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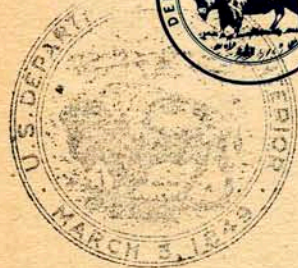
GUARDING OUR WILDLIFE RESOURCES

Number FIVE
Fish and Wildlife

Service, United States Department of the Interior, Washington, D. C.

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GUARDING OUR WILDLIFE RESOURCES

By Rachel L. Carson

Designed by Katherine L. Howe

Conservation in Action

NUMBER FIVE

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON : 1948
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Guarding Our Wildlife Resources

THIS IS THE STORY OF THE WILDLIFE RESOURCES OF AMERICA, of their place in our history, and their value in our modern life. It is the story of the forces that threaten to destroy them, and the efforts that we must make, as individual nations and as a community of nations, to preserve them.

The Western Hemisphere has a relatively short history of the exploitation of its natural resources by man. This history, though short, contains many chapters of reckless waste and appalling destruction. Entire species of animals have been exterminated, or reduced to so small a remnant that their survival is doubtful. Forests have been despoiled by uncontrolled and excessive cutting of lumber, grasslands have been destroyed by overgrazing. These and other practices have afflicted us with all the evils of soil erosion, floods, destruction of agricultural lands, and loss of wildlife habitats.

All the people of a country have a direct

interest in conservation. For some, as for the commercial fishermen and trappers, the interest is financial. For others, successful conservation means preserving a favorite recreation—hunting, fishing, the study and observation of wildlife, or nature photography. For others, contemplation of the color, motion, and beauty of form in living nature yields esthetic enjoyment of as high an order as music or painting. But for all the people, the preservation of wildlife and of wildlife habitat means also the preservation of the basic resources of the earth, which men, as well as animals, must have in order to live. Wildlife, water, forests, grasslands—all are parts of man's essential environment; the conservation and effective use of one is impossible except as the others also are conserved.

We in the United States of America have been slow to learn that our wildlife, like other forms of natural wealth, must be vigorously pro-

Opposite: Geese over Tule Lake, California

tected if we are to continue to enjoy its benefits. The present generation has seen the awakening of a vital conservation sentiment. Aroused by the spectacle of critically depleted resources, the public at last demanded action. The year 1903 brought the beginning of a movement to create national sanctuaries for wildlife—a movement that has by now resulted in approximately 300 such refuges, totaling nearly 18 million acres of land. Beginning in 1916, a series of international treaties and national legislation recognized the obligation of the national government to conserve migratory species—especially birds—that move freely over State and International boundaries. Other legislation followed to finance and otherwise assist constructive conservation efforts.

In 1872 a national agency had been created to carry on the research needed to guide conservation of the fisheries, and a few years later an agency with similar responsibilities regarding birds and mammals was established. These agencies today are merged in the Fish and Wildlife Service. In addition to conducting research, the Service enforces conservation laws relating to migratory birds and, in Alaska, administers laws for the conservation of all wildlife, including game and commercial fishes.

Each of the States now has its own conservation agency, since the chief responsibility for conserving resident birds, mammals, and fishes belongs to the States. Through appropriate laws, they regulate the seasons of hunting and

fishing, establish bag and creel limits, and control commercial fishing.

While the enforcement of laws to protect and foster wildlife must remain a governmental responsibility, conservation in the United States owes much of its effectiveness to the interest and participation of individuals and private organizations. Some of these groups sponsor research, some acquire and maintain lands for sanctuaries, others actively work to restore and improve wildlife habitats. By their advocacy of constructive measures and their opposition to waste and destruction of our natural resources, these organizations collectively represent a powerful force for conservation.

The pages that follow tell briefly the story of wildlife conservation in North America, with examples chosen largely from the United States. They describe the difficulties and discouragements of attempting to preserve our wildlife in a modern world, in which the advance of civilization is too often a destructive one. These problems are not confined to the United States; they are met, with differences only of detail and degree, wherever a nation is fighting to preserve its natural resources.

Like the resource it seeks to protect, wildlife conservation must be dynamic, changing as conditions change, seeking always to become more effective. We in the United States have much to accomplish before we can feel assured of passing on to future generations a land as richly endowed in natural wealth as the one we live in.

Migratory Birds—A Hemisphere Resource

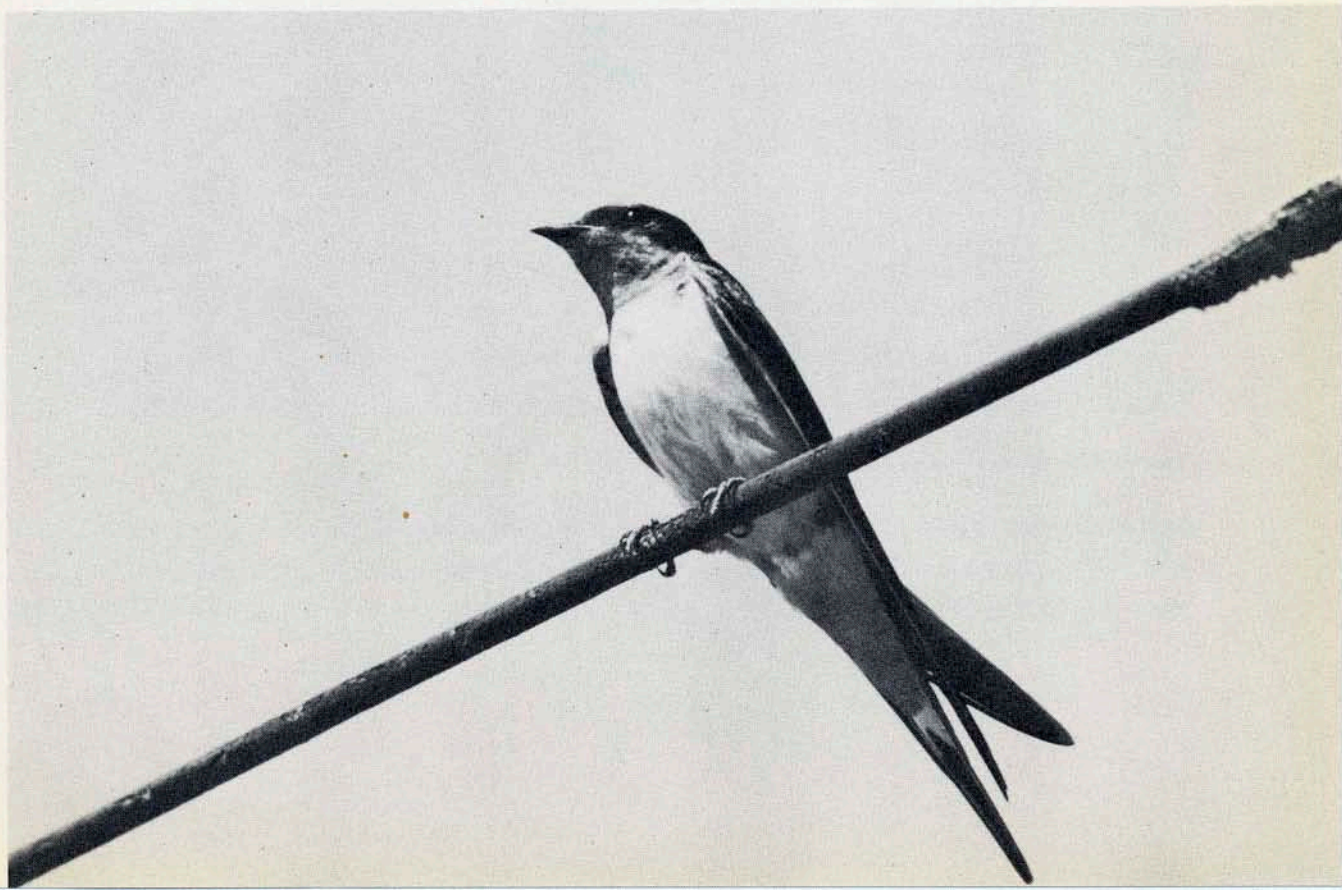
THE NATIONS OF THE WESTERN HEMISPHERE have one great living resource which they possess in common—the migratory birds. Including long-range migrants like the plovers, sandpipers, hawks, ducks, swallows, and warblers, these birds belong to all the countries of North, Central, and South America, and of the Caribbean region. In their migrations between summer and winter homes they freely cross international boundaries, and some range all the way from the southern part of South America to the shores of the Arctic Ocean.

Like all living creatures, the migratory birds must have food, shelter, and suitable conditions

The barn swallow, a long-range migrant

for breeding. No one country has it in its power to provide all these requirements for the migrants, for the birds pass only a part of the year in any one place. For example, Canada and Alaska contain most of the breeding areas of North American waterfowl; the United States of America, Mexico, Central America, and parts of South America contain the wintering grounds, which are equally important for the survival of the birds.

Recognizing this basic conservation fact, the United States and Great Britain concluded a Migratory Bird Treaty in 1916. This treaty obligated both contracting governments to protect ducks, geese, and most other migratory





Shore birds feeding during migration

birds. A similar treaty, including also the protection of game mammals, was concluded between the United States and Mexico in 1937.

In 1941 many of the countries of the Western Hemisphere joined in the Inter-American Convention on Nature Protection and Wildlife

Preservation. While indicating the interest of the signatory countries in conservation, this instrument is very general with no provision for active measures. There is, therefore, a need for additional treaties similar to those between the United States and Great Britain and Mexico, aimed specifically at the protection of migratory birds.

Shore birds perform some of the most remarkable of all migrations. Many of this group, which includes the snipes, sandpipers, plovers, and other less known forms, breed on the Arctic tundras of Canada and Alaska, some on the most northern islands, only a short distance from the North Pole. Some of these species winter as far south as Argentina and Chile, traveling seven to eight thousand miles twice each year.

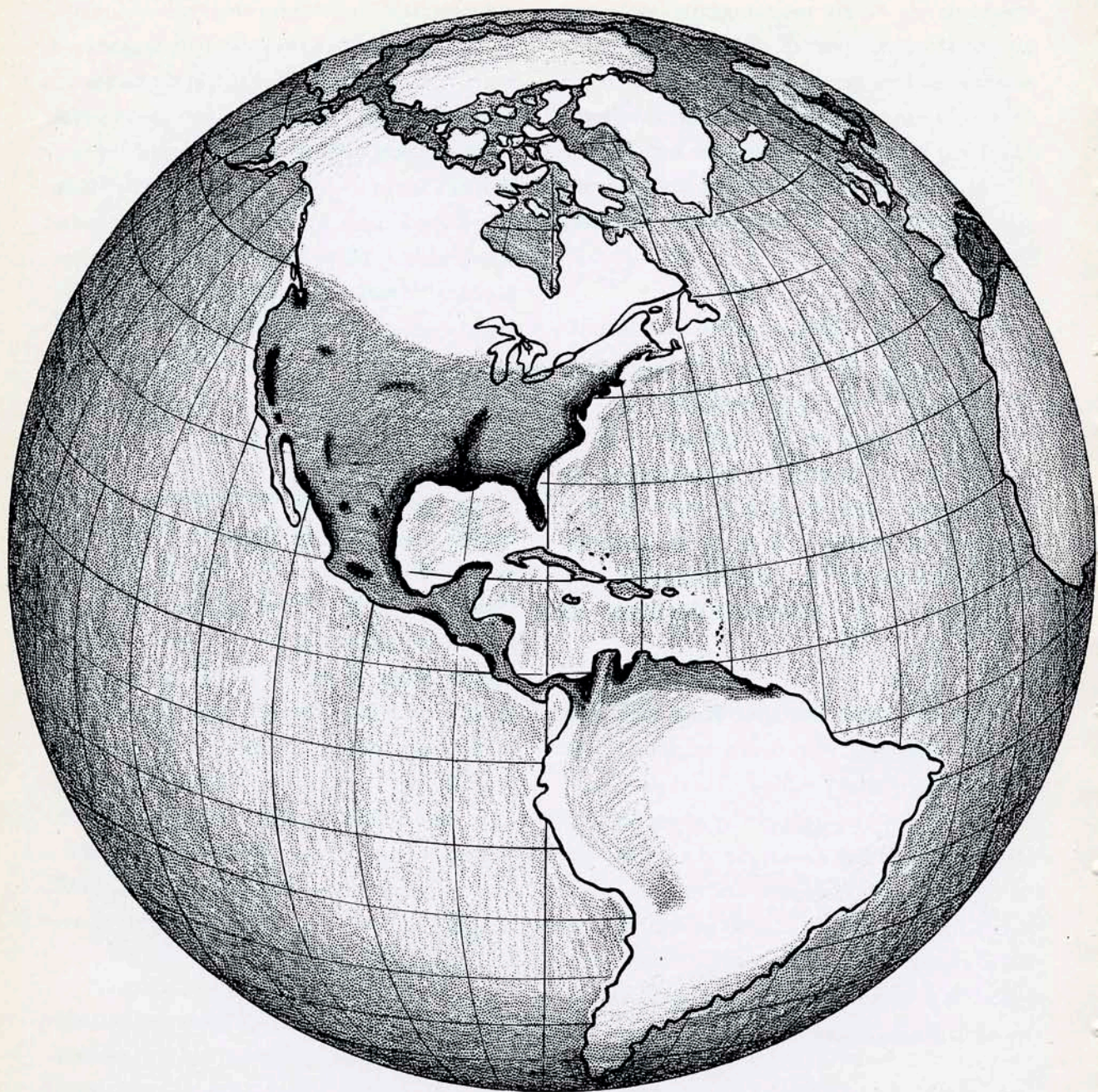
During the early 1900's the shore birds came close to extinction from heavy shooting. One, indeed, the Eskimo curlew, may have been exterminated. Throughout the spring and fall migrations up and down the coastlines, they were shot by market gunners and hunters. Their habits make them particularly unable to withstand overshooting: they raise a single, small brood in a season, and during migrations they travel in dense flocks over open coasts.

Today the shore birds are protected in North America under the Migratory Bird Treaties; here the shooting of the migrants has been outlawed. Practically all of the species have shown

some increase in numbers since the negotiation of the Treaties, but they are still subjected to heavy shooting in parts of the West Indies and South America. Also, the birds face certain other dangers. Those whose normal breeding grounds are in southern Canada and the United States need more undisturbed areas of marsh and prairie. Those that winter on the grassy plains of Argentina, Brazil, and Peru—including the Hudsonian curlew, the golden plover, the upland plover, and others—are menaced by agricultural developments, which have reduced the areas suitable for them.

The migratory song and insectivorous birds include a great variety of species, most of them directly beneficial to man. The natural role of these birds in the control of insects is so important to human society that they deserve the highest degree of protection that can be afforded them. In North America, the group is protected under the Migratory Bird Treaties. Cutting of virgin forests and drainage of swamps have caused local changes in abundance and distribution, but for many species the activities of man have not proved harmful, the birds having adjusted themselves to civilization with marvelous adaptability.

The interesting birds of lakes and marshes, including the grebes, herons, rails, gulls, terns, and others, also migrate freely over international boundaries and in North America are included under the protection of the Migratory Bird Treaties.



Wintering grounds of North American waterfowl

Heavy shading indicates areas where largest concentrations occur; light shading, general limits of winter range. Breeding grounds are chiefly north of 40th parallel.

WATERFOWL.—The large group of migratory game birds which consists chiefly of ducks and geese is especially valued in the United States and Canada as one of our most important game resources. About two million licensed waterfowl hunters depend on these birds for sport each year during the fall hunting season. Probably no other resource has so many persons keenly and directly interested in its welfare, for the entire group of waterfowl hunters, individually and through organizations, are alert throughout the year to reports on the state of the waterfowl populations and prospects for the fall flights.

The conservation of waterfowl is, to an important degree, an international problem. Examination of the map opposite will show why this is true. The most extensive breeding areas of the North American waterfowl are in Canada, Alaska, and northern United States. The wintering grounds, on the other hand, are in southern United States, the West Indies, Mexico, Central America, and the northern countries of South America.

Most of the waterfowl that go south of the borders of the United States during the winter months are those that migrate across the western half of the country. Many of these western ducks spend the winter season in Texas and California, but in some years large numbers seek winter feeding grounds in the coastal waters and river valleys of Mexico, and along both coastlines of Central America. The chief South

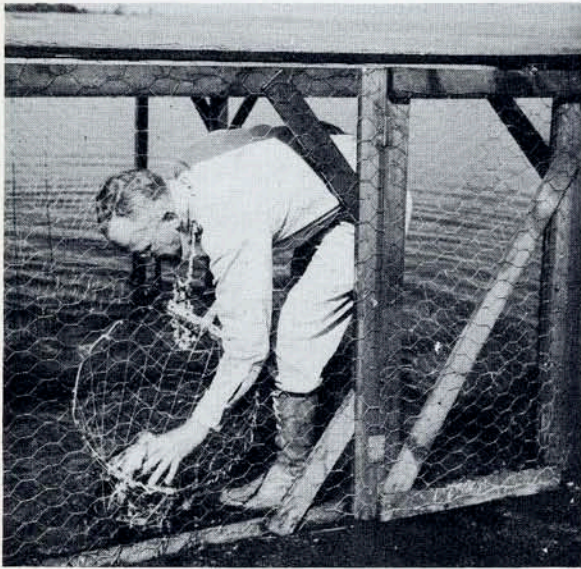
American wintering areas for this group of waterfowl are in Colombia and Venezuela, although banded ducks have been recovered also in British Guiana, Ecuador, and Peru.

South America also has its own populations of waterfowl which breed in the southern hemisphere and migrate from country to country, but the nature and extent of these migrations have not been fully determined.

Much of our information about the migratory routes of waterfowl and other birds, and about the relative importance of various nesting and wintering areas, has been learned by bird banding. Audubon, the famous painter of North American birds, probably was the first person in the Western Hemisphere to attempt to mark birds in order to trace their migrations. Later, interest in this activity by many persons led to the establishment of the American Bird Banding Association. The project soon became too large to be handled by a private agency, and is now conducted by the Fish and Wildlife Service, having been assumed by a predecessor agency in 1920. The Dominion Wildlife Service of Canada has cooperated actively in this work. There are now about 500 active cooperators in the United States and Canada, each working under permit, who annually place identifying bands on thousands of birds. Each band carries a number and instructions for its return by the finder to the Fish and Wildlife Service in Washington, D. C. Since bird banding was un-

dertaken as a Governmental study, the number of birds banded has totaled more than 5 million, and about 375,000 returns have been received from five continents and many islands of the Pacific.

Banding has established a significant fact in relation to waterfowl conservation: the birds have a hereditary attachment for one particular flyway. The term "flyway" denotes a vast geo-



Bird banding stations are operated at many of the National Wildlife Refuges in the U. S. A. to study migrations, especially of waterfowl. The birds are caught without injury in a cage trap and a numbered metal band is attached to the leg. The sex, estimated age, and weight of the bird are recorded before release.

graphic region that is occupied by definite bird populations and contains both breeding and wintering grounds, connected by a more or less complex system of migration routes. There are four major flyways for North American waterfowl: the Atlantic, the Mississippi, the Central, and the Pacific. Banding experiments especially designed to test this theory showed that birds normally belong to one flyway for life, and that there is little shifting from one to another. This fact has been fundamentally important in the management of waterfowl.

The conservation of waterfowl, like the conservation of most other living resources, is a complex problem. Over the years the pressure of civilization, encroaching more and more into what were once vast wilderness areas, has reduced to a dangerously inadequate minimum the kinds of habitats the birds need to carry on their life activities. Drainage and drought have destroyed or rendered temporarily useless



large nesting areas; agriculture, marsh drainage, and coastal oil developments have impaired the value of many wintering grounds. Combined with this shrinkage of suitable territory, the birds have been subjected to larger and larger kills as the sport of waterfowl hunting became more popular. As an inevitable result, the waterfowl populations have declined to a small remnant of the magnificent flocks that swept up and down the continents a century ago.

The present generation of Americans has seen three periods of alarming decline among the waterfowl. The first led to the Migratory Bird Treaty of 1916. The second, induced largely by drought and heavy shooting, reached its low point in 1930. Recovering from this crisis in response to increased rainfall, and emergency conservation measures, the ducks and geese increased in numbers until 1944, when another downward cycle began. This seems to have been checked in 1947; with favorable con-

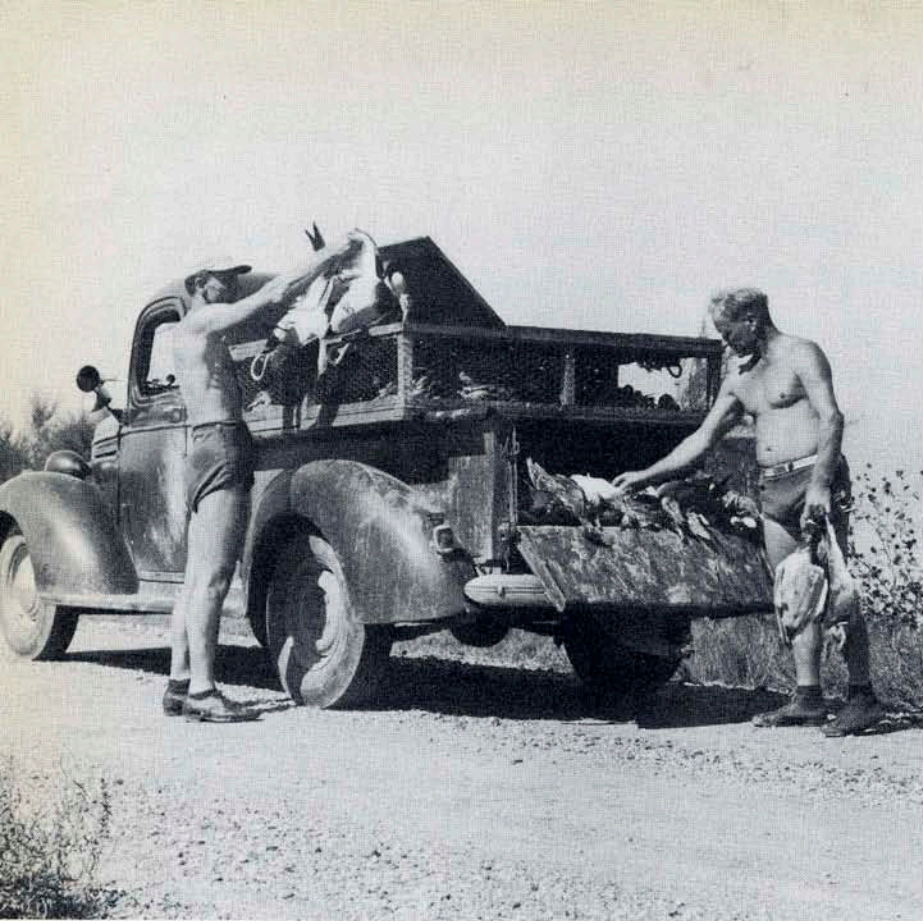
ditions, another increase in abundance should follow.

The conservation program in the United States and Canada has been directed toward improving conditions in nesting areas, controlling hunting to protect an adequate breeding reserve, and providing refuges where the birds may find conditions they require.

Under the authority of the Migratory Bird Treaties and related legislation, the Department of the Interior annually determines for the United States the length of the open season, prescribes bag limits, and places other necessary restrictions on the kill. Especially stringent regulations were adopted in the early 1930's and again since 1944.

Sportsmen's organizations in cooperation with governmental agencies have carried out restoration programs over vast areas to restore the water to the land, especially in the breeding grounds of the central prairies of Canada and northern United States.





Ducks affected by botulism being collected for study and treatment. Research has helped reduce prevalence of this disease, which kills many western ducks.

One of the most important of all conservation measures from the standpoint of lasting effects was the development of a system of waterfowl refuges throughout the country. Out of a total of nearly 300 National Wildlife Refuges, 201, comprising 3½ million acres, were created especially for waterfowl. In addition, numerous sanctuaries are maintained by the States, by private conservation agencies, and by individuals.

These refuges have been established along the waterfowl flyways to meet the special needs

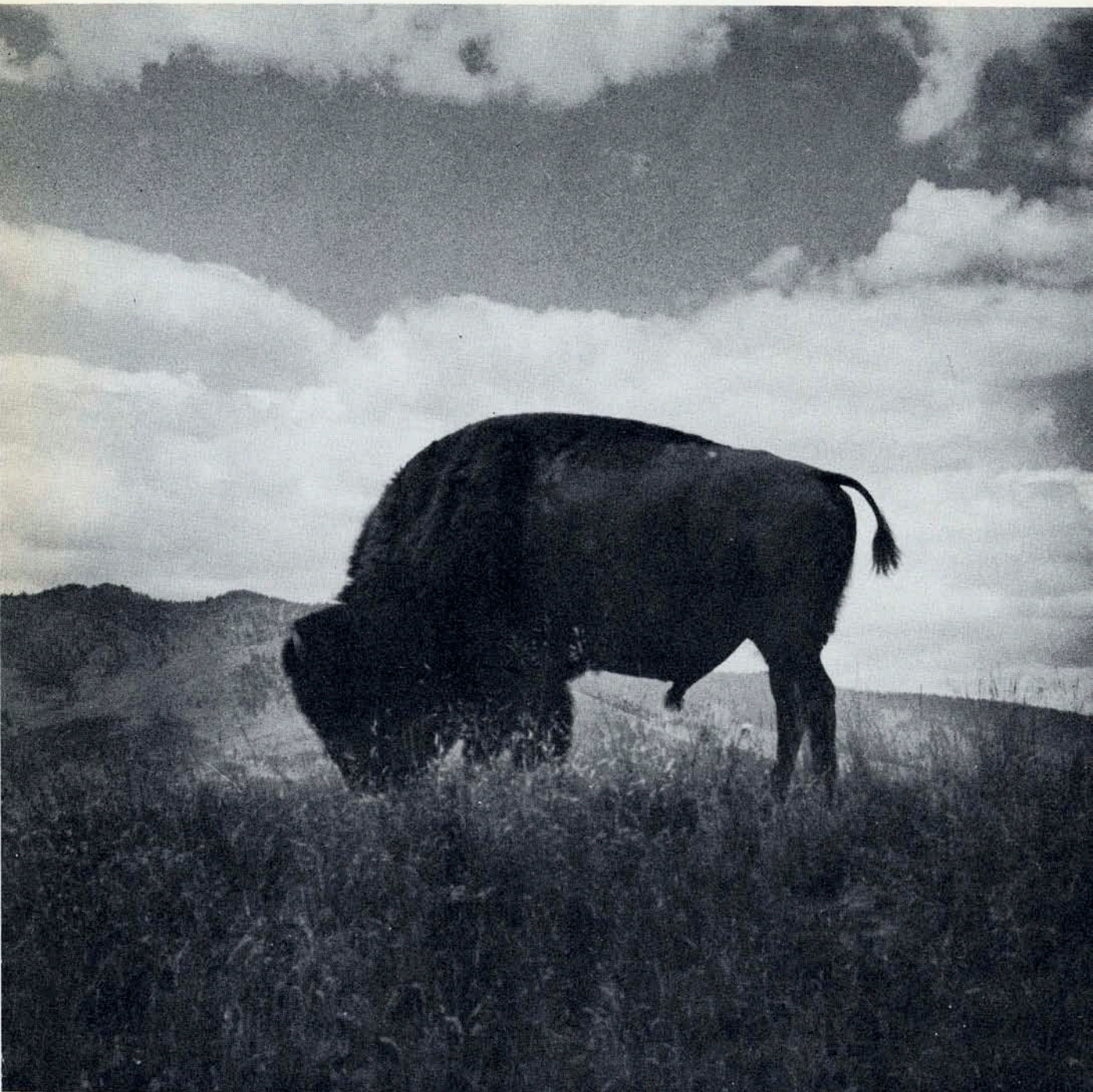
of the birds. Many of those in northern United States provide extensive nesting areas. The Bear River Refuge in Utah, Lower Souris in North Dakota, and Malheur in Oregon are refuges of this sort, and also accommodate tremendous numbers of ducks during migration. Some refuges are primarily used as feeding and resting areas on migration routes. Others, like Sabine in Louisiana, Sacramento in California, and Mattamuskeet in North Carolina, are wintering grounds in which vast natural marshlands are preserved and developed for the use of the birds.



Canada geese

Planting round-stem bulrushes on a National Wildlife Refuge to control shoreline and provide food, shelter, and nesting materials for waterfowl





American bison on the National Bison Range, Montana

Big Game Mammals

WHEN COLONISTS FROM THE OLD WORLD first came to North America, immense numbers of wild animals inhabited the continent. To these early settlers, it must have seemed that the deer, bear, elk, moose, and other large game animals could never be reduced seriously in numbers, so great then was their abundance.

For furs, for food, and later for sport these North American mammals were hunted relentlessly. Forests were cut down, prairies were transformed into cultivated lands, plains became grazing lands for domesticated stock. Soon there were not enough of the wilderness areas that the wild animals needed. From this cause, and from unregulated and often wanton

slaughter, their numbers declined to a small remnant of the original herds.

Perhaps the best-known of all the native mammals, the American bison, ran a swift course to near extinction. By 1890, there were probably no more than 500 of these animals remaining in the United States, although once there may have been 50 million.

The American elk was hunted persistently because of its good food qualities and valuable hide. By 1910 this animal had been reduced from its original millions to about 60,000.

The prong-horned antelope was regarded as doomed to extinction by the early 1920's. The black bear vanished from much of its former range; so did the grizzly. The picturesque big-horn sheep disappeared from most of the mountain and desert areas it once inhabited.

Prong-horned antelope on the Charles Sheldon Antelope Range, Nevada





Mule deer at feeding troughs in winter, National Bison Range, Montana

Fortunately, the era of unrestrained exploitation has passed. By the end of the 19th century conservationists, and finally the general public, became alarmed by the threat to the big game animals.

In the National Wildlife Refuge system, some 10,500,000 acres are now set apart primarily for the conservation of the large wild mammals. Another 4,000,000 acres of general wildlife refuges accommodate these animals, which also find sanctuary in the many National Forests and National Parks, and in numerous State refuges.

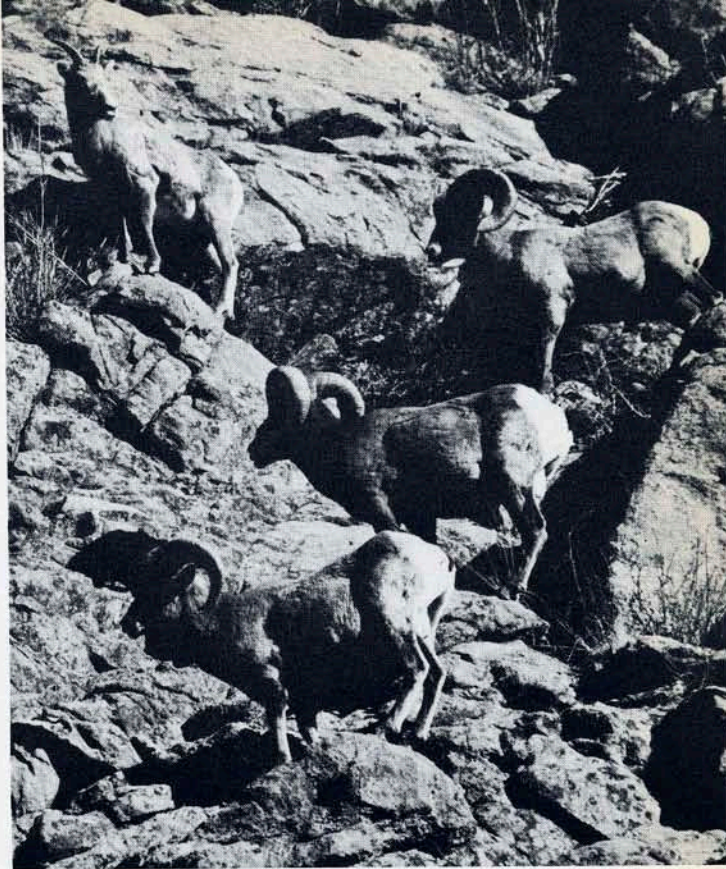
One of the most interesting of the big game refuges is the National Elk Refuge in the Jack-

son Hole region of Wyoming. This refuge was established to provide feeding grounds for thousands of elk that move down from surrounding mountains in the fall and winter to avoid deep snows and to feed in the grassy valleys. The Jackson Hole Elk are now one of the largest herds of game that remains in North America.

Herds of bison have been built up in sanctuary areas, especially the National Bison Range in Montana, the Wichita Refuge in Oklahoma, and Yellowstone National Park. From its low point of about 500 animals, the bison population has now increased to more than 5,000.

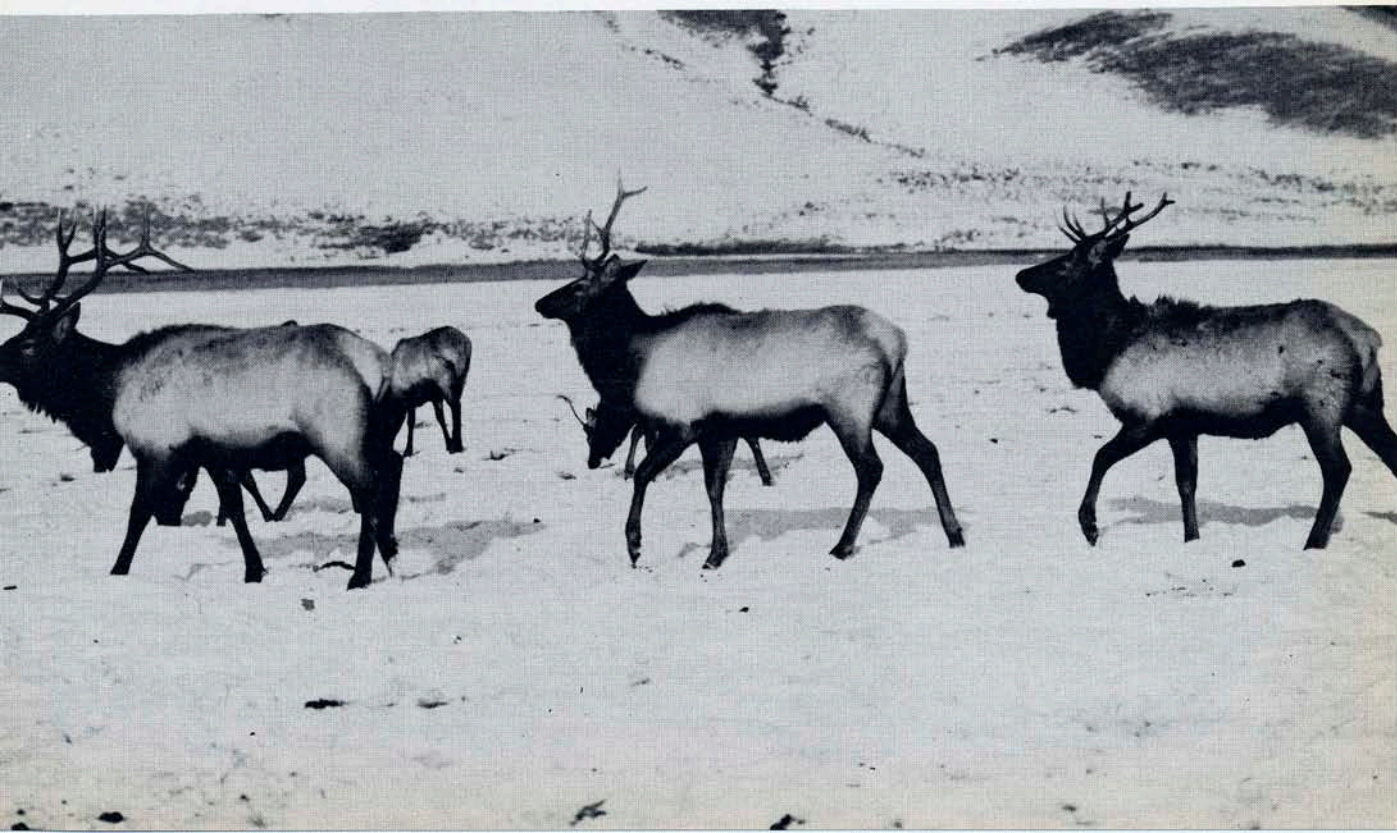
Hart Mountain National Antelope Refuge in Oregon and the Charles Sheldon Antelope Refuge and Antelope Range in Nevada were created especially for antelope; the Desert Game Refuge in southern Nevada for the desert bighorn. This latter refuge is the largest in continental United States, including more than two million acres.

These and other big game refuges, although few in number, are fundamentally important in preserving our native animals, as well as their natural habitat. Several others need to be established to attain the goal of having, somewhere in the country, a refuge for every native species.



Above: Rocky Mountain sheep

Below: Elk at Jackson Hole, Wyoming



Saving Endangered Species

OF ITS NATIVE BIRD FAUNA, North America has had the unhappy experience of seeing several species reduced to the point of actual extinction. Such vanished species include the great auk, the passenger pigeon, the heath hen, the Labrador duck, the Carolina parakeet, and probably the Eskimo curlew. For these birds, the conservation movement in the United States came too late. A few others, like the trumpeter swan and the whooping crane, have come perilously close to extermination, but small populations remain.

To protect one of the few remaining colonies of the trumpeter swan, the largest and one of

the most beautiful of North American waterfowl, the Red Rock Lakes Refuge was established by the United States Government in 1935. The Red Rock Lakes lie in a high and remote valley in the mountains of southern Montana. Here the swans find plenty of food, good nesting cover, and freedom from disturbance. The winters are severe, but large springs at the head of the chain of lakes keep an area of open water. This is important, because this remnant colony seems to have lost the migratory instinct of its ancestors, and remains in the vicinity throughout the year.

Since the refuge was established, the swan population in the United States has increased from 75 birds in 1935 to 350 in 1947. About half of this number are at Red Rock Lakes,

Whooping cranes on Aransas Refuge, Texas





Trumpeter Swan on Red Rock Lakes, Montana

the remainder in nearby Yellowstone Park and on adjacent small lakes. The Fish and Wildlife Service has transferred small numbers of young swans from Red Rock Lakes to Oregon, Nevada, and Wyoming, where new colonies may eventually be established.

The whooping crane is in even more serious danger. According to the latest estimate there are not more than 30 of these picturesque birds left on the North American continent today. Agricultural developments in the central part of the United States and in the Canadian prairies have destroyed most of its breeding grounds. The few survivors nest in some remote Canadian marshlands, and winter on the coast of the Gulf of Mexico. The Fish and Wildlife Service has

established the 47,000-acre Aransas Refuge in Texas to help provide suitable wintering areas. About 25 of the birds are found at Aransas each winter.

The conservation of the whooping crane is made especially difficult by its annual migration of 3,000 miles through the interior of the continent, which exposes it to great dangers, although for many years it has been given full legal protection. Discovery of its nesting grounds and protection of the birds while raising their young, together with increased public interest in the enforcement of existing laws, may in time rescue this bird from its present precarious situation.

Cooperation in Wildlife Restoration

THE WILDLIFE RESOURCES BELONG TO ALL THE PEOPLE; to conserve them successfully the landowners and the local and Federal governments, through their various conservation agencies, must coordinate their efforts in a program with clearly defined goals. In the United States, such cooperation is now achieving excellent results in practical conservation.

In 1937, the Congress of the United States adopted legislation known as the Federal Aid in Wildlife Restoration Act, making possible active conservation programs in all of the States, and in Alaska, Hawaii, Puerto Rico, and the Virgin Islands. Several hundred cooperative projects are now under way, including surveys and investigations, acquisition of land, and development of wildlife habitats.

The need of surveys and research to discover basic facts is now widely recognized. Today every State has its staff of wildlife technicians. Before the Federal-Aid program was begun many of them — perhaps half — had none. Many States, especially those with large populations of game mammals, make annual population surveys, which form the basis of game laws regulating open or closed seasons.

Restocking depleted game ranges is one of the most important cooperative activities in relation to large game. Thousands of elk, deer, and antelope have been moved from localities of comparative abundance and released on de-

pleted or vacant ranges. Small mammals like beaver, muskrats, and raccoons also are transplanted. Some States trap and transplant turkeys, pheasants, quail, and sage grouse. Often two or more States agree to exchange animals of which they have a surplus.

About 728,000 acres had been acquired by the States with cooperative funds by the end of the fiscal year 1947. Some of these lands are devoted to waterfowl nesting or feeding areas, supplementing the system of Federal waterfowl refuges. At least a part of every area acquired for waterfowl is set aside as a sanctuary, with no shooting permitted. Especially in the west where competition for range lands between game and livestock may be a problem, some of the land purchased is being used for big game ranges. In agricultural regions small areas are leased and managed to provide demonstrations of desirable farm-game habitats. In developing land for wildlife, the States work in active cooperation with the landowners and with conservation agencies such as the Soil Conservation Districts.

This entire program derives its principal financial support from the Federal tax on sporting arms and ammunition. Through this tax, which is set aside for wildlife conservation, the 12 million hunters in the United States contribute to the restoration of game birds and mammals.

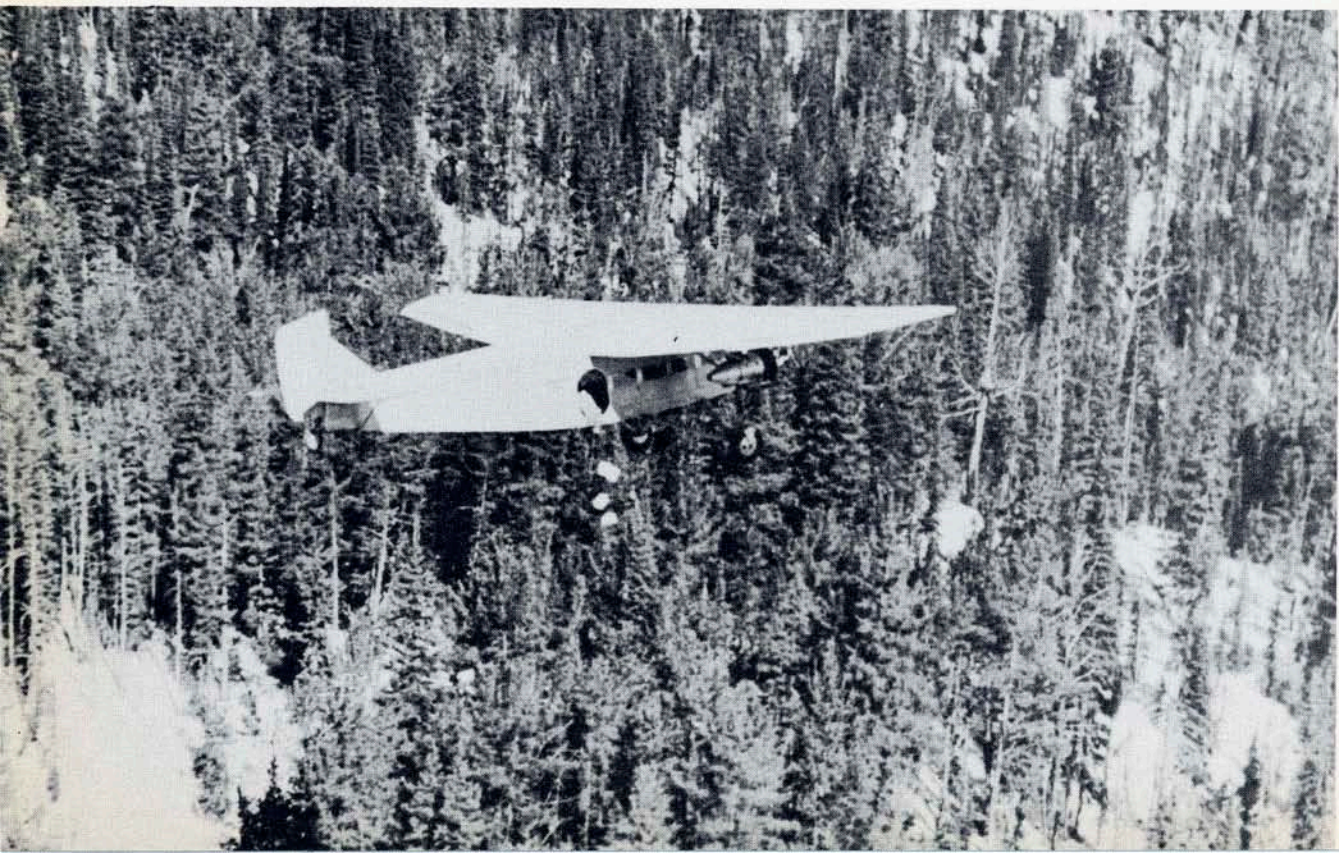


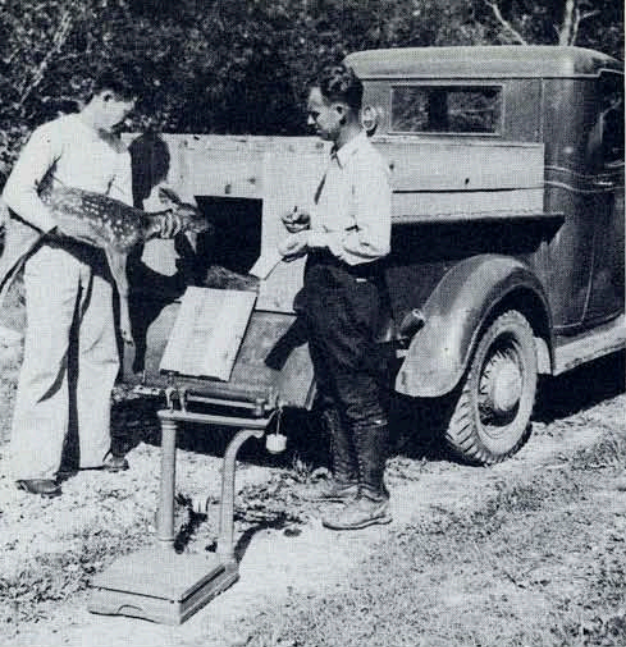
State and Federal agencies cooperate in winter inventories of the big game animals of the country, counting animals when they are concentrated on winter ranges. Airplanes are widely used for such inventories, permitting surveys of inaccessible mountain terrain, and making possible relatively accurate counts. Airplane counts are supplemented by men traveling on horseback, or on skis or snowshoes. Present estimates of the big game population of the United States total about $8\frac{1}{4}$ million animals.





Besides their importance in game inventories, airplanes have many other uses in game management. Here 50-pound blocks of salt are being loaded aboard a plane, which will carry them over mountain ranges, dropping them on summer feeding grounds of elk and other game animals. The purpose is to lure the game onto the summer ranges earlier in the spring and hold them later in the fall, thus saving winter forage, of which in many localities there is a critical shortage.



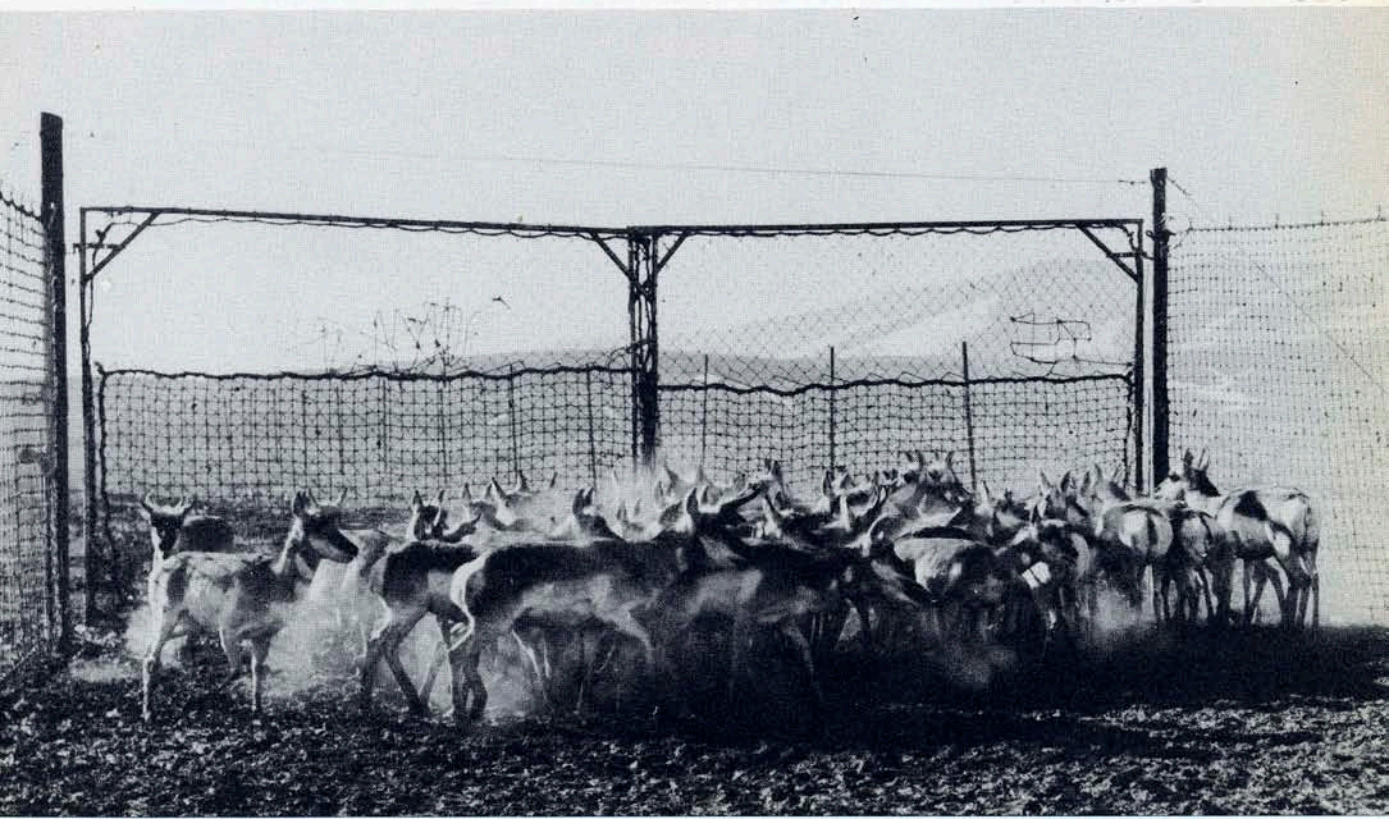


Above: Deer are involved in more transplanting operations than any other animals. All game animals transplanted are ear-tagged so that later movements may be studied.

Below: Antelope for restocking are herded into traps, from which they are shipped by truck, train, or plane to their new range. Elk usually are caught in traps built around haystacks where the animals come for winter food; deer in large cage traps baited with salt or attractive foods such as mistletoe or cotton-seed cake.



Above: Trapping sheep and goats on their range in high mountain peaks is particularly difficult. Here a young goat is being carried down the mountain.





The beaver is nature's hydraulic engineer, habitually cutting down streamside trees, building dams, and living in the ponds so created. Near headwaters, it may be a useful agent for soil and water conservation. Downstream, in farming and irrigation districts, its activities may cause damage. Some States now regularly trap and transfer beaver to areas where their activities are useful. In the stream shown below, beavers built a series of dams, raised the water table, and turned semi-arid land into a good hay-producing meadow.





About 80 percent of all the wildlife of the country is produced on agricultural lands. Intelligent management of these lands can increase game; practices that lead to deforestation, erosion, and soil impoverishment result in dwindling wildlife stocks. In the southeastern parts of the United States, field border plantings of lespedeza, a leguminous plant, retard soil erosion at field edges, and provide food and cover for quail and other small game (*above*). On demonstration farms, (*below*) harmful effects of overgrazing contrast graphically with properly managed fields.





Seining for sardines on the coast of California

Marine Fisheries

THROUGHOUT THE WORLD, the most important sources of protein food are the marine fisheries. In the Western Hemisphere, these fisheries have a long history of exploitation. They were the basis of the first organized industry in the New World. Fishing by European vessels was carried on along the shores of eastern North America long before the original colonies were established. During the first difficult years of gaining a foothold on strange shores, the fisheries were a ready source of food for the colonists. They provided the first items of export trade by the New England settlements. During the four centuries since the first Old World vessel crossed to the North American banks, they have provided employment and profit for many thousands of our citizens, and recreation for additional millions.

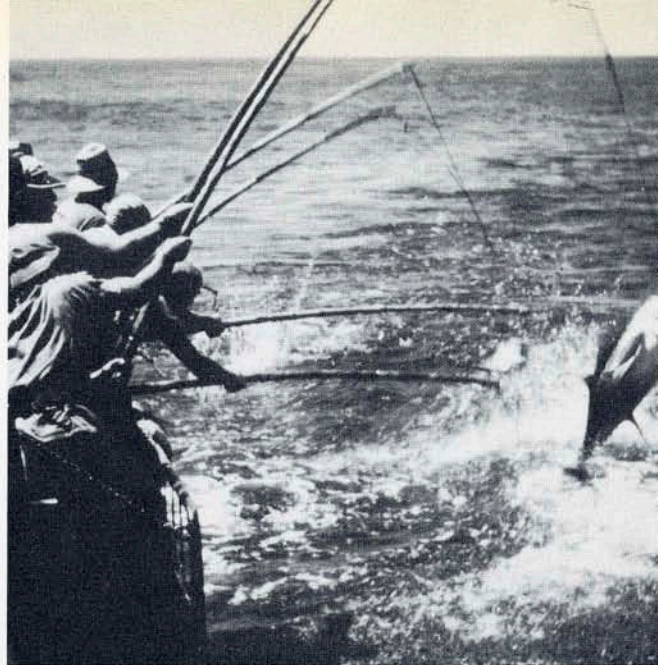
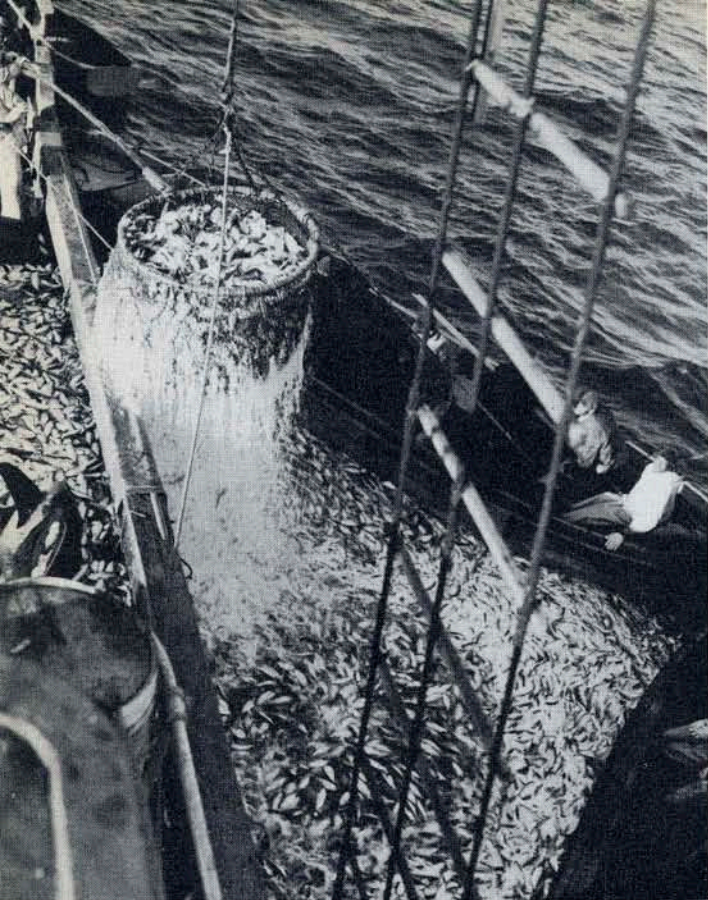
From their small beginning, the fisheries have spread to all parts of our coastline and have been established in many lakes and rivers of the interior. Collectively, these industries yield a commercial catch of 4 to 5 billion pounds annually, and employ about 125,000 fishermen. Marine species make up more than 90 percent of the total tonnage.

The heaviest producers among United States marine fisheries are the pelagic or surface-living species like the sardines, menhaden, tuna, and sea herrings. As a group, these fishes are widely

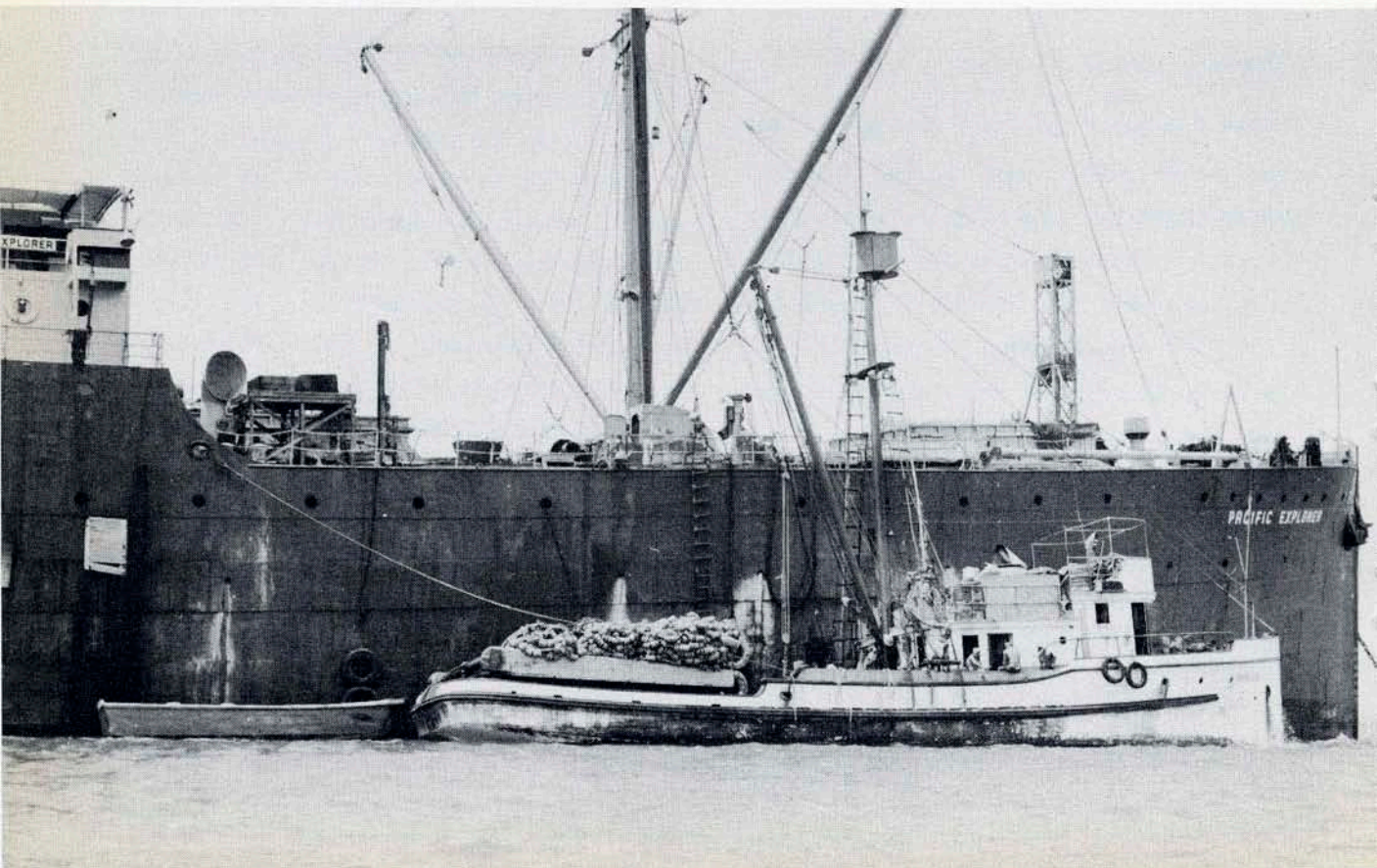
used for canning, yield high quality meal and oil, are seldom eaten fresh. The large group of bottom-feeding fish found on offshore banks, most abundantly in northern latitudes, are the chief sources of supply of the fresh fish markets. These include chiefly the members of the cod family, some of the rockfishes, and the flatfishes like the flounders and halibut. The most valuable fisheries in the United States are those for salmon, of which the largest quantity comes from Alaska. Other species with high market value include such shellfish as shrimp, oysters, clams, crabs, and lobsters.

The salmon are among the most popular sport fishes of the world. Other marine species cherished as recreational resources are the tunas, swordfishes, marlins, sailfishes, and tarpon.

The early colonists had little understanding of the principles of managing a renewable resource. Under the commercial exploitation of the Nineteenth Century, some of the fisheries suffered periods of reduced yields. By 1872, public concern over the decline of important fisheries led to the establishment of the United States Fish Commission to foster and promote the fishery resources. The work of this former agency is carried on today by the Fish and Wildlife Service. It includes basic biological research, the collection of statistics, improvement of methods of catching and marketing fish, artificial propagation, and the actual management of the fisheries in the Territory of Alaska.

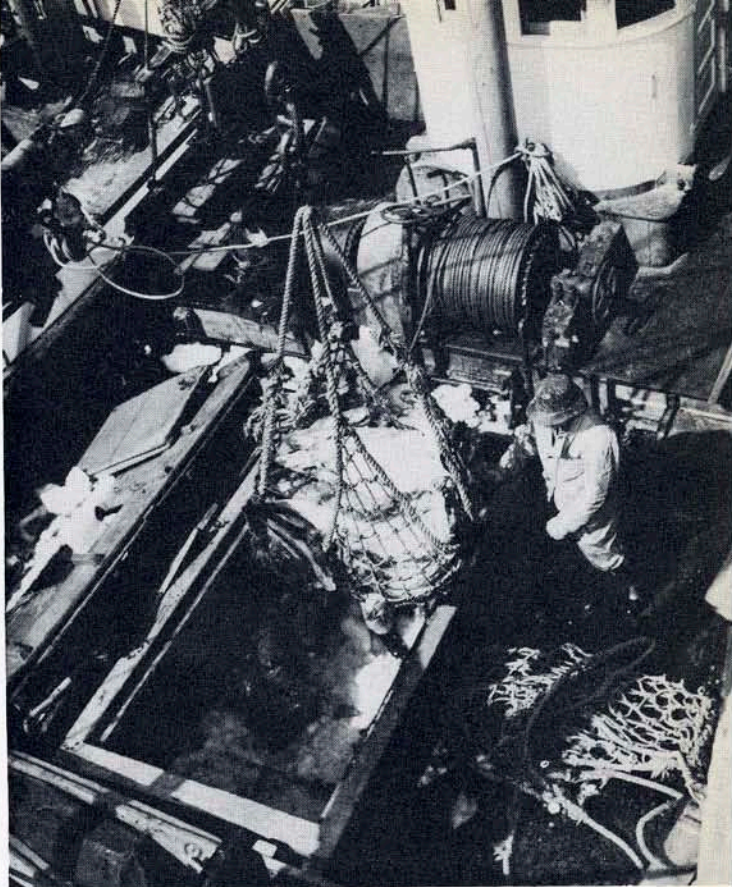


Left: Dipping menhaden from the net to the deck of the seiner. Above: Fishing for tuna in the Pacific Ocean. Below: Large factory ships accompanied by trawlers or seiners are a recent development in the fisheries. By processing fish at sea, they make possible longer trips, better quality products.





Shrimp support small, locally important fisheries in Alaska (*above*) but major U. S. shrimp fisheries are in the Gulf of Mexico. Conservation of the Pacific halibut (*right*) under international treaties has increased the yield of this important species. About 500,000,000 pounds of salmon (*below*) are caught annually in Alaska, smaller quantities in the Pacific coast states.



BIOLOGISTS AT SEA.—Today, with nearly 200 species of fish and shellfish under exploitation by commercial fishermen, the United States Fish and Wildlife Service maintains a staff of 120 biologists to study basic conservation problems, and operates five marine laboratories. In addition, many of the States conduct fishery research independently or in cooperation with the Federal Government.

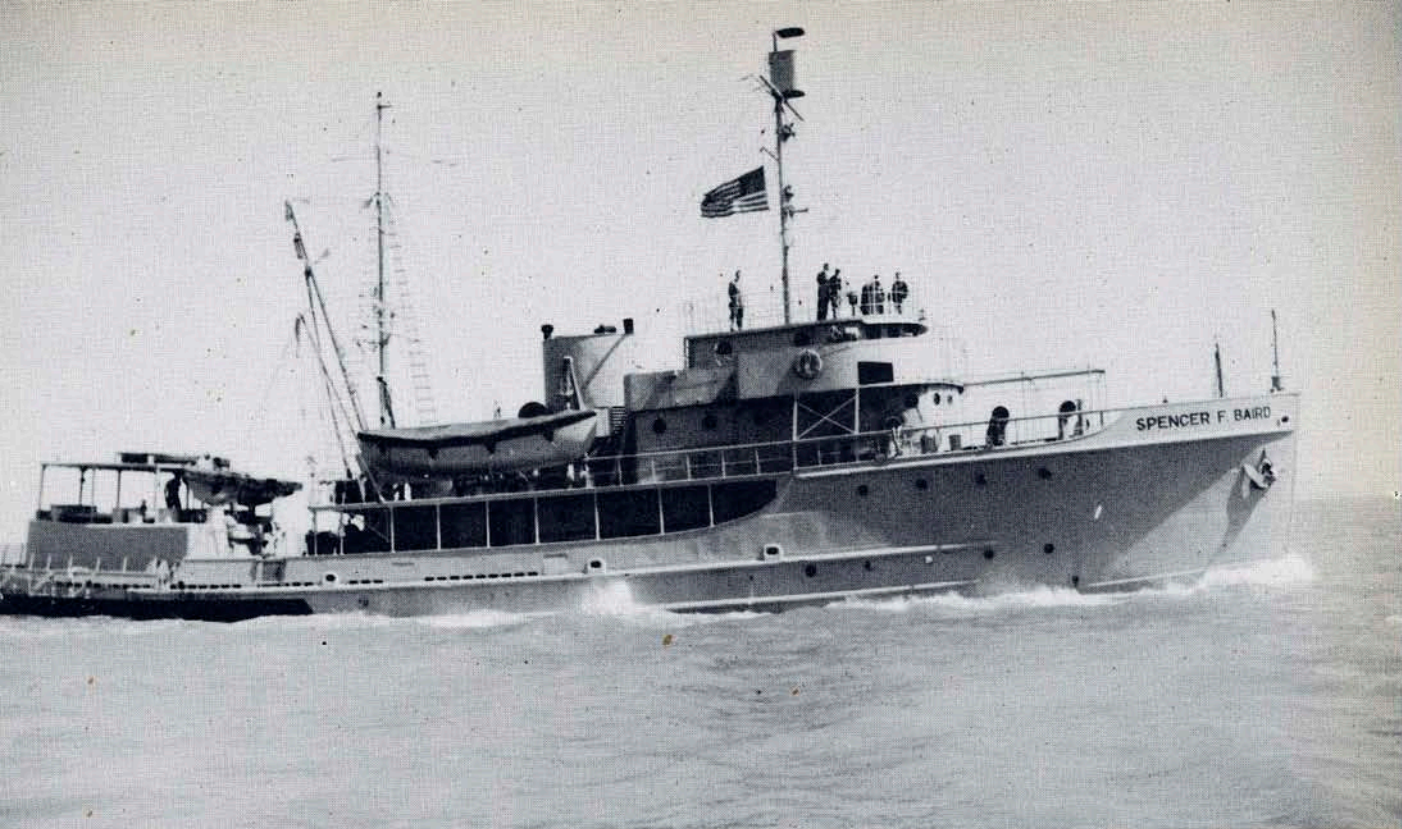
Biologists work on trawlers at sea, on fish piers, and in laboratories ashore to find answers to the basic questions that determine how a fishery may be managed to sustain large yields without impairing the brood stock. They tag fish to study their migrations, carry on age and growth studies as an index to population changes, make observations on water temperatures, salinities, currents, and other conditions that control the lives of marine creatures. Such studies are a practical guide to management. They may

show that a particular area needs to be fished more or less intensively to keep its population in balance with the food supply. They may show that, for a particular species, fish below a certain size need complete protection through use of nets with larger mesh. Surveys of conditions in the marine environment combined with population studies sometimes make possible annual predictions of abundance as a practical aid to fishing operations.

The United States now operates two modern deep-sea research vessels, the *Albatross III*, on the North Atlantic Banks, and the *Spencer F. Baird* in the Pacific Ocean. Equipped with modern electronic instruments and devices, underwater photographic equipment, oceanographic facilities, and experimental fishing gear, they are studying the conditions of the oceanic feeding and spawning grounds as well as the habits of fishes and the most economical methods of utilizing them.



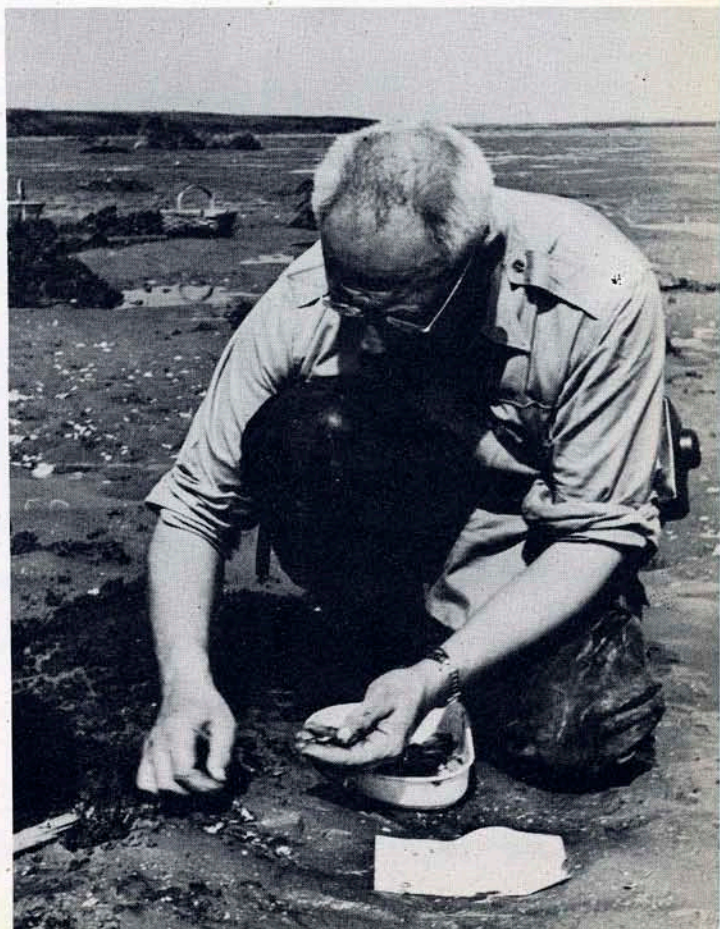
A seagoing laboratory, the **RESEARCHER** studies fish processing and handling in Alaska.

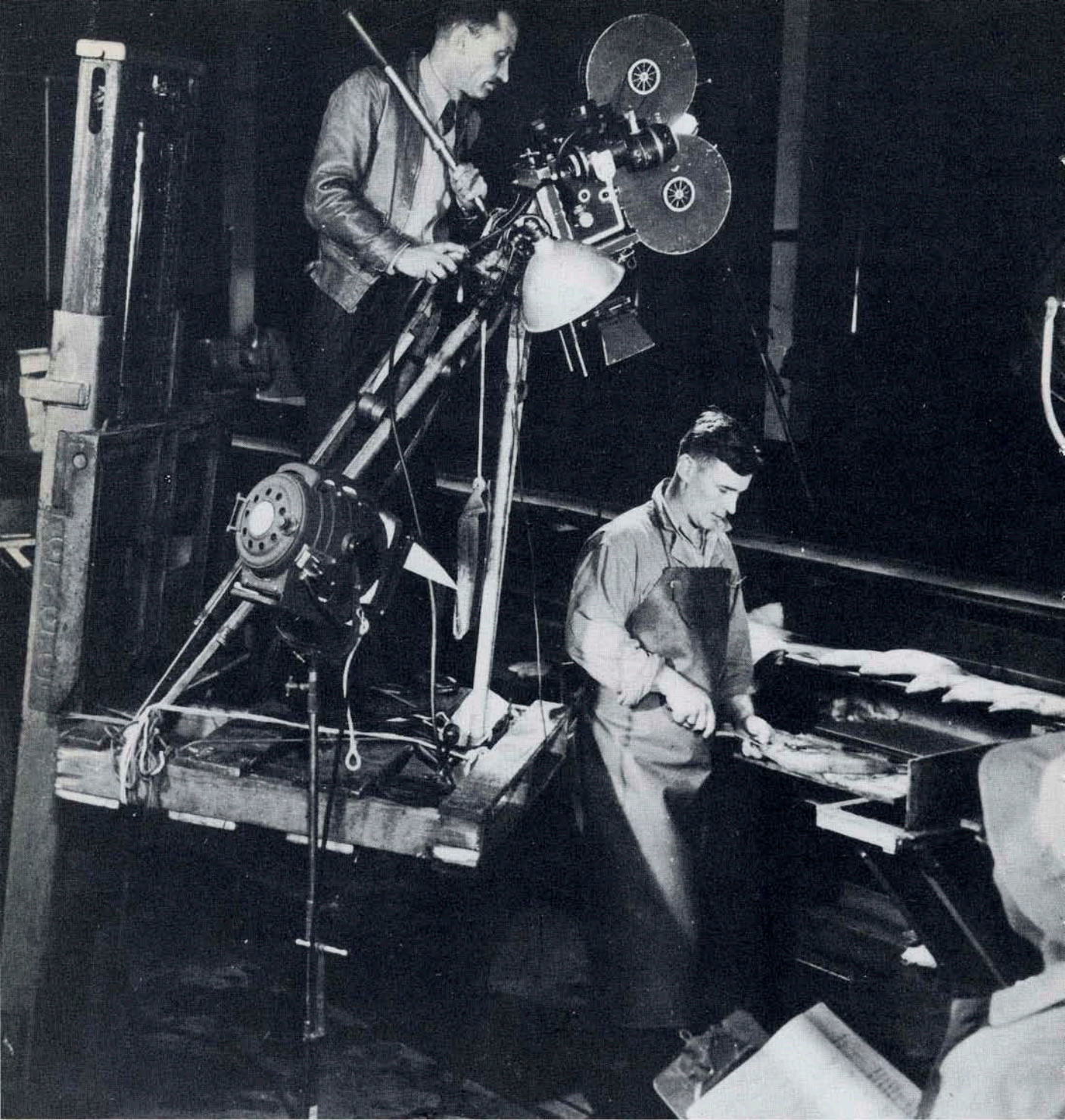


The SPENCER F. BAIRD (*above*), a modern oceanographic vessel.

Below, right: A biologist investigating the abundance of young clams on the New England coast.

Below, left: Aboard a fishing trawler, a biologist makes observations on the catch.





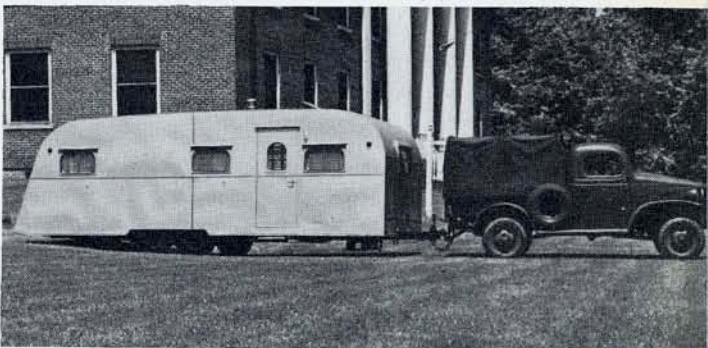
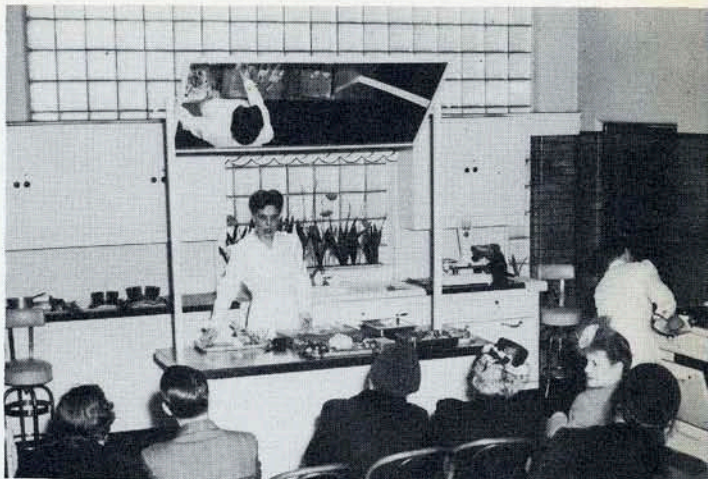
Motion pictures are used as educational aids in demonstrating approved methods of fish processing. Here the camera records fish filleting as part of a film which shows the handling of fish from its capture to the market.

UTILIZING THE CATCH.—Conservation of the fisheries is aided not only by biological studies which direct management, but by improving methods of utilizing the catch.

Formerly there was much waste in the handling of fish. Technological research, carried on in governmental laboratories and by private industry, is now developing ways to convert formerly wasted material into valuable by-products. Such research is also helping the industry maintain proper sanitation on boats and in shore plants and markets. For use in remote areas, the Fish and Wildlife Service maintains several trailers equipped to perform laboratory tests in the field. It also carries out educational programs to demonstrate to the industry the most efficient methods of filleting, freezing, packaging, canning, or smoking fish.

The final step in the utilization of most fishery products is their use as food in the home. The Fish and Wildlife Service maintains a staff of cookery experts who demonstrate methods of cooking fish to create tasty and attractive dishes and at the same time retain the rich nutritional values possessed by aquatic foods.

Photographs at right: (1) Fish cookery demonstration before a group of housewives. (2) Trailer laboratory equipped for field research. Such mobile laboratories handle principally emergency problems requiring quick action, or those that arise in areas remote from major laboratory facilities. (3) Conducting an experiment in fish canning.





Trout fishing in Yosemite National Park, California

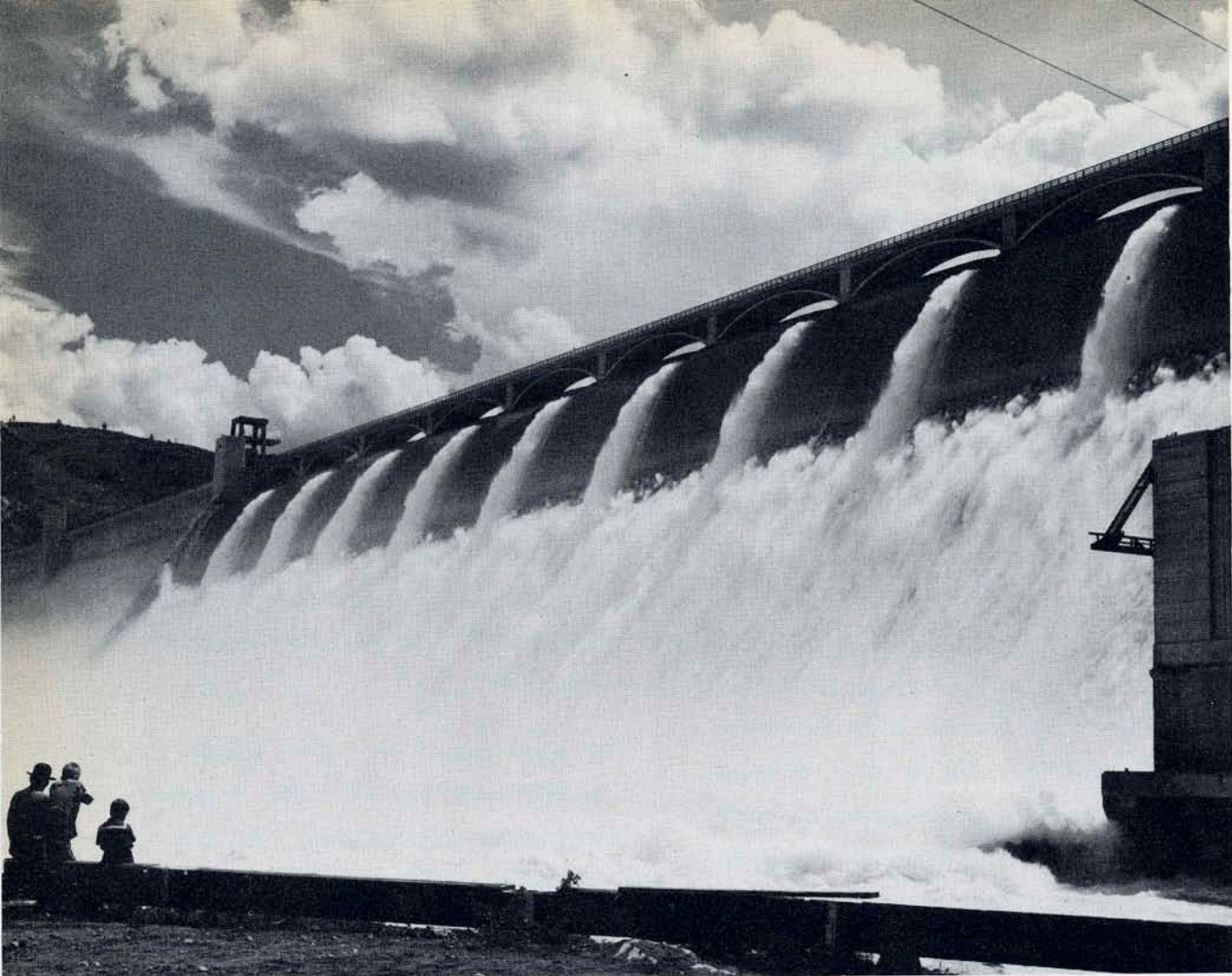
Inland Fishery Resources

THE FISHERIES of the inland lakes, ponds, and streams are probably the most important single recreational resource possessed by the United States. It is estimated on the basis of license statistics and other information that about 20 million persons engage in sport fishing each year. The annual catch of these fishermen probably amounts to at least 250 million pounds. The inland waters also support commercial fisheries. These, however, are conducted on a much smaller scale than the marine fisheries, and their total yield—about 85 million pounds—is a small fraction of the oceanic harvest. In addition to the catch of organized commercial fisheries, an unknown but fairly large poundage of fresh-water fish is caught by individuals fishing for their own use as food.

On the whole, the fresh-water fisheries are more easily harmed by human activities than the great ocean fisheries, which, by their very remoteness, are largely immune to injury except from overfishing. The inland waters, on the other hand, can be poisoned by industrial pollution, depleted by diversion of water for irrigation, or choked with erosion silt. Compared with this destruction of their essential habitat, the damage to fresh-water fishes by excessive fishing is, except for particular localities, relatively slight.

In early attempts to manage fresh water fisheries, chief reliance was placed on artificial propagation in hatcheries. This activity is still extremely important, particularly in relation to trout. In fishing waters near large centers of population, or in public recreational areas like the National Parks, sport fishing could not be maintained throughout a season without regular plantings of hatchery fish. Now, it is realized, however, that hatching and stocking fish must be accompanied by the protection and restoration of habitat.

The conservation of the inland fisheries and the conservation of soil and water are inseparable parts of the same problem. Bad farming practices and excessive lumbering, which denude the land and hasten erosion and loss of soil, create stream conditions which cannot be tolerated by fish. Rapid run-off of rain waters may scour stream beds, destroy fish food, bury spawning beds under silt. Muddy, turbid waters support few fish. Water that contains the chemicals of industrial pollution, the oxygen-consuming wastes of food-processing plants, or untreated sewage is generally destructive to fish. Reforestation, soil-conserving methods of farming, and control of pollution are some of the most important ways of improving fishing in inland waters.



Grand Coulee on the Columbia River, a giant irrigation dam too high to permit construction of fishways. Fish that normally spawned above this dam were transplanted to lower tributaries.

Harnessing the waters of a river to provide hydroelectric power, to irrigate agricultural lands, or to control floods often creates conditions hazardous to fish. These hazards are especially acute where runs of migratory fish are concerned. In the course of their life cycle, these fish typically spawn in fresh water streams or lakes, the young (and sometimes the adults)

migrate to the ocean, and later return to spawn. Dams obstruct spawning runs and may destroy the young fish on their seaward migration. Irrigation diversions often are death traps for young migrants. The United States has such problems in relation to its salmon and steelhead trout fisheries, and, to a lesser extent, its shad and river herrings. Resident lake and stream

fishes also may be affected, especially where the character of the water is changed, as from a cool, running stream to a warm reservoir pool.

Where dams obstruct the migration of salmon, herring, and other fish that come in from the sea to fresh-water spawning grounds, fishways should be provided. These, as designed by hydraulic engineers, usually take the form of a broad ladder or "stairway" in which the steps are pools of water, so that the fish in their ascent may swim or jump easily from one level to the next. Such ladders may sometimes serve the young fish as well on their downstream journey; usually, however, special bypasses or other devices must be provided in an effort to protect them from the dangers of passing through powerhouse turbines.

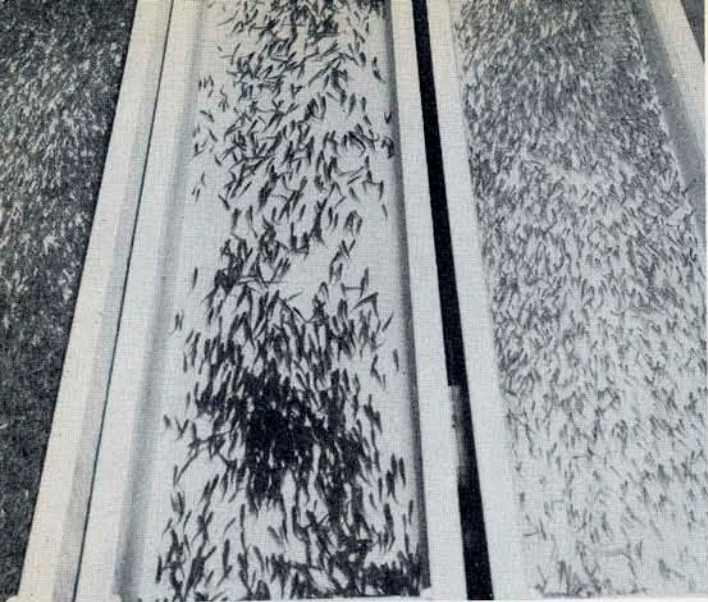
On irrigation projects, not only must the dams

The largest fish ladders in the world are those at Bonneville Dam on the Columbia River. About 600,000 fish, mostly salmon, ascend these ladders each year.

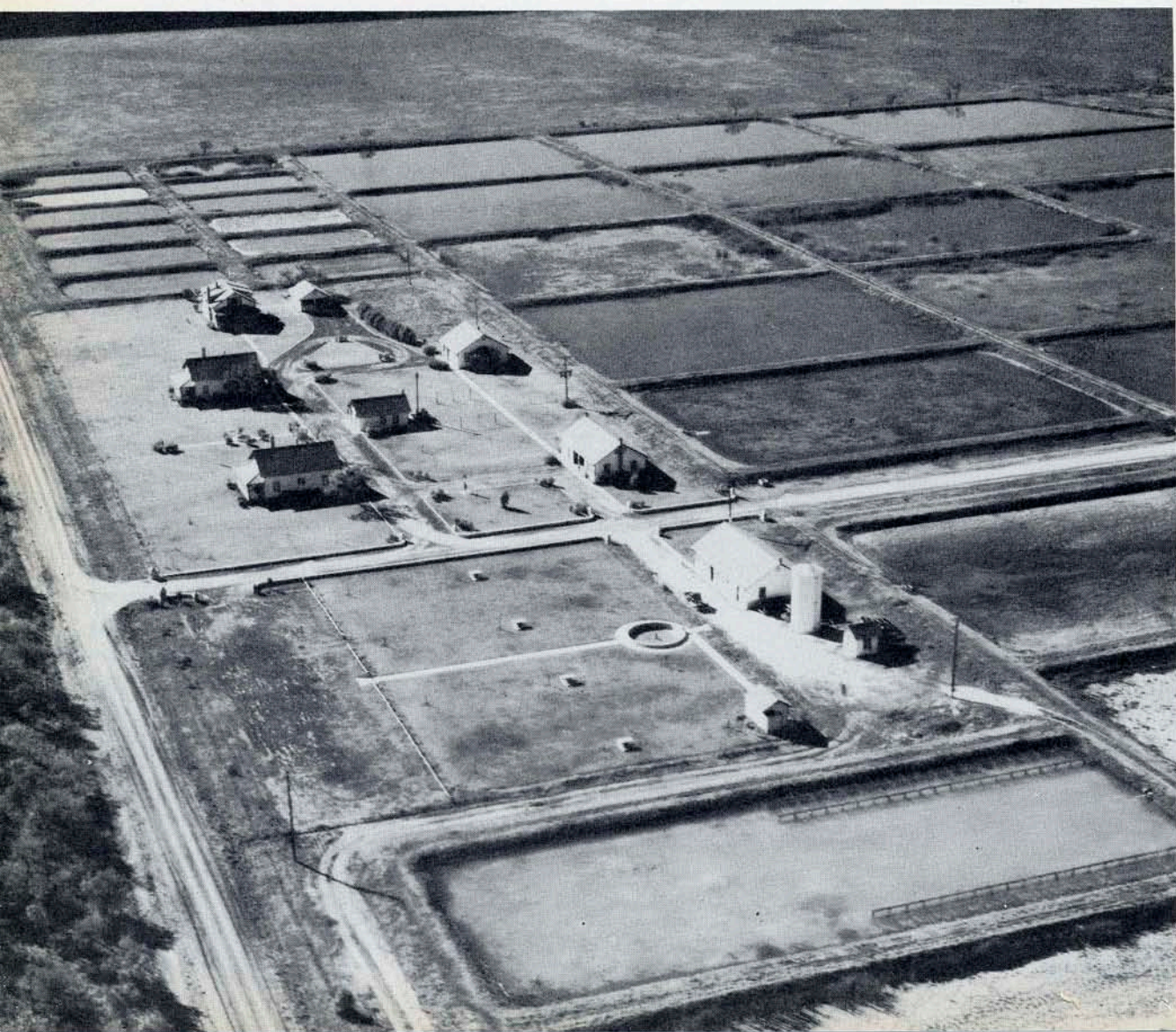
be provided with fishways, but the irrigation diversions must be screened to prevent the entrance of fish which would eventually find themselves stranded on agricultural lands. Many resident river fish are so destroyed; on the Pacific coast of the United States the problem is especially serious as it affects seaward-migrating young salmon.

Conflicts between such water-utilization projects and the fisheries often can be resolved by advance planning; once actual construction has begun it may be too late to provide for fishery requirements. In the interest of fishery conservation, the United States recently has established closer coordination between Governmental agencies concerned in river development and those familiar with the requirements of the fisheries.





In the United States, the Federal Government operates about 100 hatcheries, the various States about 500. Federal hatcheries in 1947 produced 58,450,000 trout and other cold water species, 34,000,000 warm water species like basses and sunfishes, 81,250,000 salmon and steel head trout, in addition to the hatching of marine species. *Below:* Fish and Wildlife Service hatchery at Uvalde, Texas. *Left:* Young trout in a hatchery trough.





Farm fish ponds provide food and recreation and are important in soil and water conservation. Hundreds of thousands of such ponds have been built in the United States during recent years; however, many more are needed for effective soil conservation. Properly managed, a farm pond may yield several hundred pounds of fish per acre—much more than the average food production of farm land. Good management includes fertilization, stocking with the proper species in proper proportion, and harvesting the crop regularly. Federal hatcheries annually supply about 12 million fish for farm pond stocking; many States also raise fish for these ponds.



International Cooperation in Fishery Conservation

FUR SEALS.—One of the most impressive stories in the history of conservation is that of the North American fur seals. These seals, concentrated during their breeding season on the Pribilof Islands in Bering Sea, were once on the verge of extinction; by careful management based on international agreement, they have been fully restored. This herd now contains about 80 percent of all the fur seals in the world, smaller herds being found off Uruguay, the Cape of Good Hope, and in the Western Pacific off Siberia.

When the Pribilof Islands were discovered in 1786 by the Russian navigator, Gerassim Pribilof, there were probably 4 million seals on the Islands. About a hundred years later, in 1867, the United States acquired possession of the seals through the purchase of Alaska and the adjacent islands from Russia. During the interval, intensive sealing had reduced the herd to about 3 million.

Ruthless exploitation of the fur seals continued. Besides the excessive kill, the most harmful practice was pelagic sealing, or the killing of seals at sea. This was done by the fishermen of several countries—Canada, the United States, and Japan. It was particularly destructive because it often resulted in the killing of

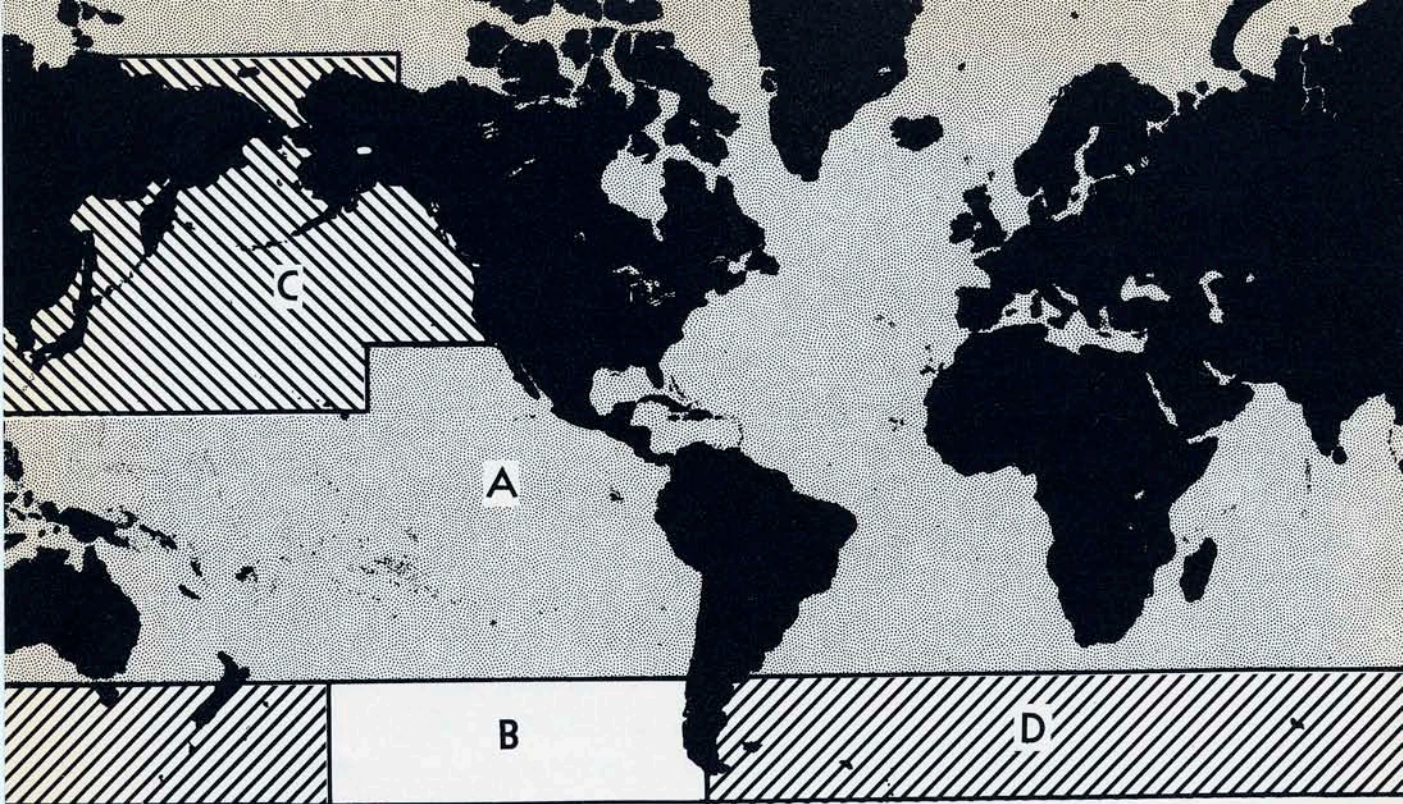
the mother seals, whose pups then died of starvation.

By 1910, the herd had been reduced to only about 130,000 animals, from its former strength of 3 to 4 million. With virtual extinction of this immensely valuable resource threatened, a program of international cooperation was undertaken. Under a treaty effective in 1911, the countries interested in the resource agreed that there should be no more pelagic sealing. The United States, which owned the breeding grounds of the herd, took over its management and all sealing operations. A share of the profits was annually paid Canada and Japan. Since that time, the taking of seals for their pelts has been carefully adjusted to the size of the herd and has been confined to the immature males in excess of those needed as a breeding reserve.

The success of this system of management may be judged by its results. The herd has now increased to 3,600,000 animals (1947 census), and yields 60,000 to 70,000 skins a year.

In 1941, the treaty of 1911 was abrogated by Japan. A provisional agreement between the United States and Canada, continuing the principal provisions of the treaty, now affords protection to the seals.

Opposite: After a southward migration in winter that takes the seals as far as the coast of southern California, the herd returns to the Pribilof Islands. On the breeding grounds they are associated in family groups known as harems, consisting of one bull and about 40 cows. The pups are born soon after the arrival of the female seals in March or early April.



- A. Factory ships for taking baleen whales not allowed.
- B. Proposed sanctuary for baleen and humpback whales.
- C. Factory ships for taking baleen whales allowed.
- D. Factory ships for taking baleen whales allowed, but ships operating here cannot be used in any other waters within one year from termination of that season. Humpback whales cannot be taken.

About 75 percent of the world's whaling is now carried on pelagically from factory ships in the Antarctic. Coastal whaling grounds exist off Chile and Peru, and off Japan, South Africa, the Azores, New Zealand, and in the North Atlantic and North Pacific. The leading whaling nations of the world, all of which operate in the Antarctic, are Norway, Great Britain, the U. S. S. R., the Netherlands, and South Africa. The present world demand for whale oil and other products of the industry is enormous.

WHALES are a marine resource that occur in varying abundance in all oceans of the world and have been the object of pursuit by 20 to 30 nations.

As a world industry, whaling is perhaps a thousand years old. Throughout the history of the fishery, on one whaling ground after

another, the same pattern of events has been repeated: The rise, climax, and decline of a great industry. As each area in turn became exhausted through overfishing, the whalers moved on to new fields. Shortly after 1900, the industry began operation in the last great unexploited area, the Antarctic Ocean.

Fearing that the same pattern of overfishing and depletion would be repeated in the Antarctic, and that the remaining profitable grounds in other parts of the world would become exhausted, the world's leading whaling nations took action in the early 1930's. The League of Nations called together a committee to consider international regulation of the whaling industry. From this action, several international conventions have set forth regulations for whaling, the first in 1932, another in 1937, upon which, with subsequent protocols and agreements, the present whaling regulations are chiefly based.

These regulations prescribe seasons for whaling, establish the minimum legal size for whales of each species, and prohibit the killing of females accompanied by calves, and of any whales of certain species. The regulations also require the fullest possible use of each whale taken. The participating nations, which include most of the important whaling countries, share responsibility for enforcement.

HALIBUT.—The history of the world's natural resources has many examples of their misuse and destruction. In a few cases the course of depletion has been halted and even reversed before it was too late. The story of the Pacific halibut is an example of such a conservation effort.

The halibut is a giant flounder of northern oceans, found on both coasts of North America

and in the Arctic Ocean. Being a slow-growing fish, maturing at the age of 12, it is especially subject to depletion.

The exploitation of this resource ran a swift and destructive course. From a small, local enterprise on the Pacific coast of the United States, the fishery extended its operations along 2,000 miles of coastline, from California to Bering Sea. Aided by gasoline and Diesel power and by mechanical fishing devices, it grew more and more intensive. Stocks of fish began to decline. Fishermen found they had to work longer and harder to fill their holds, and despite their efforts the total catch fell.

The halibut fishery was exploited by two nations, the United States and Canada. Moved by evidence of alarming depletion, these two countries in 1924 joined in a conservation program. Under an international treaty a commission was established to study the biology of the halibut and formulate sound principles of conservation. Later the international convention was renegotiated to provide powers of regulation.

Years of biological study have revealed the facts concerning migrations, spawning, growth, and survival upon which a successful management program is now being carried out.

Under international regulation, the abundance of halibut has increased markedly on all grounds. The resource is now yielding an annual catch 10 million pounds larger than under unrestricted fishing immediately before regulation.

FRASER RIVER SALMON.—The sockeye salmon fishery of the Fraser River is another example of a resource shared and managed by two nations. Although the salmon of this river system spawn in British Columbia, the young fish migrate to the sea and the mature salmon return to spawn through American as well as Canadian waters.

Once these salmon were enormously abundant. For many years the exploitation of this valuable fishery by the two countries was an unhappy story of overfishing, destructive methods, declining runs. In 1913, rock slides on the Fraser River 130 miles from the sea, in a narrow passage known as Hell's Gate, prevented millions of fish from reaching their spawning grounds. This disaster not only virtually destroyed a complete cycle of fish, but created an obstruction for future runs. From these various

causes, the runs declined to about a tenth of their former magnitude.

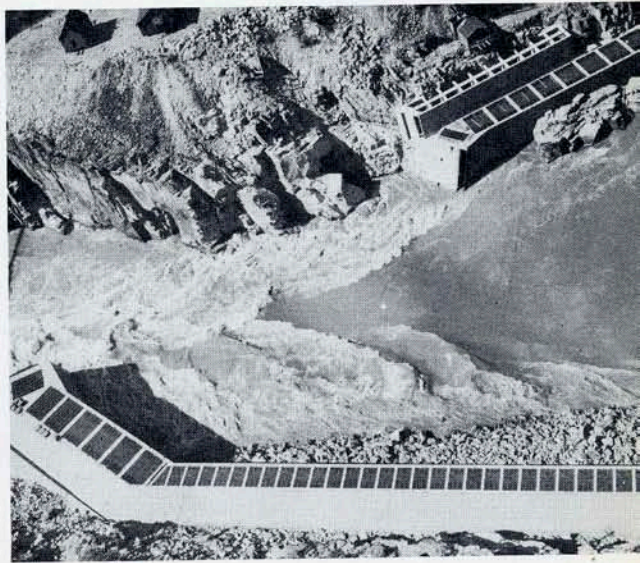
In 1937 the Governments of Canada and the United States of America concluded an international convention for the conservation of the Fraser River salmon. An International Commission was appointed, with authority to make biological studies and, after eight years of study, to regulate the taking of salmon.

With two million dollars provided by the Governments of the United States and Canada, the Commission has built fishways at Hell's Gate and several other points where passage was difficult. It also plans to improve and restore many former spawning areas. These measures, in addition to regulation of the catch, give promise of restoring this fishery to something approaching its former importance.

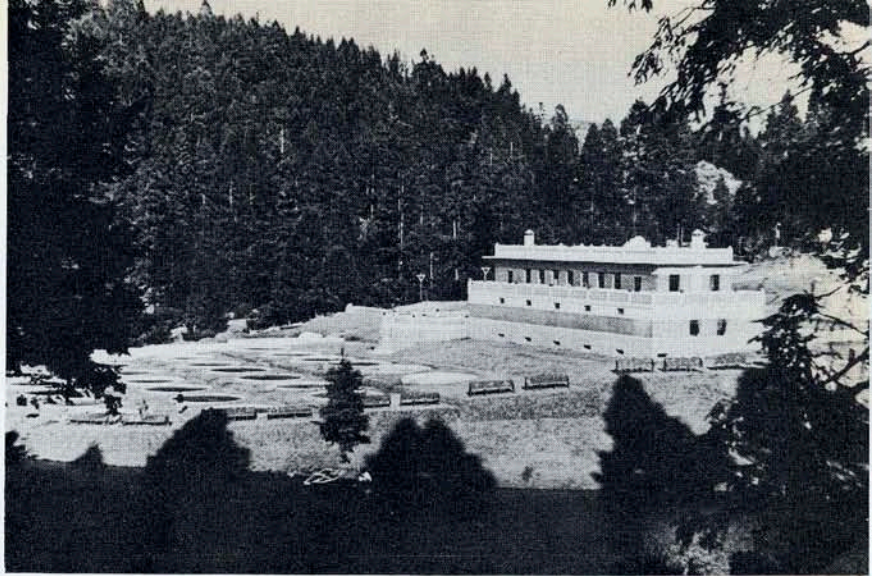
Tagging salmon as part of biological studies on the Fraser River



Fishways at Hell's Gate in the Fraser River canyon



El Zarco trout hatchery at Salazar,
Mexico



Inter-American Cooperation in Conservation

The study and solution of conservation problems of common interest to the people of all the American Republics has been aided during the past ten years by the United States Government through its Interdepartmental Committee on Scientific and Cultural Cooperation. This Committee implements resolutions concerning technical cooperation adopted by conferences of American Republics. Its program provides a practical plan, through exchanges of information and technical skills, for conserving and developing the fishery and wildlife resources of the American Republics. Some of these resources belong only to one or two nations; others, especially the migratory fishes and birds, move freely across international boundaries, and their conservation is important to all nations which share them.

The first of these cooperative projects was carried out with the Government of Peru, which had become interested in investigating

the extent of its fishery resources and, if possible, increasing them. In 1941, at the request of Peru, the United States sent a mission of three fishery experts, equipped with a fishing vessel and special gear and apparatus, to explore the Peruvian fisheries. Expenses were paid by the Peruvian Government. At the time of the investigation, the problem of increasing supplies of protein foods was made especially urgent because of disturbed world conditions. The mission assembled much basic information and made specific recommendations for the development of the industry and more efficient utilization of its products.

Similar requests from other nations followed. A survey of the entire Caribbean area was made in 1942. As was true of most sections of Latin America, little was known about the extent and potential productiveness of the fisheries of the Caribbean. Critical wartime conditions made increased local production of foodstuffs a necessity. The mission covered some 30,000 miles



Divers at work during the pearl oyster survey off the coast of Panama

of coastline and was completed in about seven months. It visited every capital city, and made field surveys of fishing areas in almost every country.

Mexico and the United States have benefited from close cooperation in fishery studies during recent years. These two countries have—especially in the tuna and shrimp fisheries—important contiguous fishery resources. Many mutually important problems arise in connection with such fisheries—problems that require facts as a basis for their solution. Under the Mexican fishery mission, a marine fishery laboratory has been established at Guaymas, marking the begin-

ning in Mexico of modern fishery research. Marine fishery surveys have been undertaken in about a dozen Mexican states.

The depleted fisheries of inland Mexico also need restoration. Encouragement of farm ponds, like those so popular in southern and southwestern United States, has helped to relieve food shortages in these inland areas. Bass and sunfish have been planted in such ponds, and in new reservoirs, connected with hydroelectric and irrigation projects. By improving production and stocking procedures, it has been possible to extend the planting of trout in the colder waters of Mexico.

Some species of white-winged doves are migratory, spending part of the year in the southwestern parts of the U. S. A., migrating in winter as far south as Guatemala and El Salvador.



Other fishery missions were carried out in Venezuela in 1943 and 1947, in Chile in 1944 and 1945, and in Panama in 1948. In each instance the Government requesting the technical assistance bore the expenses of the mission and cooperated actively in the project. In 1945, the United States, at the request of the Government of Nicaragua, detailed a biologist to survey potential trout streams in that country. Nicaragua was interested in developing better fishing, not only for its own citizens, but as a tourist attraction.

Extending beyond fisheries to include bird and mammal resources within its scope, a mission to Guatemala in 1946 and 1947 made an inventory of the natural biological resources of that country and drew up a suggested conservation program. This program included migratory birds, and, if adopted, would make its effects felt in other American Republics north and south of Guatemala.

On the invitation of the Cuban Government, the Fish and Wildlife Service assigned a party of three ornithologists in 1948 to a survey of the migratory bird fauna of Cuba. Many birds which spend the summer on the continent of North America winter in Cuba, or pass through that country during the spring and autumn migrations. For this reason their conservation is important to all the countries within their range.

The decline of valuable pearl oyster fisheries in Panama led that country to ask for the services of a specialist to discover causes for the depletion of the oyster reefs. Early in 1948, the Fish and Wildlife Service sent an expert in shellfish biology to Panama to make a detailed survey of conditions on the reefs and recommend conservation measures.

These cooperative programs reflect the ever-increasing need and desire for international cooperation in conserving and developing the natural resources of the Western Hemisphere.

Many International, Federal, State, and private conservation agencies and other organizations have cooperated with the Fish and Wildlife Service by furnishing photographs for this publication. It is a pleasure to acknowledge the assistance of the International Pacific Salmon Fisheries Commission, Allan D. Cruickshank of the National Audubon Society, Montara Fish and Game Commission, Bureau of Reclamation, Bonneville Power Administration, National

Park Service, Forest Service, Soil Conservation Service, Navy Department, Fouke Fur Company, the Institutional Magazine, and George E. Mushbach.

This publication is issued in furtherance of the program of the United States Government for cooperation with American Republics, and the material assistance of the Interdepartmental Committee on Scientific and Cultural Cooperation is gratefully acknowledged.

U. S. GOVERNMENT PRINTING OFFICE O-1948