side of the refuge was closed during part of the year, but on the Arizona side State laws permitted fishing throughout the year. Catfish and bass are the principal game fishes; and bass weighing as much as 7 pounds were caught.

SACRAMENTO MIGRATORY WATERFOWL REFUGE, CALIF.

The Sacramento Migratory Waterfowl Refuge, situated in the Sacramento Valley, in Glenn and Colusa Counties, Calif., and established by Executive order of February 27, 1937, consists primarily of the old Spaulding ranch, which was formerly used for rice farming and livestock grazing. It is now an important wintering sanctuary for migratory waterfowl, particularly geese, six species of which were observed there, in the order of abundance, as follows: Lesser snow (31,200), cackling (31,000), Hutchins's (30,000), white-fronted (22,800), Canada (3,000), and Ross's geese (100). Pintails were the chief wintering ducks, followed by cinnamon teals, baldpates, mallards, green-winged teals, and shovelers. Early fall rains made conditions ideal for waterfowl: green food was available for the geese, and the ponds were kept fresh for the ducks.

Chinese pheasants, valley quail, mourning doves, and band-tailed pigeons were the upland game birds noted. The pheasants, of which 3,250 were estimated to be on the refuge, made extensive use of the food patches planted for waterfowl. Many shore birds frequented the area, and several species nested in large numbers.

The C. C. C. camp, assigned on May 15, 1937, continued development work, making the area more attractive to wildlife and easier to administer. Among the accomplishments were completion of 9 water-control structures and 1,933 rods of fence, graveling of almost 13 miles of roads, construction of dikes involving the use of 173,299 cubic yards of material, cleaning channels, planting 40 acres to winter grain for the birds and 300 acres to crops, and planting 2 old ponds on the refuge with pondweed, millet, rice, and prairie bulrush.

ARANSAS MIGRATORY WATERFOWL REFUGE, TEX.

Title to the major tract (approximately 46,000 acres) on the Aransas Migratory Waterfowl Refuge, in Aransas and Refugio Counties, Tex., was taken in December 1937. Acquisition of this area makes a most important addition to the refuge system, as it is advantageously situated in the great Texas Gulf coast wintering area for waterfowl. For a number of years the former owners had restricted hunting and trespass, and as a result the area has been extensively used by upland game species as well as waterfowl. Since regular

refuge personnel has not yet been assigned, detailed information is lacking as to waterfowl use of the area during the past winter. The reconnaissance studies, which were the basis for the acquisition of the area, however, adequately reveal its importance as a winter resort for migratory waterfowl.

In addition to supporting a large population of wintering ducks and geese, the refuge, because of its relative isolation, is one of the wintering places of the rare whooping crane, four of which were observed. Summer residents among the interesting species include the roseate spoonbill, great and little blue herons, Louisiana heron, snowy, American, and reddish egrets, black-crowned night heron, wood ibis, and mottled duck. The refuge also supports a varied population of mammals, including approximately 2,500 white-tailed deer, a few white-collared peccaries, and large numbers of raccoons, opossums, and armadillos. About 100 wild turkeys and large numbers of bobwhites also inhabit the area. The extensive thickets of live oaks, wild grapes, dewberries, and other plants produce almost unlimited food for these upland game species.

Before the refuge was established, large numbers of domestic hogs were permitted to roam over the area, to utilize the annual mast crop. Immediately after title was acquired, trapping operations were begun to eliminate these animals, not only to preserve the mast for the upland game but also to halt depredations on ground-nesting birds.

Most of the time of a small crew of W. P. A. workers assigned to the refuge in April has been spent in reconditioning truck trails needed for later development work, and in June construction was begun on camp buildings to be occupied by a C. C. C. company in October.

BIG-GAME PRESERVES AND RANGES

IMPROVED CONDITIONS

The herds of big-game animals on the preserves and ranges administered by the Biological Survey are benefiting by greatly improved grazing conditions. An abundance of moisture at the Charles Sheldon Antelope Refuge and Range, Nev., and the Wichita Mountains Wildlife Refuge, Okla., has resulted in the finest growth of forage in years. Elimination of domestic livestock from the Wichita Refuge has contributed largely to the improved condition of its ranges, and all of the many lakes in its 20,000-acre recreational area were filled by rains. At the Charles Sheldon Refuge all the dry lakes and reservoirs were filled, and all the springs now supply an abundance of water for the roving antelope, deer, and other wildlife.

At the National Bison Range, Mont., abundant rain has caused a fine growth of grass, and the range is recovering from the severe damage caused by the drought and grasshopper infestations of previous years. At the Fort Niobrara Game Preserve, Nebr., there was twice as much spring rainfall as last year, resulting in greatly improved forage conditions. While dry weather still prevailed in the section of the Sullys Hill Game Preserve, N. Dak., there has been enough moisture to keep the vegetation growing, and at the end of the year there was plenty of grass for the animals.

The buffalo herds on the four fenced preserves have increased satisfactorily, as have the Texas longhorns on the Wichita Refuge and on the Fort Niobrara Preserve. Installation of an adequate scale at the Wichita Refuge made it possible for the first time to weigh some of the longhorns, and two of the largest steers, each about 10 years old, weighed 2,045 and 2,035 pounds, respectively.

In order to keep the big-game herds at optimum size, to prevent overgrazing of the pastures, and to avoid resort to excessive winter feeding, the usual practice of disposing of the annual surplus was followed. In all, 259 buffalo, 215 elk, and 58 mule deer were removed from the herds, but as many of these as possible were used for breeding, restocking, and exhibition purposes.

The growing number of visitors indicates a wide interest in big-game preserves. With the aid of W. P. A. workers and employees of the C. C. C. camps much has been accomplished in improving the preserves by the construction of roads, trails, dams, and water-storage units, as well as buildings for personnel and equipment. Extensive recreational use of the Wichita Refuge—camping, swimming, fishing, and picnicking—attracted more than a quarter of a million people.

Two mimeographed leaflets on big-game preserves were issued, entitled "Preserves and Ranges Maintained for Buffalo and Other Big Game" (BS–95); and "Fort Niobrara Game Preserve, Nebraska" (BS–109). The numbers of animals on fenced preserves maintained by the Survey are shown in table 7.

TABLE 7.—*Animals on fenced big-game preserves maintained by the Bureau of Biological Survey*[1]

Preserve	Buffalo	Elk[2]	Antelope	Bighorn sheep	Deer		Total[3]	Young born in calendar year 1937[4]	
					Whitetail	Mule[2]		Buffalo	Bighorn sheep
National Bison Range, Mont.	340	22	-------	48	[2] 23	109	542	83	8
Fort Niobrara Game Preserve, Nebr.[5]	134	27	-------	-------	7	5	173	30	-------
Sullys Hill Game Preserve, N. Dak.	22	33	-------	-------	[2] 12	-------	67	6	-------
Wichita Mountains Wildlife Refuge, Okla.[5]	345	204	15	-------	[2] 773	-------	1,337	53	-------
Total	841	286	15	48	[2] 815	114	2,119	172	8

[1] With the exception of those of young born, figures are for June 30, 1938. No antelope were born on these preserves during the calendar year.
[2] Estimated.
[3] Including estimates.
[4] Young of elk and deer omitted, as in most cases only estimates could be made, but during the calendar year approximately 70 elk calves, 15 fawns of mule deer, and 60 of white-tailed deer were counted on these preserves.
[5] There are also 132 Texas longhorns on the Wichita Mountains Refuge and 14 on the Fort Niobrara preserve, including 26 calves of 1938, 4 of which are in the herd at Fort Niobrara.

ELK REFUGE, WYO.

Numerous visitors from various parts of Wyoming and adjacent States were able to see the elk concentrated on their winter feeding grounds on the Elk Refuge, Wyo., when the State Highway Department undertook during the winter to keep open the road that leads in from the nearby town of Jackson.

An unusual winter followed a heavy rain in December that melted much of the snow on the meadowlands; alternate storms and thawing and freezing in January formed a heavy layer of ice over most of the refuge, thus depriving the animals of much of the forage growth normally accessible to them. Early in February the feed that had not become frozen down had been grazed fairly close and the elk began leaving. This made it necessary to begin feeding on February 12, and one band of about 3,000 elk was fed on the meadows so close to the road that visitors had excellent opportunity to view them. Many persons also were taken around the feeding grounds on sleighs used to carry the hay. If the great display of interest results in the roads being kept open in the future, the Elk Refuge will become one of the principal winter attractions for the public in that section.

Records kept during the hunting season in 1937, when checking stations were maintained by the Forest Service and the State Game Department, show 3,219 elk taken. While no information is available as to the number killed by local hunters, it is believed that approximately 400 were so taken, bringing the total kill during the season to some 3,600.

A census of the elk in the Jackson Hole herd taken in cooperation with the State Game Commission and the Forest Service during March showed a total of 6,206 on the three feeding grounds and 1,576 wintering on adjacent areas outside. The elk inside were counted by men on the ground, while those wintering outside were counted from an airplane. Thirty hours' flying time was required to complete the count, which showed a total of 17,370 elk in the herd.

Among the elk concentrated on the feeding grounds there was a loss of 158—120 calves, 27 cows, and 11 bulls. Based on the airplane count, it was estimated that there was a winter loss of about 15 percent in the upper Gros Ventre Valley, or some 600 head, of which about three-fourths were calves. An unusually severe blizzard late in March contributed materially to these losses.

Feeding operations ended on April 16, and during the 64 days of feeding the elk consumed approximately 1,700 tons of hay. More than 1,600 tons was harvested on the refuge during the summer of 1937, and approximately 4,000 tons was carried over from the previous winter. To prevent loss through deterioration, 1,220 tons of surplus hay was sold to nearby ranchers, and 616 tons of baled hay was shipped to the National Bison Range, Mont., for feeding

the buffalo herd. After feeding operations were concluded there remained at the refuge about 1,475 tons of hay and 130 tons of cottonseed cake for next winter, to which will be added the 1938 harvest.

The elk were slow in leaving the refuge, as the snow did not melt farther north until late in May. Approximately 1,000 were driven from the refuge meadowlands north across the Gros Ventre River the latter part of May toward their summer range, but a few were still left on the refuge late in June, having drifted in from nearby foothills.

Seventeen mule deer ranged on the butte in the refuge during the early spring, and about 30 of these animals wintered in the northwest section of the refuge. Forty bighorn sheep wintered near the western boundary, and late in March seven moose were seen in the Gros Ventre River bottoms in the refuge. Fewer waterfowl were on the refuge during the fall migration than in the previous year, as many birds visiting the valley remained nearer the grainfields in which they feed. Hunters reported a larger number of Canada geese in areas along the Snake River than for several years. Fifty-two sage grouse were observed on the refuge. Coyotes were more numerous than ever during the winter but did little if any damage to the elk.

Improvements at the refuge included the roofing of eight hay sheds previously framed, and the construction of 1¼ miles of telephone line. W. P. A. workers, under the supervision of a regular Bureau employee, built three two-room cabins for housing men handling irrigation work. A gas and oil house was built, a dwelling on a recently acquired tract was repaired and remodeled, 250 logs were hauled in for use in constructing a new headquarters building, 540 rods of buck-and-pole fence was built, 1,600 rods of pole fencing removed from interior tracts, and 16 miles of the boundary line posted.

HART MOUNTAIN ANTELOPE REFUGE, OREG.

More forage than usual remained on the Hart Mountain Antelope Refuge, Oreg., at the end of the summer, and during the fall and winter unusually heavy snows and rains produced an abundance of water. The 3 months January to March brought the most snow and the greatest rainfall that has been recorded in this locality in more than 20 years. This produced a very satisfactory range condition, and it is hoped it heralds the return of wet years.

Delayed warm weather made all the grasses and plants slow to start, but their later growth and restoration, even on depleted areas, has been remarkable. Full advantage will be derived from the seeding of the present satisfactory cover, since grazing by domestic stock has been substantially curtailed.

The antelope reappeared on the refuge on April 7 and, with exceptionally favorable conditions and nearly total absence of livestock, have been more widely distributed over the tablelands than for many years. There was a marked tendency of the more venturesome animals to follow the receding snow lines to the hills and mountains. Wide distribution was a factor in preventing the sighting of numbers of fawns until early in June, but by the middle of the month they were seen traveling with their mothers when the does were disturbed. Not only the antelope but the mule deer appear to be in uniformly good condition.

Absence of domestic sheep from the refuge during the last half of the year reduced the ordinary food of predators and appears to have lessened their abundance. Some coyote dens were destroyed on the refuge, and other control operations continued.

Sage grouse were not greatly in evidence at the close of the year, and while broods of four to nine were seen throughout June, they were not yet able to fly readily, so that accurate counts were impossible. Moisture and food conditions were excellent for their summer development. At the end of the year ducks, mainly pintails and teals, were present on all the lakes.

Development work included the improvement of 79 miles of desert-type roads by the removal of high centers and loose rocks, and improvement or rebuilding of approximately 25 miles of other roads. In addition, 4 miles of travel ways were made through the rocks, a small bridge was rebuilt, dams were replaced in several channels of a creek, and fences were repaired. The establishment of a C. C. C. camp made possible the inauguration of an improvement program that includes the construction of administration buildings and the development of water-control structures, springs, roads, and trails.

DESERT GAME RANGE, NEV.

The Desert Game Range, Nev., embracing 2,022,000 acres, established by Executive order of May 20, 1936, primarily for the conservation of Nelson's bighorn sheep, was placed under administration, during the year. An old cabin was put in condition to serve as quarters for the superintendent until better accommodations can be provided. This is one of the areas administered jointly by the Biological Survey and the Grazing Division of the Department of the Interior in connection with the organization of grazing districts for livestock under the Taylor Grazing Act of 1934.

The large bands of bighorns that in former years frequented the high desert ranges have been greatly reduced by various causes so that they have just about held their own in some sections and in others have become extinct. Small bands of 4 to 12 have been seen on various parts of the range, and while it has not yet been possible to compile a satisfactory census of the whole area, the range is being extensively patrolled with this in view. Springs are being systematically located and studied for future development and for the conservation of the scant supply of water in this extremely arid section. Careful observations are also being made of the feeding habits, forage plants, lambing beds, presence and effect of predators, and other factors bearing on the welfare and upbuilding of the animals on the refuge.

Through the cooperation of the Forest Service and sportsmen of Clark County, Nev., 20 antelope fawns were received on June 15, from the Charles Sheldon Antelope Refuge, Nev., where they had been picked up on the refuge soon after birth and raised on the bottle. It is hoped that these may form the nucleus for reestablishing antelope on this range.

ADMINISTRATION OF WILDLIFE-CONSERVATION LAWS

Federal statutes administered by the Bureau of Biological Survey for the conservation and restoration of wildlife are as follows: The Lacey Act of 1900, as amended June 15, 1935, regulating shipments interstate and in foreign commerce of wild animals, their dead bodies, or parts thereof, and the importation of live birds and mammals from foreign countries; the Migratory Bird Treaty Act of 1918, protecting birds that migrate between the United States and Canada, as amended June 26, 1936, to extend its provisions to the treaty concluded March 15, 1937, protecting birds that migrate between the United States and Mexico and regulating the movement of game mammals and parts thereof between the two countries; the Migratory Bird Conservation Act of 1929, authorizing the establishment of bird refuges; the Migratory Bird Hunting Stamp Act of 1934, as amended June 15, 1935, to aid in refuge establishment; the Federal Aid to States in Wildlife Restoration Act of 1937; a law (sec. 84, Criminal Code) protecting wildlife and property on national wildlife refuges; and, through the Alaska Game Commission, the Alaska Game Law of 1925, as amended June 25, 1938.

To make the text of these laws readily available to Federal and State law-enforcement officers, legislative committees, conservationists, and others interested, a compilation was published in the series of Service and Regulatory Announcements (B. S. 87), and various regulations thereunder separately.

REGULATORY ACTION

The Migratory Bird Treaty Act regulations were amended in 1937 to include the migratory birds embraced in the Mexican convention additional to those covered by the treaty with Great Britain and also to include certain game mammals and make provision for their transportation to and from Mexico. These regulations provided an open season on migratory waterfowl of 30 consecutive shooting days in each of three transcontinental zones, beginning in the northern zone on October 9, in the intermediate zone on November 1, and in the southern zone on November 27. Full protection was continued on canvasback, redhead, wood, ruddy, and bufflehead ducks, Ross's goose, and swans throughout the country, and on the snow goose and brant in the States bordering on the Atlantic Ocean.

The restrictions on taking waterfowl by means of bait or by the use of live decoys, and the three-shell limit on repeating shotguns also remained in effect. The hours for shooting waterfowl and coots were from 7 a. m. to 4 p. m. Wil

son's snipe, rails and gallinules (other than coot), woodcock, mourning doves, white-winged doves, and band-tailed pigeons were permitted to be taken from 7 a. m. to sunset. The daily bag and possession limits on ducks remained unchanged, but on geese and brant the number permitted to be taken and possessed was increased from four to five. The limits on rails and gallinules remained unchanged except that for the sora, which was reduced from 25 to 15, and that on coots, increased from 15 to 25. The limit for Wilson's snipe, or jacksnipe, remained at 15 and for the woodcock at 4. The bag limit on mourning doves was reduced from 20 to 15. White-winged doves were added to the federally protected game birds and for these and mourning doves the limit was fixed at 15 in the aggregate of both kinds. Band-tailed pigeons remained in their previous status, with a maximum bag of 10. The interstate shipment of migratory game birds remained restricted to not more than 1 day's bag in a calendar week.

The regulations for 1937 [2] were published in the series of Service and Regulatory Announcements (B. S. 88), and the open-season dates and other information regarding hunting were shown on a poster (No. 60–Bi). A migratory-waterfowl hunting-stamp poster (No. 59–Bi) also was issued. Other publications relating to conservation laws included a mimeographed abstract of State fur laws affecting trapping seasons, possession, and the sale and shipment of pelts (Leaflet B. S. 97); and the annual directory of Federal, State, and Canadian game-protection officials (Miscellaneous Publication No. 276). At the close of the year there was in press the annual volume of the Department's Agricultural Statistics, 1938, containing tables (625 and 626) of hunter's licenses issued by States, with total money returns for the seasons 1935 and 1936, and sales of migratory-bird hunting stamps for the years 1934–36. Many press statements on wildlife-conservation subjects were issued for educational purposes and also to advise the public of the results of law enforcement as well as of changes in the regulations. Amendments to the regulations under the Alaska Game Law were published in Alaska Game Commission Circular No. 14.

According to a plan, advanced by the Survey, and already endorsed by a majority of the State commissioners, representatives of the States will meet annually with officials of the Bureau to discuss conditions affecting migratory game birds and their pursuit by hunters. The State leaders met with members of the Biological Survey in June and were a great aid in preparing the draft of the hunting regulations for the 1938 season.

WORK OF GAME-MANAGEMENT AGENTS

Working under central direction and the general supervision of regional directors, 41 game-management agents covered the entire country in enforcing Federal game laws in assigned districts and were aided by 19 deputy agents, who were given seasonal employment of about 6 months each. The agents spent most of their time patrolling important waterfowl-concentration areas where game is likely to be taken illegally, and arrangements were made for the deputy agents to be readily available to investigate reported violations. More than 6,500,000 game-license holders (1,500,000 of whom are potential waterfowl hunters), the several State game departments, and millions of citizens interested in birds and other wild animals look to the Biological Survey for leadership in the enforcement of game laws and wildlife protection.

A VARIED AND HAZARDOUS TASK

The wildlife resource of this country, of inestimable value, may be preserved and enjoyed only as it is protected. The game-management agents are actively engaged in furnishing this protection and in conducting educational programs in conservation. In this latter work they write for newspapers and talk before schools and sportsmen's clubs and over the radio. When citizens in a community complain of damage to crops by game, these agents are available to verify the reports. When beavers become destructive to dikes and drainage ditches, the agents are called upon for advice and assistance in capturing and transplanting them to headwaters of streams where they become water conservators and are preserved as valuable fur animals.

[2] Regulations for the season 1938, adopted by the Secretary after the close of the fiscal year, were approved and proclaimed by the President on July 16, 1938 (3 F. R. 1766; S. R. A.–B. S. 92).

Each winter the game-management agents join with other Bureau employees and a host of cooperators in the annual waterfowl census. Each summer the agents carefully cover their respective districts to ascertain the relative abundance of nesting migratory birds and the success of the spring hatch. When called upon, some of the agents journey to the great waterfowl breeding areas of the Canadian Provinces to carry on these investigations, which are of material assistance to the Bureau in recommending regulations for the hunting of migratory birds.

Outrunning violators, rowing boats, swimming rivers, wading marshes, and being liable to exposure and physical encounter and other risks, including assaults, accidental shooting, and failure of equipment, are not uncommon incidents in the work of the agents and make it necessary that they be alert mentally as well as physically. Tact and understanding of local conditions and a fair-minded approach to all problems confronting the men also are essential qualifications. In the hunting season they may follow the migrations of birds from Canada to Mexico, and each year they travel on the average about 30,000 miles, by car or train, on horseback, on foot, in boats, and on snowshoes, and even use airplanes to apprehend violators when necessary. A few instances of the hazards faced by game-management agents, occurring during the year may be cited:

On February 26, 1938, two deputy agents apprehended three men violating game laws on a Federal refuge at midnight. Preceding the arrest there was a struggle in which a deputy shot one of the violators in the shoulder after this man had cut a severe gash in a fellow deputy's head and threatened to kill him rather than submit to arrest.

Deputy Agent Delbert Hubbard died at Poplar Bluff, Mo., on January 11, 1938, of an accidental gunshot wound, received while pursuing law violators.

On November 21, 1938, a deputy on patrol duty with a State investigator in Illinois found three men unlawfully hunting waterfowl and seized their ducks and guns. Later in the day the three men, temporarily released, and accompanied by a fourth, accosted the officers, and while the fourth man trained a shotgun on them, the other three obtained their confiscated property. Later on, however, the guns and ducks were recovered, the violators were tried and sentenced to jail for resisting Federal officers.

COOPERATION WITH STATES

That the cooperative relations between State officers and the Survey's law-enforcement personnel are effective may be noted in the following record:

The Bureau's agents furnished information in 1,637 cases brought into State courts involving violations other than illegal transactions in furs. These cases, prosecuted in the courts of 40 States, resulted in 39 jail sentences and fines to the amount of $45,972.

Game officials in 35 States were furnished records by Survey agents of 4,190 possible illegal transactions in furs, and as a result 141 cases in State courts were closed by fines and costs totaling $3,106, and 1 jail sentence of 30 days was imposed.

APPREHENSION OF VIOLATORS

The activities of the Federal agents are exemplified in the following apprehensions:

In a drive against the sale of game, a large number of ducks were seized in a Texas night club, the proprietor of which had been making a market for thousands of waterfowl and other game hunted in and out of season. In March the club proprietor was sentenced to 13 months in Leavenworth Penitentiary, on the charge of conspiracy to violate the Migratory Bird Treaty Act. A number of his market gunners also received jail sentences. The club catered to a wealthy clientele, and 23 persons who were buying the illegal offerings were fined in State court sums aggregating $1,315. State game wardens aided Federal agents in these cases.

In another drive to break up commercializing game in an area in Arkansas, Mississippi, and Tennessee within 100 miles of Memphis, Tenn., Federal agents apprehended 52 persons for alleged illegal slaughter, interstate transportation, and sale of wild ducks, quail, and woodcock. Evidence obtained included more than 3,000 illegally possessed waterfowl and other game birds. Most of the

market gunners were old offenders and had been hunting the marshes and quail ranges of the three States and selling their bags to individuals, restaurants, hotels, and night clubs. Evidence against them was obtained by more than 18 months of undercover work. The 52 persons arrested were arraigned before United States commissioners and in State courts in the three States. Some of the minor cases, prosecuted against 18 men and 2 women, resulted in fines and costs totaling $1,065. In addition, the courts suspended three 60-day jail sentences and $125 in fines. Three of the offenders are serving time in jail in lieu of payment. In Mississippi and Arkansas, 32 of the men brought before United States commissioners were placed under bonds totaling $21,850, to appear for trial in Federal courts for violations of the Migratory Bird Treaty and Lacey Acts. Not all these cases had come to trial at the close of the fiscal year. State game agents aided in the last stages of this drive, and when the undercover work was in progress very material assistance was received from the Tri-State Game and Fish Association and the American Wildlife Institute.

A fur trader operating in Idaho and Nevada and selling his furs in New York City was fined $500 and sentenced to a year and a day in a Federal penitentiary last March for unlawful transportation of 362 beaver pelts. He was convicted of conspiracy to violate the Lacey Act. This man made a market for the pelts of beavers trapped in Idaho, which were shipped by truck into Nevada and from there sent to New York City for sale. The arrest of the head of the ring dealing illegally in furs broke up this racket.

Three men charged with illegally importing Canadian silver fox furs into New York City received punishment in Federal court, and 48 skins, as well as two automobiles used in transporting them, were seized. The men had been smuggling furs from Canada into this country for several years. Customs officials and New York detectives aided in this case.

During a 3-month period more than 500 wild-duck traps were destroyed on Maryland and Virginia marshes in an effort to stamp out the illegal practice of trapping and marketing waterfowl. Most of the ducks trapped in this section are bought by "duck bootleggers" who in turn sell them in large eastern cities. Hundreds of ducks—mostly pintails, mallards, and black ducks—were liberated from the traps after being banded by the agents for further study of their migratory habits. Progress is being made in breaking up the practice of trapping ducks, but much still remains to be done. The cooperation of sportsmen, State game and police officials, and others has helped the Federal agents greatly in this work.

Of the 669 new cases filed in Federal courts, 343 were disposed of, resulting in 280 convictions. That more than 81 percent of the prosecutions in new cases thus filed and disposed of resulted in convictions indicates that the agents are neither prosecuting people needlessly nor making useless arrests.

In the enforcement activities 41 game-management agents and 19 deputies gathered information in cooperation with State officers, supplemented evidence, or furnished all the evidence themselves in a total of 2,443 game-law violation cases brought into State and Federal courts.

VIOLATIONS AND PENALTIES IMPOSED

MIGRATORY BIRD TREATY ACT CASES

An increase of 59 cases over the preceding year reported for Federal prosecution, an increase in the number of convictions obtained, and a slight decrease in cases disposed of is shown in table 8. In 137 violations, prosecution was not recommended because of lack of evidence, youthfulness of accused, or other satisfactory reasons. Fines ranging from $1 to $500 and costs, aggregating $12,456, were imposed in Federal courts; and in 22 cases, fines aggregating $969 were suspended. Jail sentences were as follows: 1 day (8), 4 days (3), 10 days (3), 20 days (3), 30 days (12), 40 days (1), 60 days (4), 73 days (1), 90 days (1), 120 days (1), 6 months (1), 13 months (1, penitentiary). Suspended jail sentences were as follows: 16 days (1), 30 days (4), 60 days (2), 90 days (3), 4 months (4), 6 months (5), 1 year (1), 13 months (2). Probation terms were as follows: 30 days (4), 4 months (1), 6 months (9), 8 months (3), 10 months (3), 18 months (1), 1 year (12), 2 years (8), 3 years (2), 5 years (8).

TABLE 8.—*Cases of violation of the Migratory Bird Treaty Act disposed of during the fiscal year and cases still pending on June 30, 1938*

Disposed of	Number	Pending	Number
Convictions	576	From former year	324
Dismissals	68	New cases	669
Nol-prossed	16		
Jury trial not guilty	24	Total	993
Closed without prosecution	38	Disposed of	730
No bill	5		
Closed by death	3	Pending at end of year	263
Total	730		

The following court sentences are noteworthy:

Purchasing and selling wild ducks: Texas (1), 13 months in Leavenworth Penitentiary. Unlawfully killing and selling ducks (2), 13 months each in Leavenworth, suspended for 3 years. Selling ducks: Michigan (1), 60 days at Milan Federal Prison; Arkansas (3), $100 fine each; Louisiana (1), 60 days in jail and 5 years on probation. Purchasing ducks: Michigan (1), $130 fine.

Exceeding possession limit on ducks: California (1), $300 fine and 60-day jail sentence.

Hunting ducks by means of bait and live decoys: Illinois (10), $135 fine each. By bait, Arkansas (3), $50 fine each.

Trapping wild ducks: Maryland (1), $500 fine.

Using motorboat to rally and stir up ducks: Ohio (2), one, $329.50 fine and suspended jail sentence of 3 months; the other, $100 fine and jail sentence of 3 months.

Killing and possessing ducks in close season: Texas (1), $250 fine and 2 years' probation; Illinois (1), 30 days in jail. Possessing ducks in close season: Louisiana (1), 6 months in jail and (1), 30 days in jail. Possessing redhead ducks: Michigan (1), $100 fine and 4 months in jail.

Killing a swan: Wisconsin (1), $100 fine.

Killing geese in close season: Washington (1), $100 fine; Texas (1), 73 days in jail.

Hunting game birds with unplugged gun and after 4 p. m.: Michigan (2), $150 fine each.

Hunting waterfowl without a duck stamp: Michigan (1), 60-day jail sentence suspended, on probation 2 years.

Hunting doves with unplugged gun: Texas (1), $50 fine; Kentucky (2), $50 fine each; Georgia (4), 30-day jail sentence each. Killing doves over bait: Tennessee (1), $224 fine.

Shipping live quail interstate: Alabama (2), jury trial, $100 fine, and 60 days each in jail.

Hunting and possessing Hudsonian curlew: California (2), one, $200 fine; the other $100 fine and 2 years on probation.

Trapping painted buntings: Louisiana (4), 4 months' jail sentences suspended and probation for 5 years. Selling buntings (1) 30 days in jail.

MIGRATORY BIRD CONSERVATION ACT CASES

For violations of the Migratory Bird Conservation Act, 11 new cases were submitted, 3 were pending from the previous year, and 10 were closed as follows: $25 fine (1); $10 fine (2); probation for 6 months (4); probation for 2 years (1); jail sentences of 30 days (2); leaving 4 cases pending.

MIGRATORY BIRD HUNTING STAMP ACT CASES

New cases submitted for violations of the Migratory Bird Hunting Stamp Act totaled 74. Of this year's pending and new cases, 76 were successfully concluded, the fines ranging from $1 to $25 and aggregating $339.50. In addition two fines of $25 each were suspended. Other cases were disposed of as follows: Nol-prossed, 4; dismissed, 12; closed without prosecution, 3; closed by death, 1; no bill found, 1; verdict of not guilty, 3. Sentences were as follows: 1 day (1); 60 days (1) suspended for 2 years; probation 1 year (2); 2 years (2); 6 months (1); 2 months (1). Cases still pending, 45. It is significant to note that more than 780,000 hunters and others purchased these $1 stamps, and the returns exceeded the $635,001 realized from the first-year sales (of 1935) by about 23 percent.

WILDLIFE REFUGE TRESPASS CASES

Under the law protecting wildlife and Government property on national wildlife refuges, 32 new cases were reported and 3 were pending from the previous year. Of the 35, 14 were closed, 1 in Arkansas, 1 in Delaware, 2 in Nevada, 6 in Montana, and 1 in California, by fines aggregating $142, and 3 in California,

where the defendants were placed on probation for 6 months. Cases still pending, 21.

LACEY ACT CASES

Eleven new cases of illegal interstate shipment were reported for prosecution in the following States: Nevada (4), of beavers to New York; Michigan (1), illegal transportation of deer to Wisconsin; Texas (1), transporting interstate bighorn sheep illegally taken in Wyoming; Missouri (4), transporting illegal beaver skins from Illinois; California (1), mismarking beavers and muskrats shipped to St. Louis. Of these new cases, nine were disposed of as follows: California (1), $50 fine; Missouri (1), $100, (1), $50 fine, (2), dismissed; Texas (1), $200 fine (suspended for 5 years); Michigan (1), 6 months in jail (suspended on 2 years' probation); Nevada (1), a year and a day at McNeil Island and a $500 fine, (1), dismissed due to spending 4½ months in jail prior to arraignment. Previously pending cases were disposed of by the following fines: Missouri, illegal transportation of beavers from Colorado to St. Louis (1), $300, (1), $100, (1), $50; Ohio, illegally transporting a deer from Michigan (1), $100 and costs; Montana, illegal transportation of deer from Wyoming (2), dismissed.

The Federal courts ordered forfeitures as follows: 91 beaver skins, 2 muskrat pelts, and 2 heads and 1 skin of bighorn sheep.

Agents operating under this statute discovered information relating to possible infractions of State game laws as a result of inspections at fur-receiving centers in 18 States. Invoices relating to 4,190 shipments of skins of fur animals were sent to game-protection officials in 35 States, Alaska, and Canada, and of the 1,853 returns received all were legal or did not merit action except 141, and in these cases fines and costs aggregating $3,106 were collected, and one 30-day jail sentence was imposed.

Evidence regarding 1,637 cases involving violations other than illegal interstate shipments of skins of fur animals were handled in 40 States, where fines and costs imposed by State courts aggregated $45,972 and 39 jail sentences of 5 to 90 days aggregated 1,068 days. In 34 of the remaining cases suspended jail sentences of 5 days to 1 year were imposed, aggregating 1,666 days. In eight cases juries returned verdicts of not guilty, and in eight others the defendants were adjudged not guilty. In 12 cases defendants were placed on probation, and 66 cases were dismissed.

UPPER MISSISSIPPI RIVER REFUGE CASES

Of 8 cases pending from previous years and 12 new cases reported for prosecution, 12 were closed as follows: Nol-prossed (1); no bill (2); 30 days in jail (2); $50 fine (1), $25 (1), $10 (3); 6 months' probation (1), 1 year probation (1); leaving 8 still pending.

Based on information obtained by refuge protectors involving State game-law offenses, 23 cases were successfully closed in State courts, 15 of these by fines and costs aggregating $343, and 8 by jail sentences, as follows: 10 days (1), 15 days (1), 30 days (2), 60 days (1), and 90 days (3).

COURT ACTION ON BAITING CASES

The Circuit Court of Appeals for the Seventh Circuit (Illinois) affirmed the action of the Federal court for the Southern District of Illinois, which had imposed a fine of $200 and costs on two defendants charged with taking migratory waterfowl by means of feed or bait. The United States Supreme Court denied the applications for writs of certiorari in these cases.

A case from the Southern District of California wherein it was contended the Migratory Bird Treaty did not authorize Congress to give the Secretary of Agriculture power to regulate the means by which migratory birds could be taken and in which the lower court decided in favor of the Government was appealed to the Circuit Court of Appeals for the Ninth Circuit (California). The appeals tribunal sustained the action of the lower court and in the course of its opinion stated:

> We do not agree * * * that bringing the line of flight of wild fowl by baiting to a hunting territory is not indirectly a luring within the meaning of the regulation.
>
> We believe the appellants have violated the Secretary's regulation whether by pursuing the indirect method of baiting before the season opens to keep the birds there to be shot after the season opens, so that hunters may flush them as they walk or punt over the

preserves, or by directly placing the grain in front of the blinds or stands during the season. Wherever the grain is placed on the preserves, the wind will create lines of the birds' flight, to and from it, which will aid the slaughter from blinds located for the purpose.

The court further held, in referring to the regulation not permitting the taking of migratory game birds by means of feed, that the act and regulation are supported by the treaty, that making the regulation against baiting is not a delegation of legislative power, and that it does not lack the definiteness necessary to describe a penal offense.

1938

IMPORTATION AND OTHER PERMITS ISSUED

FOREIGN SPECIES EXCLUDED

Several unsuccessful efforts were made to import skylarks, common and crested mynas, greenfinches, and chaffinches, excluded from this country by joint action of the Secretary of Agriculture and the Secretary of the Treasury pursuant to the Lacey Act of May 25, 1900, since which date no forbidden species of bird or mammal has established a foothold in the United States.

One mongoose arrived at the port of New York, N. Y., in May, from Naples, Italy, but was intercepted by the Survey's inspector at that port and refused entry. The importer had the mongoose in a specially constructed handbag, with wired ventilation openings, and declared it as a squirrel. The animal was seized and placed in the custody of the chief purser of the steamer for deportation.

Attempts to smuggle two Brazilian cardinals at New Orleans, La., in April were frustrated, and the birds were seized and donated to the Audubon Park Zoo. Before the legal division of the Customs Service, the smugglers were fined $10 each, and the steamship company $20 for failure to declare the birds. Another fine of $90 was imposed in a similar case of attempted smuggling at New York.

Fines also were collected from members of the crew of a steamer for entering two monkeys and two canaries at Morehead City, N. C., without permits. Upon advice from the customs officials, the purchasers returned the birds and mammals to the ship, which left for Scotland.

MIGRATORY BIRDS EXCLUDED

Numerous applications were rejected for permits to import, usually from Mexico and Cuba, migratory birds the possession of which is forbidden by the Federal law, except for scientific purposes. The Bureau's inspectors at several ports of entry also refused permits to passengers to enter indigo buntings, painted buntings, and blue grosbeaks, but permitted them to donate the birds to public zoological parks for scientific and educational purposes. Satisfactory progress also is being made in the exclusion of native migratory birds from the channels of the cage-bird traffic.

SPECIES ENTERED UNDER PERMIT

BIRDS

There were 1,925 permits issued, including 37 at Honolulu, Hawaii, for the importation of foreign birds and mammals, and 426 importations were inspected. A total of 270,000 foreign birds were imported into continental United States, as compared with 300,817 last year, including 136,704 canaries, 3,086 parrots, 79,465 Mexican quail, 14,905 Hungarian partridges, 1,937 pheasants, and 33,903 miscellaneous birds, decreases being especially notable in the numbers of quail and canaries. At Honolulu 1,090 foreign birds were entered.

Entries of Hungarian partridges from Europe greatly exceeded those of several years past. Several large shipments containing 1,500 to 2,000 birds each were brought in during January and February, principally for stocking purposes in Pennsylvania. About 400 of these partridges were imported from Canada, and 9 bamboo partridges (*Bambusicola fytchii*) came from China.

Bobwhite quail imported from Mexico aggregated 79,465, a decrease of more than 21,000 from the number imported last year. The quail imported during the past season were distributed to the following States: Mississippi, 23,374; Indiana, 23,350; Texas, 15,548; Kentucky, 4,040; West Virginia, 3,214; Tennessee, 1,350;

South Carolina, 1,275; North Carolina, 1,033; Florida, 925; Delaware, 795; New York, 525; Pennsylvania, 200; District of Columbia, 175; Illinois, 155; Alabama, 125; Missouri, 115; Maryland, 100; and the rest in small lots of fewer than 100 each to several other States.

Among the more interesting pheasants imported were 2 Lady Amherst pheasants (*Chrysolophus amherstiae*), from China; 13 copper pheasants (*Syrmaticus soemmerringi*), from Japan; 1 Bulwer's pheasant (*Lobiophasis bulweri*) and 12 crested fire-backed pheasants (*Lophura rufa*), from Singapore; and 1 Temminck's tragopan (*Tragopan temminckii*), which arrived in a shipment from France.

Quarantine restrictions continue to be maintained by the Public Health Service on the importation of birds of the parrot family, and in addition the State and city health authorities in New York prohibited by regulation last April the importation, breeding, and sale of birds of the psittacine family, with an exception allowing public zoological gardens or laboratories, in which scientific research is being carried out, to receive or import such birds under certain restrictions. Several other States and cities have taken similar action against the importation of psittacine birds, including Connecticut, California, Maine, Minnesota, Oregon, Territory of Hawaii, and Pittsburgh, Pa. Parrots in great variety were imported, however, during the year, including 4 Alexandra parrots (*Spathopterus alexandrae*), 6 Barraband parrots (*Polytelis swainsonii*), 1 purple-crowned lorikeet (*Glossopsitta porphyrocephala*), 8 Stanley's parakeets (*Platycercus icterotis*), and 2 crimson-winged parakeets (*Aprosmictus erythropterus*) from Australia; 1 vulturine parrot (*Psittrichas fulgidus*), 3 Banksian cockatoos (*Calyptorhynchus magnificus*), and 7 Kramer's parakeets (*Psittacula krameri*) from Sumatra; 2 Peruvian parakeets (*Forpus coelestis coelestis*), and 41 orange-winged parakeets (*Brotogeris pyrrhopterus*) from Ecuador.

Other interesting importations were 1 oropendola (*Zarhynchus wagleri*) and 4 thick-billed pygmy grosbeaks (*Oryzoborus crassirostris*), from Venezuela; 1 Sumatran hilltit (*Mesia laurinae*), 1 Sonnerat jungle fowl (*Gallus sonneratii*), and 1 Count Raggi's bird of paradise (*Paradisea raggiana*), in shipments from France; 2 Mallee fowl (*Leipoa ocellata*), 3 tawny frogmouths (*Podargus strigoides*), and 6 Cape Barren geese (*Cereopsis n. hollandiae*), from Australia; 1 Wilson's bird of paradise (*Schlegelia wilsoni*), 11 red birds of paradise (*P. rubra*), 2 lesser birds of paradise (*P. minor*), one 12-wired bird of paradise (*Seleucides ignotus*), 1 pied cuckoo shrike (*Lalage nigra*), 5 purple-capped fruit doves (*Ptilinopus regina*), 1 silver-eared hilltit (*Mesia argentauris*), 5 East Indian nonpareils (*Erythrura prasina*), 6 Celebian imperial pigeons (*Ducula paulina*), 1 Malayan wreathed hornbill (*Rhytidoceros undulatus*), 3 Molucca megapodes (*Megapodius freycinet*), 2 lesser frigate birds (*Fregata ariel*), and one Malay fish-owl (*Ketupa ketupa*), from Sumatra; 21 Siberian blue robins (*Luscinia cyane*), and 2 Bonin Island blue pigeons (*Columba janthina nitens*), from Japan.

MAMMALS

There has been a noticeable decrease in the importation of black bear cubs from Canada. Only 87 were brought in, as compared with 113 last year.

During the calendar year 1937, there were imported into the United States, chiefly from Canada, 1,256 live silver foxes, as compared with only 414 in 1936. A considerable number of the 1937 importations were probably brought in for pelting, however, since the duty on live animals is only 15 percent, whereas on pelts it is 50 percent ad valorem. Other fur animals imported during the same year were 443 live minks, compared with 591 during 1936; and 8 nutrias, 4 martens, and 2 fishers.

Importations of monkeys included three gorillas and several chimpanzees, baboons, and mangabeys, from Africa; orangutans and gibbons from Singapore; and a great variety of the smaller monkeys, including marmosets, ringtails, spider monkeys, and capuchins from Central America and South America. Rhesus monkeys from India continued to lead all other species in point of numbers, 15,851 having been imported.

Among the more interesting mammals imported were 1 Sumatran orangutan (*Pongo abelii*), 1 Bornean orangutan (*P. pygmaeus*), 5 slow loris (*Nycticebus coucang*), 1 clouded leopard (*Neofelis nebulosa*), 2 golden cats (*Profelis temminckii*), 1 small-clawed otter (*Micraonyx leptonyx*), 2 tree kangaroos (*Dendrolagus inustus*), 1 Asiatic marten (*Charronia flavigula henricii*), 10 Egyptian jerboas (*Jaculus jaculus*), from Sumatra; 1 pampas cat (*Felis passerum*) shipped from Holland; and 2 two-toed sloths (*Cholocpus didactylus*), and 1 prehensile-

tailed porcupine (*Coendou prehensilis*), from Venezuela; and 2 giant pandas (*Aeluropoda melanoleuca*) from Shanghai, China.

PERMITS UNDER THE MIGRATORY BIRD TREATY ACT

PERMITS FOR SCIENTIFIC PURPOSES

Two hundred and twenty-three permits for scientific purposes, general or under specific limitation, were issued authorizing the taking of migratory birds, and 1,942 were outstanding at the close of the year. Permits of similar limitation to possess migratory birds lawfully acquired for scientific purposes were issued to 180 persons, and the total number outstanding at the close of the year was 434. For possession of one or a few specimens found dead, 208 permits were issued. For banding migratory birds, permits were issued to 146 persons cooperating with the Bureau.

One formal order of the Secretary was issued to revoke the permit of a holder who had sold, and in consummation of the sale, had transported, migratory birds in violation of the regulations and the terms of the permit. This action was promptly followed by like revocation by the State game department concerned.

PERMITS FOR WATERFOWL PROPAGATION

Permits to take migratory waterfowl for propagation were issued to 31 persons, each permit limiting the species or the number of individuals and the time during which they might be taken. To possess migratory waterfowl lawfully acquired permits were issued to 229 persons.

It became necessary to recall, cancel, or revoke 415 propagating permits because of failure of permittees to render the annual reports required by the regulations or to surrender the permits when they discontinued propagating operations. At the close of the year 3,800 propagating permits were outstanding.

Reports submitted by permittees disclose that 3,683 wild geese and 61,951 wild ducks were raised in captivity, of which 56,477 were mallards, 3,608 black ducks, 525 wood ducks, and the remainder principally teals, ringnecks, wigeons, pintails, and redheads. Sales of propagated migratory waterfowl for food included 12,825 ducks and 438 geese; and for propagation, 10,096 ducks and 1,429 geese. From the propagating stock, 12 swans, 37 mourning doves, and 14 band-tailed pigeons were produced. Of propagated birds, 13,492 ducks and 285 geese were liberated.

DEPREDATION PERMITS

Since the Migratory Bird Treaty Act of 1918 became effective many general and special orders and some special permits have been issued authorizing the killing of one or more species of migratory birds found injuring agricultural and horticultural crops and other property. In order to condense these orders and to bring about uniformity in the issuance of permits, the Secretary, on June 10, revoked all previous permits and all but two previous orders—one applying to certain blackbirds and sparrows in California and the other to blackbirds throughout the United States. Provision is made in this order for the issuance of permits by the regional directors of the Survey, when authorized by the Chief of the Bureau, reserving to the Chief the issuance of permits involving the killing of migratory waterfowl except mergansers. Investiture of this authority in the regional directors will facilitate the issuance of the permits usually required in sudden and unexpected emergencies.

COOPERATIVE CONTROL OF INJURIOUS ANIMALS

Expenditures in cooperative predator and rodent control involved $609,022 from regular departmental appropriations, supplemented by $456,324 from cooperating States, $818,598 from cooperating counties, livestock associations, and others, and about $512,877 from emergency funds on work under Biological Survey supervision. The year's catch of predators taken through this cooperation aggregated 94,040, exceeding last year's records by 4,751, and consisted of 84,844 coyotes, 1,360 wolves, 7,189 bobcats and lynxes, 392 bears, and 255 mountain lions. Cooperative campaigns for rodent control involved the treatment of 29,204,282 acres infested with prairie dogs, ground squirrels, pocket gophers, jack rabbits, porcupines, field mice, cotton rats, kangaroo rats, and woodchucks, and of 237,788 premises for the eradication of common brown rats.

Publications issued on control procedure and matters related to control operations included Leaflet No. 132, Den Hunting as a Means of Coyote Control, and the following mimeographed leaflets: European and American Methods of Rat Control (BS-113), Cultural and Other Methods for the Control of Injurious Wildlife (BS-115), and Protecting Orchard Trees from Deer (BS-117). In addition, there was released one reel of sound motion picture entitled "Mouse Control in Orchards."

PREDATORY-ANIMAL CONTROL

Predatory animals, especially coyotes, continue to be an important cause of losses in livestock herds and flocks, as well as among big-game animals and upland game. An estimate by the Forest Service of domestic livestock and big-game animals killed by predatory animals on national forests only during the fiscal year 1937 includes 122,077 big-game animals, 1,038 cattle, 41 horses, 156 goats, and 78,346 sheep. The heavy loss of sheep is significant when one considers that the flocks are attacked on national forests during the summer grazing season only, which averages little more than 3 months. The increased interest in the matter among livestock producers, sportsmen's associations, State legislatures, and boards of county officials resulted in increasing the funds available for predator control in cooperation with the Biological Survey.

An expedition into Mexico, in cooperation with the Chicago Academy of Sciences and the Smithsonian Institution, for the purpose of conducting work on the self-photography of mountain lions and bobcats developed further proof of the utility of catnip oil as an attractant to these animals.

Acting upon a resolution of the National Woolgrowers Association adopted at its annual convention at Salt Lake City, Utah, the Wyoming Woolgrowers Association organized an advisory committee to aid in coordinating predator-control activities. Its first meeting, held in April at Cheyenne, was attended by representatives of all organizations interested in the predator problem within the State. In a letter received from the president of the South Dakota Woolgrowers Association the serious aspect of the predator situation in that State is described and it is emphasized that livestock losses attributable to predatory animals have been a major factor in forcing many livestock owners out of business.

A number of valuable predatory-animal specimens were collected by the field force for addition to the Survey's mammal collection in the National Museum. Among these is a coyote taken in Wyoming in November which weighed 74¾ pounds and measured 63 inches in length.

SOME BENEFITS FROM THE WORK

Previous to 1937 the largest single sheep-raising outfit in Nevada reported annual losses of 8 to 10 percent in its herds through coyote depredations. During 1 month in the fall of 1937, 130 coyotes were trapped on the company's range, with the result that losses were curtailed to a negligible figure. Other ranching outfits have reported a 75-percent reduction in lambing-range losses this year as a result of coyote-control measures.

During December and January a pack of eight wolves migrated across the Mexican border into Arizona and New Mexico. Bureau hunters of these two States assigned to capture them took the last member in Arizona on March 17. The skin and skull of one of the pack, a male measuring 6 feet in length, were added to the Bureau's collection.

In May a large renegade wolf, known to have been a killer of long standing in Le Flore County, Okla., was captured after having been hunted relentlessly in that State for 2 years. A bear that had killed 24 young purebred rams valued at $25 each on one ranch and had a reputation as a stock killer for a number of years, was taken near Cody, Wyo.

Previous to 1914 it was nearly impossible to raise turkeys in McCullough County, Tex., because of severe wolf depredations, and the annual income from this industry in that county was less than $5,000. During the past several years, however, the wolves have been put under control, and the turkey industry has risen in importance, now amounting to $300,000 annually.

Improvements in trapping technique are shown by a 2½-year record in Wyoming on trap-crippled coyotes, which reveals that Bureau hunters took 1,059 peg-legged coyotes and made only 410 cripples, whereas during the current year these hunters took 416 peg-legged coyotes and crippled only 138. This has further significance in that trap-crippled coyotes are more destructive to livestock because of their lessened ability to capture wild prey.

Requests for assistance in coyote control were received from Mississippi, where a recent State law authorizes the game and fish commission to cooperate with the Bureau in control work. A Survey hunter was detailed to Mississippi in March, and through his immediate taking of three coyotes succeeded in curtailing livestock and poultry losses in Pearl River County.

In cooperation with the Forest Service in Georgia, North Carolina, South Carolina, Florida, and Tennessee, the Survey detailed an experienced trapper to train forest officers and game protectors in the technique of trapping wildcats and foxes on forest game-management areas. One result was a threefold increase in the wild-turkey crop over that of the preceding year on one area in Georgia.

EMERGENCY PROGRAMS

Predator control through the agency of Works Progress Administration was continued in Utah, Idaho, Wyoming, Montana, and Oregon, and provided an important supplement to the Bureau's regular program in those States. These projects have afforded opportunity to establish control and protect livestock and game from predatory-animal depredations, where it would otherwise have been impossible.

RODENT CONTROL

In addition to the severe damage inflicted by rodents on agricultural and horticultural crops and range plants, and the recognition that these animals constitute reservoirs and carriers of certain diseases communicable to man, other phases of rodent damage deserve mention, such as damage to mechanical structures and spoilage of food in storage. Pocket gophers, through their burrowing 7 feet into the earth supporting a concrete spillway on the Kyle Dam on the South Dakota Pine Ridge Indian Reservation, started a leak that resulted in the wash-out of the dam. Repairs will cost in the neighborhood of $25,000. Approximately 63,000 barrels of oil stored in a surface tank at Gladewater, Tex., were released into the Sabine River when floodwaters entered pocket gopher runways in the tank dam. Cooperative rat control on the pier of the Galveston Wharf Co., where 84,000 sacks of flour were stored, was so effective that only 2 sacks were destroyed by rats this year, whereas previously 50 percent of the stored flour was damaged.

A new outlet for the meat of jack rabbits has been developed in Colorado which should serve to further efforts toward their control. A private company in Denver last year purchased 300 tons of the meat from farmers and ranchers, which was processed and placed in cold storage for resale to members of the Rocky Mountain Fur Growers Association for fox feed. The fox growers report that jack rabbit meat is an excellent ration and are enthusiastic over this new source of feed supply. Prospects for an expansion of the industry appear good.

EMERGENCY PROGRAMS

Cooperative rodent control was conducted through the medium of the C. C. C. and the Works Progress, Agricultural Adjustment, Farm Security, and Emergency Relief Administrations. The C. C. C. projects were conducted cooperatively with the Forest Service and the Soil Conservation Service of the Department of Agriculture and with the Division of Grazing, Bureau of Reclamation, and Office of Indian Affairs of the Department of the Interior. The work, which was supervised by trained and experienced field workers of the Survey, was undertaken only where control would lead to the restoration and development of wide areas of grazing lands, and for the protection of irrigation projects, agricultural crops, forest-tree plantings, horticulture, and engineering structures on soil-conserving projects.

Throughout the farm-forestry project areas within the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, it was necessary to protect young tree plantings from being destroyed by rodents, especially by jack rabbits, which are a constant menace to the successful growing of trees.

RODENT CARRIERS OF PLAGUE AND TYPHUS

Measures for the control of rodent-plague carriers were continued at points of previous infection and steps taken for the inauguration of control work at recently discovered points. The Public Health Service of the Treasury Depart-

ment reported that plague infection was identified on June 27, 1938, in 1 ground squirrel (*Citellus armatus*) and in 19 fleas taken from 9 squirrels of a related species (*C. elegans*) collected 15 miles northwest of Evanston, Uinta County, Wyo. This is stated to be the first positive demonstration of plague among wild rodents in Wyoming. The Public Health Service reports that sylvatic plague was found among native rodents in additional localities as follows: Douglas and Clark Counties, Nev.; Gallatin County, Mont.; Wasatch, Kane, Cache, and Morgan Counties, Utah; Lincoln County, Wash.; Union, Baker, and Malheur Counties, Oreg.; and Bear Lake County, Idaho. Several new foci of infection also were found in counties from which plague was reported last year.

Typhus fever of an endemic type increased rapidly in Georgia and called for increased rat control in cooperation with the State Health Department. Typhus fever cases reported by the Health Department of Texas showed a marked increase, especially in the city of Austin. Cooperative rat-control campaigns directed by the Biological Survey were immediately inaugurated to stamp out the infection.

RANGE IMPROVEMENT BY RODENT ERADICATION

Supplementary to rodent control for range improvement conducted by C. C. C. camps, operating under the jurisdiction of the Forest Service and the Division of Grazing, the Survey extended supervision over control work on grazing areas in connection with other range-improvement projects of these agencies.

ORCHARD MOUSE CONTROL IN THE NORTHEAST

Progress has been made in the introduction of more effective methods of orchard mouse control in the Northeastern States. Orchardists, nurserymen, and farmers are becoming more conscious of the serious damage to their crops inflicted by tree-girdling field mice, and enthusiasm over control operations has increased. For the first time it has been possible to employ cooperative field workers to demonstrate and supervise mouse-control projects.

Orchardists owning three-quarters of the apple trees in Connecticut are faced with mouse-damage problems, and in many large orchards 75 percent of the trees are damaged to such an extent that they no longer bear a paying crop. Severe damage is inflicted also on commercial garden crops and ornamental shrubbery.

In the Champlain Valley fruit section of New York one orchard had 800 20-year-old apple trees completely girdled by mice, and in other sections mouse damage to orchard trees ran from 55 to 70 percent. On Long Island severe damage was inflicted on white pine trees by pine mice.

Cooperative funds aggregating $5,424.98 have been provided in Maine, New Hampshire, Vermont, Massachusetts, and Connecticut to finance mouse-control operations in cooperation with the Bureau.

CONTROL IN SOIL-CONSERVATION DISTRICTS

Several States have enacted legislation providing for the establishment of soil-conservation districts in cooperation with the Department of Agriculture. In many of these districts, wherein a sound policy of land use is being established, rodent control is of paramount importance, it having been determined by the local agencies involved that proper land use cannot be realized without the removal of heavy rodent populations. With that in mind, the board of supervisors of the Great Divide Soil Erosion District in Moffat County, Colo., requested assistance from the Bureau in prosecuting ground squirrel control within that district.

SUPPLY DEPOT AND LABORATORY

Construction of an addition to the present supply depot at Pocatello, Idaho, was inaugurated in cooperation with the Works Progress Administration and the Pocatello Chamber of Commerce. When completed the building will provide approximately 23,000 square feet additional room, thus affording more adequate storage space for rodent-bait materials, field supplies, and miscellaneous equipment. A machine shop, chemical vault, small-mammal room, and production laboratory also will be provided.

In cooperation with the Pocatello Chamber of Commerce, the supply depot prepared and distributed to cooperators in the United States 1,646,307 pounds of rodent-bait materials, and 529 gallons of paste bait for jack rabbit control. The supply depot has also dispensed to cooperating agencies a carload of predatory-animal traps and trap parts, and has manufactured horse and utility trailers, pocket gopher probes, trap stakes, and other equipment used in mammal control.

CONTROL METHODS RESEARCH

Investigations conducted by the Control Methods Research Laboratory at Denver, Colo., have progressed on several lines, including improvement of lethal baits for controlling range and farm-land rodents, orchard mice, and rats, and of rodent repellents for use in connection with silvicultural plantings. Ecological studies also have been made of various species of field rodents, looking toward new approaches to problems in control. The laboratory has also processed and prepared baits for use in predator control.

REPELLENTS AND FUMIGANTS

Experiments with repellent sprays for preventing jack rabbit depredations were continued in national-forest areas in the Northwestern States, where they involved 11,000 yellow and Jeffrey pine seedlings. In the Kitsatchie National Forest, La., similar protection against cottontail rabbit damage was tested with 7,000,000 slash pine seedlings. Further work on repellent sprays also was conducted in Colorado on farm wood lots.

The laboratory experimented with poison-gas pyrotechnic cartridges and other means of application of various toxic gases in fumigating burrows for rodent control. Definite progress has been made, and under certain conditions this method has produced encouraging results.

RODENT AND PREDATOR STUDIES

Looking toward more effective operational work in predator control, the laboratory inaugurated predatory life-habit studies in Wyoming to determine lines of predator migration, relationship of denning areas and predator populations to soil type and land topography, and relationship of predator distribution to beneficial wildlife, livestock, and rodent populations.

On the Kisatchie National Forest milo bait was used in experiments for the control of pocket gophers, which inflict heavy damage to seedling trees on plantation areas. Ecological studies on forage plant-pocket gopher relationships indicate that the rodents are more prevalent on overgrazed areas, where the less desirable, bulbous-type plants have become established. These heavy infestations serve to aggravate an already bad situation and retard the establishment of desirable forage plants. These studies indicate the need for better grazing control that will keep the range in a climax sod; this in turn would aid in controlling the numbers of pocket gophers.

Investigations continued in the Northeastern States, including life-habit studies of orchard mice, surveys of damage to horticultural and nursery crops, and improvement of bait formulas. Progress has been made in perfecting a more acceptable and efficient bait for use in orchard mouse-control work. Studies also were made looking to improvement of field applications of mouse-control methods in order to assure protection to beneficial forms of animal life.

HAWAIIAN RODENT-CONTROL PROJECT

The work of rat abatement for the protection of pineapple, sugarcane, coffee, and macadamia nuts, and for the control and prevention of typhus fever, bubonic plague, and trichinosis, continued in Hawaii with good progress, in cooperation with the Agricultural Experiment Station and Extension Service of the University of Hawaii and the Territorial Board of Health. Research resulted in the improvement of sausage and grain-type baits—red squill baits that can be used safely in cities and rural communities—in the method of vacuum-packing baits for ready use, and in trapping technique. Education work was conducted along the lines of proper rat control, ratproofing of buildings, and other preventive methods. In addition to the research and educational program, the Rat Abatement Laboratory also served the Territory in manufacturing rat bait for distribution to cooperating agencies.

WILDLIFE CONSERVATION IN ALASKA

ALASKA GAME LAW AMENDMENTS

An act amending the Alaska Game Law passed by Congress and signed by the President on June 25 (Public Law No. 728, 75th Cong.) authorizes the Alaska Game Commission to purchase, maintain, and operate aircraft, a facility that has become essential with the marked economic developments in the Territory. With fur dealers and trappers rapidly abandoning boat, dog-team, and snowshoe travel in favor of aircraft, it is necessary for wildlife agents to utilize the same expeditious transportation. The amended act also confers upon the Commission authority, which heretofore had been limited, to carry on wildlife investigations, feed wildlife when necessary, and restock depleted areas, in addition to enforcing the Alaska Game Law. It also gives the Secretary of Agriculture discretionary authority, whenever conditions appear to warrant, to conserve the wildlife resources of the Territory or to prevent nonresident trappers from crowding out native Indians and Eskimos, and to require 3 instead of 1 year's residence in the Territory before nonresident trappers can become eligible for resident trapping licenses.

CHANGES IN REGULATIONS

The 1938–39 regulations of the Secretary of Agriculture, published in Alaska Game Commission Circular No. 15, provide for a close season on martens throughout the Territory and prohibit the taking of all fur animals except black bears and wolverines in fur district 1, which embraces all of southeastern Alaska. The open season on bighorn, or mountain, sheep and on mountain goats was reduced 1 month, to close on November 30 instead of December 31. The limit on caribou was increased from two to five north of the Yukon River and reduced from five to three south of it. An open season on beavers is provided during the spring of 1939 for fur districts 4, 5, 6, and 7, with a seasonal limit of 10. The Kenai Peninsula west of the Alaska Railroad remains closed for the taking of minks, martens, land otters, weasels, foxes, and lynxes. The Commission approved the revised form of the regulations as prepared by a committee appointed to revise, simplify, and clarify them.

LAW ENFORCEMENT

Two cases of outstanding importance were reported and successfully prosecuted in the enforcement of the Alaska Game Law:

An Alaskan fur trader operating an extensive "fence" for trappers smuggling furs of wolves and coyotes from Canada into Alaska was apprehended and convicted. To reduce depredations on big game, the Territory pays a bounty of $20 each on these animals, but Canada pays none. The trader fence collected $800 bounty on the smuggled animals, which he was required to refund to the Territory, and in addition paid fines and costs amounting to $400.

Two Alaska wildlife agents operating the Commission's chartered plane in the Stony River country apprehended two white men involved in the most vicious violations that have come to the attention of the Commission. They were operating trap lines more than 100 miles long nearly 2 months after the close of the season and had killed no fewer than 10 moose, including at least 1 cow with an unborn calf, the meat of which was cached along the trail for dog feed and allowed to spoil. When they were apprehended their packs contained poison, and they had driven the Stony River Indians, whose trapping territory they had usurped, out of the country by armed force. The violators were sentenced to serve 1 year each in jail, and the trial judge placed the 13-year-old son of one, who was being trained in the law-breaking habits of his father, in the custody of the agents so that he might attend school.

The problem of adequate law enforcement in Alaska has materially increased during the past 2 years, in a large measure because of the influx of nonresident trappers. In all, 346 violations were reported by the Commission, as compared with 329 in 1937 and 120 in 1936. The largest number reported in any 1 year prior to that time was 188, in 1932. Intensive enforcement is partially responsible for the apprehension of violators, but it is apparent that many newcomers to Alaska are under the impression that they can live off the country with little regard for wildlife-protective laws. The Commission reports an alarming tendency on the part of this type of violator to usurp the rights of the less aggressive and more peaceable native Indians, Eskimos, and Aleuts.

The 346 cases of violations reported included 71 involved with illegal acts by aliens, and fines in the amount of $13,468 were assessed in addition to jail sentences aggregating 3,845 days. The furs seized totaled 867, of which 581 were of beavers. A total of 57 game animals and 21 game birds illegally taken were seized and 169 firearms confiscated. The estimated value of seized articles was $10,962.

WILDLIFE-RESTOCKING PROJECTS

Four elk were liberated on an area near Ketchikan, Alaska. These animals were transported from Washington State on the Commission's vessel *Brown Bear*, the crating and incidental expenses being paid by Ketchikan sportsmen.

The results of some of the restocking projects of former years are gratifying. The elk on Afognak Island and the buffalo in the big delta country, near Fairbanks, are well established and annually show a substantial increase. At the Nunivak Island Wildlife Refuge the introduced herd of musk oxen has increased to 50 animals, including 11 calves of the year.

PREDATOR CONTROL IN THE TERRITORY

Under Bureau supervision and in cooperation with the Reindeer Service and the Office of Indian Affairs of the Department of the Interior, the Alaska Game Commission, and the Forest Service, wolf and coyote control was continued with satisfactory results, mainly for the protection of reindeer herds. It was reported, however, that mountain sheep also suffer heavily from wolf depredations in the Rainy Pass section.

A building was constructed in cooperation with the Forest Service C. C. C. camp at Juneau for use in preparing scented-bait material, which is distributed to trappers throughout the Territory, and 2,470 ounces were distributed and 463 wolf traps were supplied to trappers, in addition to 700 furnished by the Indian Service. The C. C. C. enrollees assisted both in conducting trapping operations and in training natives in proper trapping technique.

RESEARCH ON ALASKA WILDLIFE

Wildlife research was resumed with the assignment of a resident biologist to the Territory. The program was restricted to (1) studies on management of the Kenai moose herd and its relationship to agricultural developments, (2) study of the problem of brown bears versus cattle on Kodiak Island, (3) management studies of musk oxen and carideer (caribou-reindeer cross) on Nunivak Island, and (4) studies of the food habits and diseases of big game.

A second expedition, using the motorship *Brown Bear*, spent the summer on the Aleutian Chain. In the two seasons nearly all the islands have been visited by Bureau scientists, who made a brief survey of the bird and mammal life of each. Special attention was given to the fox-farming and bird-colony relationships, and observations were made on vegetation, water supply, and the invertebrate fauna. Several hundred specimens were collected and 10,000 feet of motion pictures taken.

Information gained from the research program and from field surveys of wildlife and its habitat will be of material aid in law enforcement and the application of sound wildlife policies.

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