CONSERVATION IN ACTION

MATTAMUSKEET
a National Wildlife Refuge

Number FOUR

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

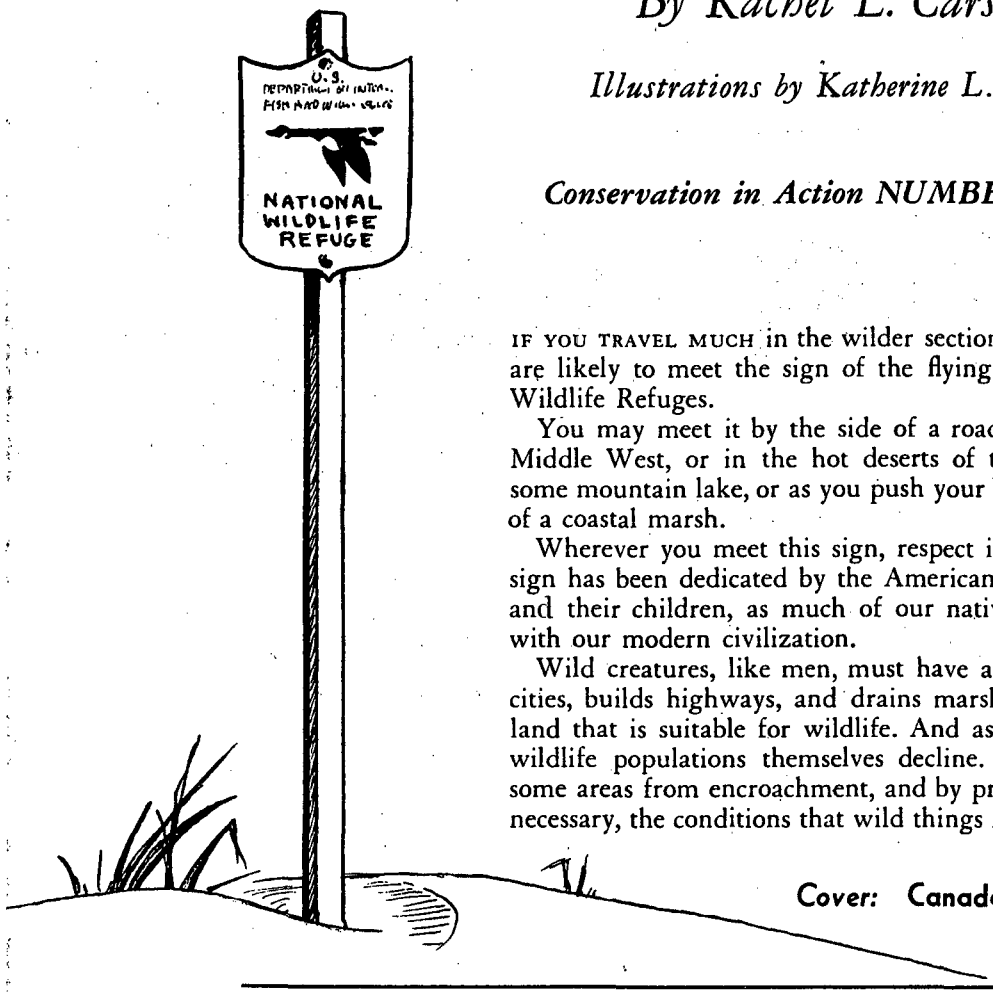
UNITED STATES DEPARTMENT OF THE INTERIOR, J. A. Krug, *Secretary*
FISH AND WILDLIFE SERVICE, Albert M. Day, *Director*

MATTAMUSKEET

A NATIONAL WILDLIFE REFUGE

By Rachel L. Carson

Illustrations by Katherine L. Howe



Conservation in Action NUMBER FOUR

IF YOU TRAVEL MUCH in the wilder sections of our country, sooner or later you are likely to meet the sign of the flying goose—the emblem of the National Wildlife Refuges.

You may meet it by the side of a road crossing miles of flat prairie in the Middle West, or in the hot deserts of the Southwest. You may meet it by some mountain lake, or as you push your boat through the winding salty creeks of a coastal marsh.

Wherever you meet this sign, respect it. It means that the land behind the sign has been dedicated by the American people to preserving, for themselves and their children, as much of our native wildlife as can be retained along with our modern civilization.

Wild creatures, like men, must have a place to live. As civilization creates cities, builds highways, and drains marshes, it takes away, little by little, the land that is suitable for wildlife. And as their space for living dwindles, the wildlife populations themselves decline. Refuges resist this trend by saving some areas from encroachment, and by preserving in them, or restoring where necessary, the conditions that wild things need in order to live.

Cover: Canada geese over Mattamuskeet Lodge

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON : 1947
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Mattamuskeet

MATTAMUSKEET, PEA ISLAND, AND SWANQUARTER—two on the mainland and one on the outermost barrier beach—are three National Wildlife Refuges in North Carolina that provide winter food and shelter for more than 100,000 waterfowl. Ducks, geese, and swans that in summer scatter across the northern rim of the world from Greenland to Alaska come down the sky lanes in the fall and in these refuges find the conditions they need to survive the hard months of winter.

At Mattamuskeet you can see one of the largest assemblages of Canada geese on the Atlantic seaboard and more of that giant white bird, the whistling swan, than the average person is likely to see in a lifetime. Pea Island is a winter haven for thousands of snow geese, Canada geese, and such ducks as goldeneyes, pintails, and mallards. At Swanquarter the diving ducks like bufflheads and scaups find the salt waters and the submerged aquatic plants that they need to tide them over winter.

These refuges lie within the Atlantic flyway of the waterfowl. There are four such flyways in the United States, the others being the Mississippi, the Central, and the Pacific.

The Atlantic flyway has extensive breeding grounds, scattered from the eastern border of the continent to the western, but its winter range is only a narrow strip on the Atlantic coast of the United States, an area that is also densely settled and developed for agriculture and industry. Waterfowl refuges are especially needed in this flyway to provide plenty of food and shelter for the birds during the critical winter period.

This booklet tells the story of Mattamuskeet, which is the largest of the three refuges in North Carolina and the most accessible to visitors, and which in some respects is unique among all wildlife refuges. It also includes brief accounts of Swanquarter and Pea Island.

MATTAMUSKEET—the rhythmic softness of the Indian name recalls the days when tribes of the Algonquin roamed the flat plains of the coast and hunted game in deep forests of cypress and pine. The Indians are gone, leaving few traces upon the land they once knew. Much of the forest as the Indians knew it is gone, too, but even today some of the wildest country of the Atlantic coast is to be found in this easternmost part of the Carolina mainland—the area bounded by Albemarle Sound on the north and Pamlico Sound on the east and south. Here, in this coastal region, are dense woods of pine, cypress, and gum; here are wide, silent spaces where the wind blows over seas of marsh grass and the only living things are the birds and the small, unseen inhabitants of the marshes.

The Mattamuskeet National Wildlife Refuge includes about 50,000 acres of land and water in this Carolina coastal country, in the county of Hyde. The dominant geographic feature of the refuge is Lake Mattamuskeet—a shallow, sluggish body of water more than 15 miles long, 5 or 6 miles across, and some 30,000 acres in extent. Being little more than 3 feet deep anywhere, the lake is stirred deeply by the winds and its waters are usually muddy. Silt-filled waters support little plant life, and so the best feeding grounds for the waterfowl are not in the open lake but in its surrounding marshes. Cypress trees form most of the northern border of the lake, but its eastern and southern shores pass into low swamplands.

Try to learn the origins of this vast inland lake and at once you stumble upon a collection of local legends in which it is hard to separate fact from fiction. Of all the stories of the genesis of Mattamuskeet, local opinion divides its support between two. According to one story, the Indians long ago set fires in the peat bogs, fires that burned so long and deeply that a huge, saucer-like depression was formed. This caught the rains and the drainage water, creating a lake.

The other story has it that a shower of giant meteors once struck the Carolina coastal plain, the impact of the largest ones digging out the beds of Lake Mattamuskeet and the smaller, but otherwise similar, Lakes Alligator, Pungo, and Phelps that lie northwest of Mattamuskeet.

THE MODERN HISTORY OF MATTAMUSKEET, although less stirring to the imagination, has been a troubled one. The flat plain between Albemarle and Pamlico Sounds is an agricultural country that yields crops of soy beans, cotton, collards, and grain. On the whole it has too much, rather than too little water. About 1914, people conceived the idea of draining Lake Mattamuskeet and converting its shallow bottom to farm land. Being patterned after similar projects in Holland, this community was named "New Holland."

The history of this attempt is too long to tell here—the digging of a network of canals, the building of pumping plants and a community of cottages, the spending of millions of dollars, the bankruptcy of one company after another, and the eventual abandonment of the scheme as impractical and impossibly expensive.

In 1934 the land was acquired by the United States Government and a waterfowl sanctuary was established. The Civilian Conservation Corps converted the former pumping plant into a refuge office and store rooms, combined with a modern, comfortably furnished lodge for visitors. A circular staircase was built into the former smoke stack of the pumping plant, turning it into an observation tower. This 120-foot tower affords a magnificent view of the entire refuge and the surrounding country, with thousands of geese and swans often in sight at one time.

According to an agreement with the State of North Carolina, two areas along the south shore of the lake have been set aside for managed hunting, where shooting is under the direct control of the State. Federal as well as State regulations are enforced. About 20 to 25 blinds are established, each in charge of a guide who is required to enforce hunting regulations. Reservations for these blinds should be made in advance by writing to the State Game Protector, North Carolina Wildlife Resources Commission, New Holland, N. C.

Fishing in the lake and canals is a popular recreation, also managed by the State, for which all fishermen are required to obtain a permit.

Fishes caught most abundantly are crappie, white perch, carp, and black bass. Fishing is permitted all year except during the hunting season, when it is restricted to Sundays.

Because the refuge is an excellent place to see many wild creatures native to the Atlantic coastal region, bird clubs and general nature study groups, classes in conservation, scouts and conservation-minded hunters are visiting Mattamuskeet more and more often to observe its wildlife.

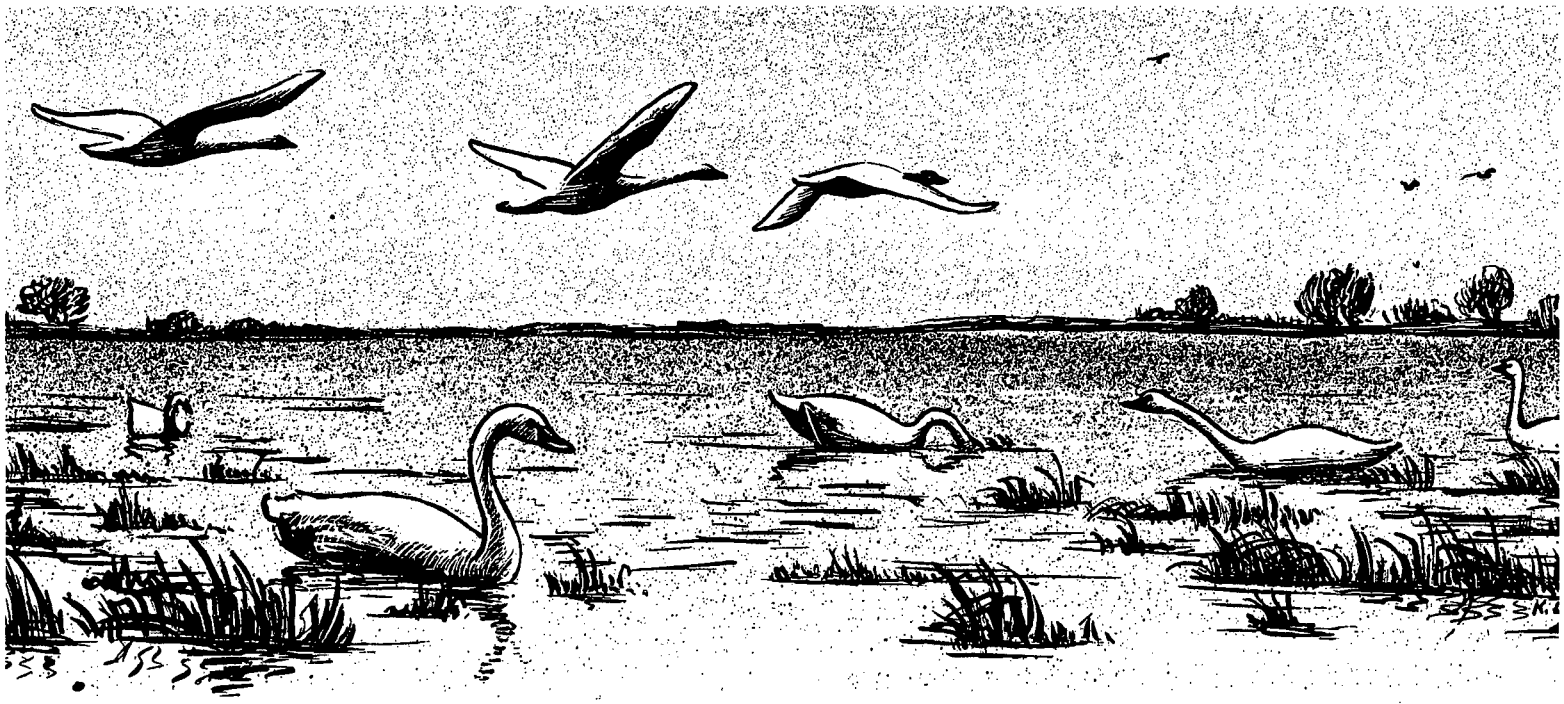
Deer are plentiful on the refuge. Often you hear them splashing as they make off through the marshes, frightened by your approach. At night, emboldened, they roam about the refuge lawns, where you may surprise them in the beam of your flashlight. Bear occur in small numbers in the region; foxes, raccoons, opossums, mink, and some other small mammals are abundant. A good many muskrat houses are to be seen in the marshes, but this little furbearer saves himself a great deal of labor by often tunneling into the canal banks.

Alligators, which give the nearby Alligator River its name, sometimes swim lazily in the canal near the lodge. Snakes native to the coastal swamps—cottonmouth and water moccasins, copperheads, black snakes, and others—occur but are not often seen in winter. Frogs are very abundant in the swamps and a throbbing amphibian chorus fills the night air even in midwinter when the weather is mild.

For visitors to Mattamuskeet, a modern and comfortable lodge is operated by a concessionaire throughout the year. The lodge has space for 45 to 50 people, accommodations ranging from single or double rooms with private bath to 4-bed rooms. Meals are served in the lodge dining room. Advance reservations and all arrangements for accommodations should be made with the Manager, Mattamuskeet Lodge, New Holland, N. C.

Because of the great demand for space during the hunting season, reservations for this period need to be made far in advance. The most satisfactory time for bird clubs to visit the refuge is during the fall before the hunting season opens, and again in winter and spring after the hunting season. There are comparatively few birds at the refuge during the summer.

Mattamuskeet Lodge



Whistling swans feeding on the marshes

WHISTLING SWANS are the most spectacular birds to be seen at Mattamuskeet. With their wing spread of 6 to 7 feet, they are the largest of all North American waterfowl except the related trumpeter swan, which is now reduced to less than 400 birds in the United States.

The whistling swans arrive at Mattamuskeet sometime in November, remain several months, and usually in February begin their northern migration. When they leave Mattamuskeet, they have a trip of 2,500 to 3,500 miles before them, for most of them breed north of the Arctic Circle. The species winters on the Atlantic coast, principally between Maryland and North Carolina, and also on the Pacific coast from southern Alaska to southern California.

A large flock of swans is noisy and their voices are a typical winter sound on the refuge. The mingled chorus of swan voices is something like the sound of geese, although somewhat softer. The name "whistling swan" is given because of a single high note sometimes uttered—a sound that suggests a woodwind instrument in its quality. The trumpeter has a deeper, more resonant voice because of an anatomical peculiarity—the windpipe has an extra loop. Trumpeters are never found on the Atlantic coast, however.

After a long history of persecution by man, all wild swans now enjoy complete protection in the United States, Alaska, and Canada. As though sensing this security, the swans at Mattamuskeet show very little fear of people and allow themselves to be approached much more closely than the geese. Five to ten thousand swans usually winter here, feeding in shallow water areas about the southern and eastern shores of the lake. It is possible to see a flock of 500 swans at one time, magnificent in their gleaming white plumage. Sometimes the swans feed or rest in family groups in which the young birds or cygnets may be identified by their grey color.

FOR THE CANADA GEESE of the Atlantic coast, Mattamuskeet is one of the chief wintering places, with a population of about 40 to 60 thousand of these handsome birds from November to the middle of March.

Magnificent though the swans are, the person who visits Mattamuskeet in midwinter is likely to come away with impressions of geese uppermost in his mind. Throughout much of the day, their wings pattern the sky above you. Underlying all the other sounds of the refuge is their wild music, rising at times to a great, tumultuous crescendo, and dying away again to a throbbing undercurrent.

Guided by the voices of the birds, you walk out along the banks of one of the canals about sunrise. A steady babble of goose voices tells you of a great concentration of the birds on the lake, probably off the end of the canal. At intervals the sound swells as though a sudden excitement had passed through the flock, and at each such increase in the sound a little party of birds takes off from the main flock and moves away to some favored feeding ground. As you stand quietly in the thickets along the canal, they pass so close overhead that you can hear their wings cutting the air, and see their plumage tinged with golden brown by the early morning sun.

The Mattamuskeet country is so famous for its geese that hunters come from great distances, and rent shooting blinds from farmers of the region or in the managed hunting areas operated on the refuge. In the 1946–47 season, the total kill of geese within these managed areas was 868. Large numbers are shot also in the surrounding countryside, but exact figures are not available.

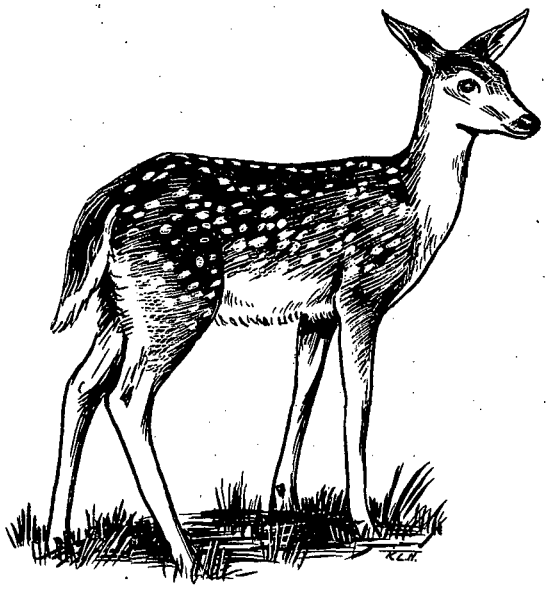
A large majority—probably three-fourths—of the Mattamuskeet geese breed along the eastern shores of Hudson Bay, smaller numbers in the Maritime Provinces.

The ducks that winter at Mattamuskeet are largely the marsh or dabbling ducks—the shallow-water feeders. Pintails are the commonest of these, and it is a beautiful sight to see 10,000 or more of these graceful ducks wheeling above the marshes. Small flocks of wigeons appear in spring along the lake road. Black ducks, green-winged teal, mallards and blue-winged teal spend the winter here in varying numbers, from a few hundred to a few thousand.

Most of the ducks found in winter from Delaware Bay south nest in the prairie provinces of Canada or in the flat country of the Dakotas and Minnesota. All of this country is subject to periodic droughts; then many ponds and marshes dry up, few ducks nest successfully, and few ducklings survive to join the fall flights south.

THE BIRD CLUBS OF NORTH CAROLINA and surrounding States have made frequent visits to Mattamuskeet ever since the refuge was established. So many birds may be seen in the thickets or along the canals within a few hundred feet of the lodge that it is unnecessary for older members or others unable for strenuous exercise to go far afield. More than one person confined to a wheel chair, who had believed his days of field ornithology behind him, has been brought to Mattamuskeet for a satisfying and refreshing experience.

To gain the best vantage points for observing swans, geese, or ducks, it is worth while to hike out along the remnants of the former canals that here and there extend in long, densely overgrown peninsulas into the lake. Sometimes this will bring into view thousands of geese resting on the water. Concentrations of swans on feeding grounds along the south shore of the lake can sometimes be spotted from the highway, and can then be approached on foot within good binocular or camera range. All cultivated fields of the area should be watched for large flocks of geese.



Fawn of white-tailed deer

The bird life of Mattamuskeet includes about 200 different species, with water birds and water-loving land birds predominating—less variety than is found in a more diversified country. Bird clubs visiting Mattamuskeet therefore may not compile a long list but see extremely large numbers of certain species, occasionally record a rarity, and have excellent opportunities for close observation of bird behavior.

Waterfowl are, of course, the chief winter attraction. Of these, swans, Canada geese, and the surface-feeding ducks find ideal conditions at Mattamuskeet. Diving ducks tend to go to the Swanquarter area (see page 8). Marsh birds like herons are common: the great blue stays throughout the year, the American bittern is here in winter, the least bittern, green and little blue herons, and American egret are summer residents. Shorebirds, loons, and grebes find little suitable country for their habits and occur only in limited numbers.

The brown-headed nuthatch is a permanent resident, probably nesting on the islands of the lake or about the borders of the canals. In winter the wax myrtles are alive with myrtle warblers. Carolina wrens, chickadees, white-throated, fox, swamp, and song sparrows fill the winter thickets. Other winter residents or transients include the hermit thrush, ruby-crowned kinglet, pipit, horned lark, and cedar waxwing. The mockingbird is common throughout the year.

The most abundant of the summer warblers at Mattamuskeet is the prothonotary, with the prairie warbler also a common bird. Vireos, both white-eyed and red-eyed, are common in summer, as are wood thrushes and orchard orioles.

Observers of birds at Mattamuskeet over the years have marked up a number of unusual species, such as the white pelican, blue goose, white-fronted goose, Hutchins goose, black tern (a fall transient), European wigeon, black rail, and—as interesting stragglers from the west—the avocet and Arkansas kingbird.

WHAT DOES THE MATTAMUSKEET REFUGE DO for the waterfowl that could not be done in the same area of wild country without management? This is a fair question, and its answer gives one of the chief reasons for establishing wildlife refuges in selected localities over the country.

The answer is this: by cultivating or managing the marshlands by scientifically tested principles, the land within the refuge is made many times as productive of natural foods as outside areas not under management.

Underlying and determining the character of the management activities are the great recurrent rhythms of nature. Moving over the marshlands

as over a stage, the passing seasons bring the cyclic sweep of two great series of events, one in the animal world, the other in the world of plants. The two cycles are directly related. In the spring the marshes that have been brown and desolate come alive with fresh green shoots of plants like the sedges, bulrushes, and salt grass. Spring yields to summer, the hot sun is over the land, the plants grow, flower, mature their seeds. By the time autumn begins to paint the leaves of the gums and the swamp maples, the marshes are loaded with food—the roots, seeds, and shoots of the plants that waterfowl eat.

Now the fall migrations of the birds—the sweep of the other, the animal cycle—fill the marshlands with ducks, swans, and geese come down from the north. Here in the marshes they find the food they must have if they are to survive the winter.

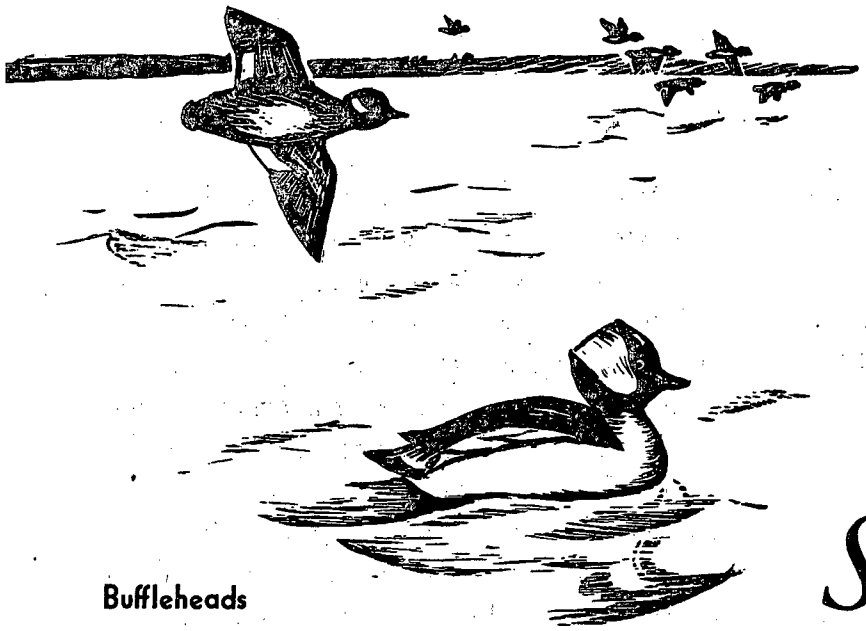
By late winter or early spring the food supplies are exhausted. But once more the urge to migrate is stirring among the waterfowl, and soon the marshes are left empty. In the stillness and heat of summer the recuperative powers of nature set to work to build up new food supplies.

To get the largest possible production of waterfowl foods out of the marshes at Mattamuskeet, the manager operates the refuge with certain aims in mind. Among the most important, he must keep down the brush that is forever moving into the marshes. Geese, swans, and ducks feed in marshes but not in thickets, so every foot invaded by the fast-growing brush is a corresponding loss of waterfowl pasture. Today at Mattamuskeet you can see hundreds of acres of productive marsh which have been won back from the thickets by burning, disking, and cutting.

Control of the water level is another method used by the refuge manager to increase the production of food plants. In the spring he lowers the water by manipulating the gates in the canals that lead from the lake to Pamlico Sound, about 8 miles distant. This lays bare extensive areas where 3-edge, 4-square, and other food plants can grow. In the fall the gates are closed, and the marsh areas flooded to serve the food plants in the way the birds prefer—under a few inches of water.

By late January or early February, most of the natural marsh food has been eaten. The thousands of birds that remain must have food to fuel their bodies on the long spring migration. This is a season of busy activity on the refuge. Crews of men move out into the marshes, starting fires in the marsh grass. Keeping the fires carefully under control, many hundreds of acres are burned. Less than a week later, new green shoots are coming up all over the marsh. Within ten days the geese have moved in to harvest this new food supply.

By thus coordinating the management of the refuge with the natural cycles of plant and animal life, the Fish and Wildlife Service has developed Mattamuskeet to the point where it now supports much larger flocks of waterfowl than came to this region in former years.



Buffleheads

Swanquarter

THE SWANQUARTER NATIONAL WILDLIFE REFUGE, like Swanquarter Bay and the town of Swanquarter, takes its name from the great flocks of swans that the early settlers found each winter in all the waters of the region. Swanquarter Refuge still has its wintering swans, although in much smaller numbers than at nearby Mattamuskeet. At Swanquarter the ducks now greatly outnumber either swans or geese.

This refuge was established chiefly for the diving ducks which include such important game species as redheads, scaups, goldeneyes, and buffleheads.

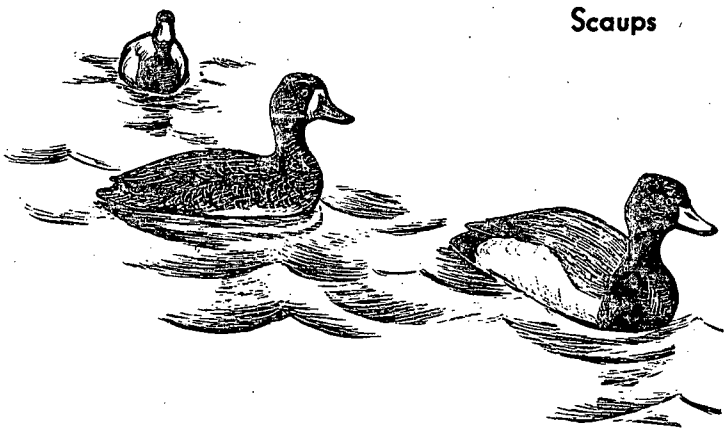
One of the principal winter foods of the divers was eelgrass. In the 1930's, a disease swept the eelgrass beds along the entire coast, but at Swanquarter, as well as in other sections, this important plant now is showing encouraging signs of recovery. As the patches of eelgrass spread over its bays again, Swanquarter may be expected to attract even larger numbers of divers than are found there today.

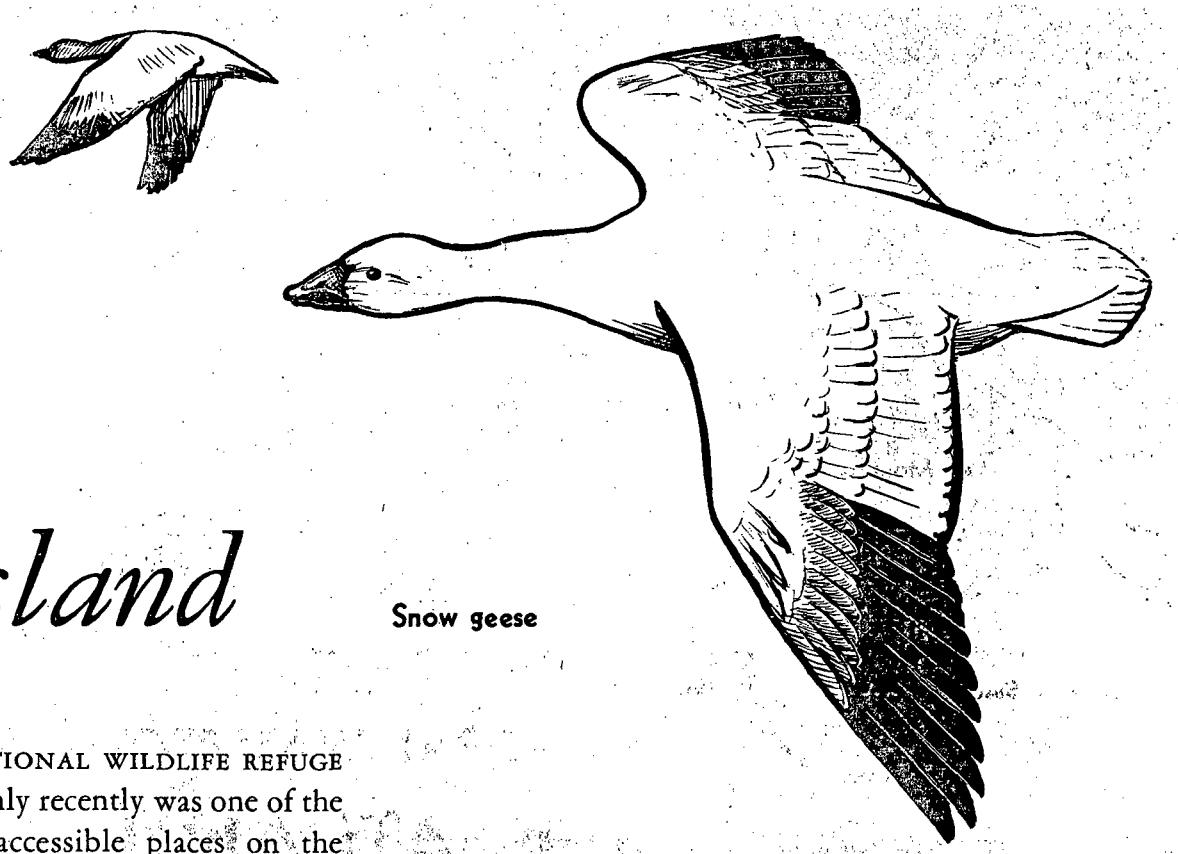
Besides waterfowl, the bird life of Swanquarter includes gulls, terns, bald eagles, ospreys, and characteristic small birds of the woods and marshes. Mink, muskrat, otter, and raccoon are the most abundant furbearers. A good many deer, and an occasional bear, occur in wooded sections.

Swanquarter includes about 43,000 acres of land and water—15,000 acres of woods and marsh bought in 1931 and 1932 under the provisions of the Migratory Bird Conservation Act, and about 28,000 acres of water closed to hunting by Presidential Proclamation in 1933. Water areas of the refuge are public, navigable waters, in which fishing and oystering are conducted subject to State (but not Federal) regulation.

The entrance road to the refuge leaves U. S. Highway 264 about 4 miles northwest of the village of Swanquarter and extends south about 2 miles to the shore of Rose Bay, where the patrolman's headquarters is located. Permission may be obtained to use the dock and beach area for swimming and picnics.

Scaups





Pea Island

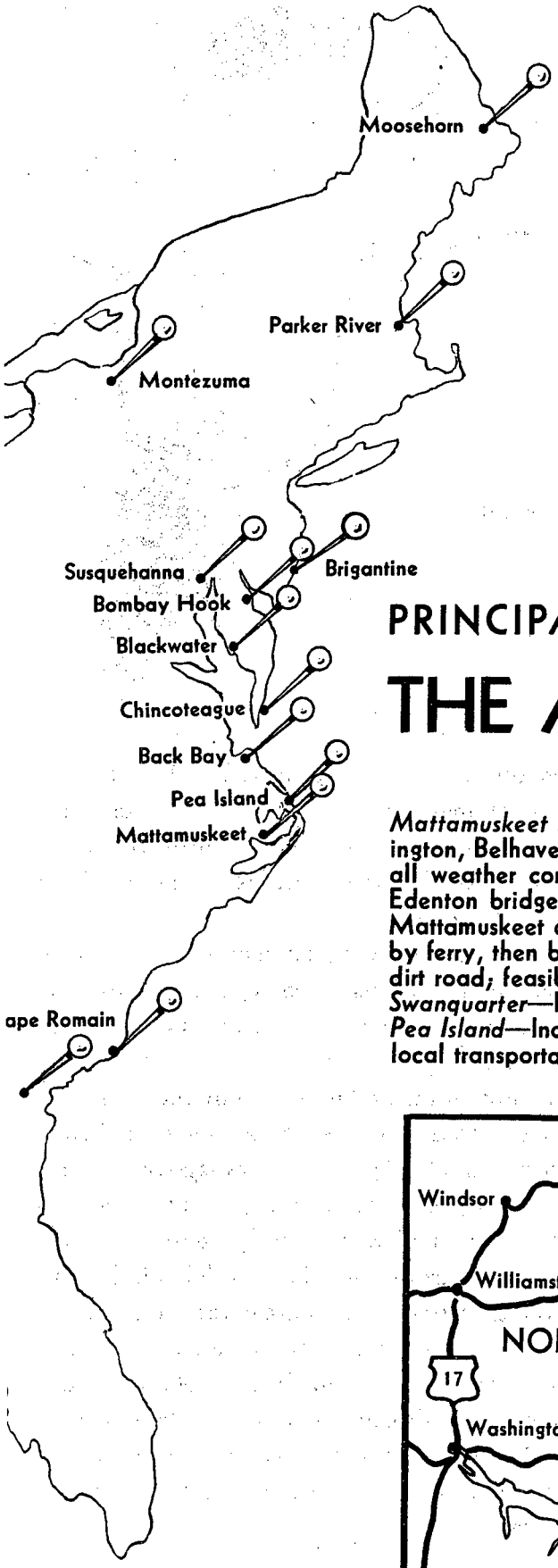
Snow geese

THE PEA ISLAND NATIONAL WILDLIFE REFUGE lies in a section that only recently was one of the most remote and inaccessible places on the Atlantic coast—the North Carolina banks south of Roanoke Island—bounded on one side by Pamlico Sound, on the other by the open Atlantic. These narrow barrier islands, consisting of beach, dunes, and marsh, are roadless and have been considered beyond the limits of automobile travel. Now jeeps and command cars make travel over the trackless beaches possible, although still hazardous and demanding skill; magazine articles and newspapers proclaim the quaintness of this unspoiled land with its scattered fishing villages, and the mounting influx of sport fishermen and tourists is fast destroying the solitude that was Pea Island's.

The Pea Island refuge begins at Oregon Inlet and runs south almost to the town of Rodanthe. It includes about 5,880 acres. This narrow island is one of the winter homes of the greater snow goose, accommodating probably half of the entire population of this bird, of which there are not more than 20 to 30 thousand in the world. Many Canada geese and brant come here, as well as practically all species of ducks that winter anywhere on the North Carolina coast. Pea Island is one of the finest places on the coast to observe the seasonal migrations of the shorebirds, of which two species—the willet and Wilson's plover—nest on the refuge.

Since the refuge was established in 1938, much development work has been done to stabilize the dunes and to create fresh water marshes by building dykes.

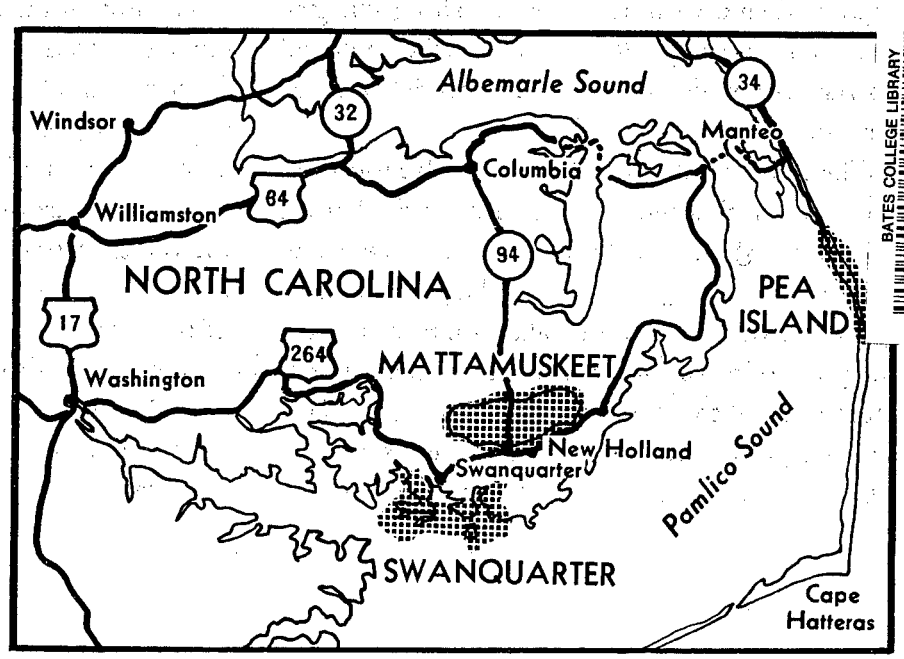
The impounded areas, with only the abundant rains as a source of fresh water, have gradually freshened and food plants such as sago pondweed, wigeongrass, bulrushes, and spikerush have become established. Surprisingly, these ponds remain fresh throughout the year. This has made the refuge attractive to a great variety of waterfowl. The average winter population of ducks and geese has increased from about 15,000 when the refuge was established to about 50,000 ten years later. Many additional birds come in during severe winters that freeze over the feeding areas north of Pea Island.



PRINCIPAL WATERFOWL REFUGES OF

THE ATLANTIC FLYWAY

Mattamuskeet may be reached: 1. Via U. S. Route 264 through Washington, Belhaven, and Swanquarter, to New Holland. (Best route under all weather conditions.) 2. From Norfolk across Albemarle Sound at Edenton bridge, then by routes 32, 64, and 94 to Fairfield, across Lake Mattamuskeet on causeway. 3. From Roanoke Island to Manns Harbor by ferry, then by road through Englehard to New Holland. (Forty miles dirt road; feasible only in dry weather.)
Swanquarter—First route recommended for Mattamuskeet is best.
Pea Island—Inquire of refuge manager in Manteo, Roanoke Island, as to local transportation by boat or bus.



U. S. Government Printing Office: 1947 O-F-761227

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BEAR RIVER

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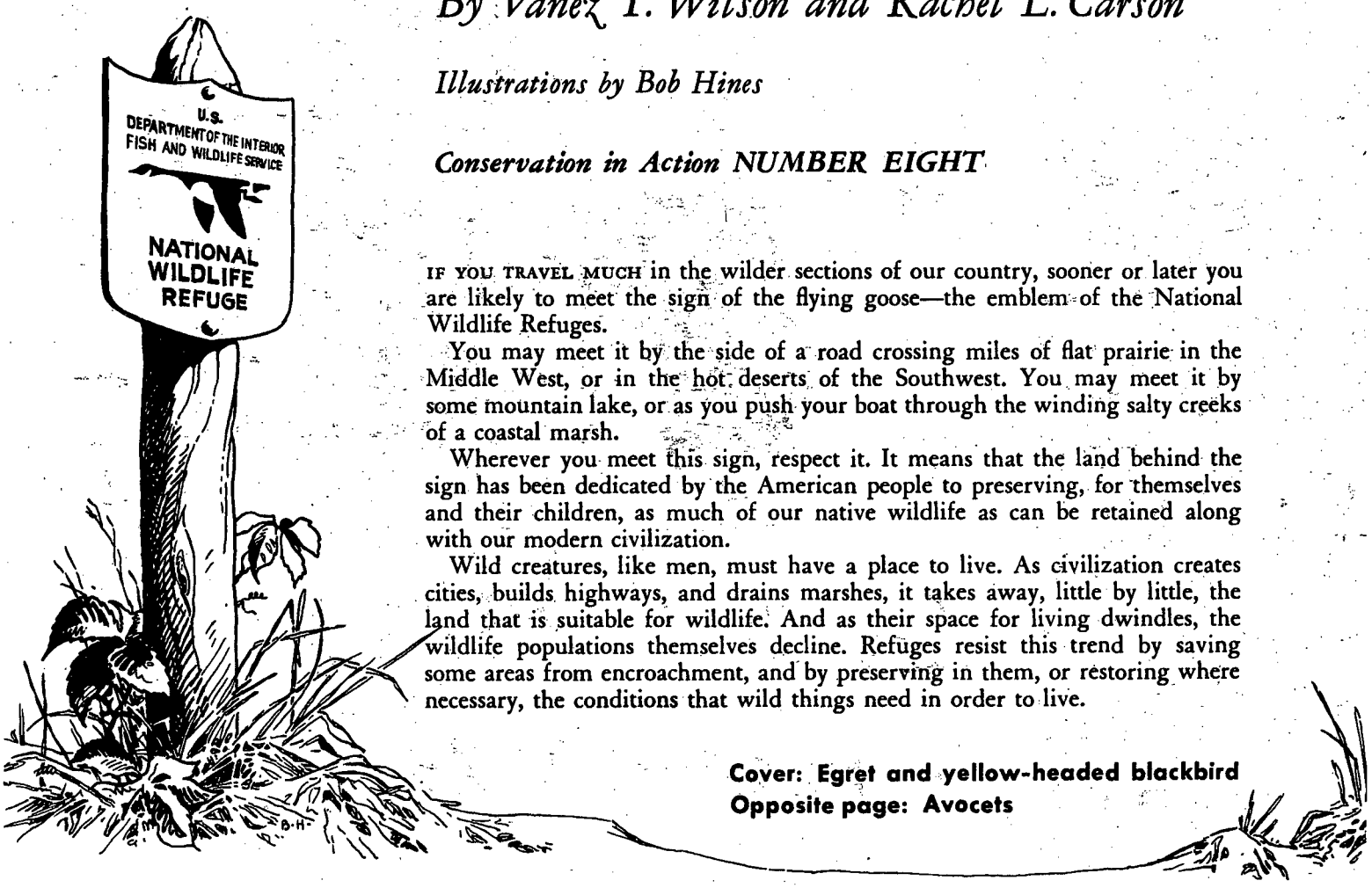

IF YOU TRAVEL MUCH in the wilder sections of our country, sooner or later you are likely to meet the sign of the flying goose—the emblem of the National Wildlife Refuges.

You may meet it by the side of a road crossing miles of flat prairie in the Middle West, or in the hot deserts of the Southwest. You may meet it by some mountain lake, or as you push your boat through the winding salty creeks of a coastal marsh.

Wherever you meet this sign, respect it. It means that the land behind the sign has been dedicated by the American people to preserving, for themselves and their children, as much of our native wildlife as can be retained along with our modern civilization.

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Cover: Egret and yellow-headed blackbird
Opposite page: Avocets

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON : 1950
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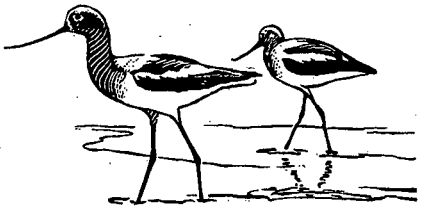


Bear River

A NATIONAL WILDLIFE REFUGE

IN THE AUTUMN OF 1824 A BUFFALO-HIDE CANOE drifted down the Bear River to its mouth in the Great Salt Lake of Utah. Within sight of that vast inland sea, Jim Bridger must have paused in amazement. Everywhere he looked—in the sky, on the open water, over the marshy borders of the lake—there were birds. It is said that the famous explorer of the western wilderness brought back reports that he had that day seen "millions of ducks and geese."

The Bear River marshes were soon to know years when their waterfowl were numbered, not by millions, but by thousands; when the white settlers had diverted water for irrigation and drained the wet lands where the waterfowl found food and protection; when gunners had slaughtered them by the thousands; and many others had fallen prey to diseases resulting from this disastrous series of events.

But now a miracle of conservation has been accomplished, and once again, as in the days of Jim Bridger, the skies over Bear River are patterned with millions of wings. The Bear River Migratory Bird Refuge which helped accomplish this miracle is one of the show places of the continent. About 20,000 people visit it annually. Here, especially during the fall migration, it is literally possible to see a million ducks in one day. Here many species considered rare elsewhere may be seen by anyone who will drive his car slowly around the miles of gravel road that crown the retaining dikes of the marshes. Here are birds that, in their north and south flights, have touched almost all parts of the western half of the continent. The site of this great spectacle is a key spot in the conservation of North American birds.

The Bear River marshes were not always as they are today. The setting of the refuge has been molded, first by the slow processes of nature, then more rapidly through changes resulting from human settlement of the region. Some of the latter changes have been for the better, some for the worse.

High up on the flanks of the mountains around the flat marshlands of the refuge there are plainly marked terraces that stand out as light streaks against the blue background of the mountains. These were the shorelines of ancient Lake Bonneville, a large inland sea that covered some 20,000 square miles of this part of the world during the Pleistocene Epoch, some scores of thousands of years ago. Rain and snow fell heavily during those times, and streams ran full with the water of melting ice during the interglacial periods. Lake Bonneville was

1,000 feet deep in places. Through Red Rock Pass in its northern rim its waters drained by way of old channels of the Snake and Columbia Rivers into the Pacific Ocean.

Over the centuries the climate underwent a change from wet to dry, and with increasing aridity the level of the lake fell below its outlet and drainage ceased. The area covered by water shrank; the lake became increasingly salty. Great Salt Lake is the present-day remnant of old Lake Bonneville; it is a tenth the size of its ancestral lake, its average depth is not more than 20 feet, and it contains one part of salt to five parts of water. The flat land enclosed within the rim of mountains is the former floor of Lake Bonneville. This is the site of the Bear River Refuge.

THE WATERFOWL THAT FLEW OVER THIS PART of the Pleistocene world must have found little to attract them to the deep, steep-walled Lake Bonneville. But as Great Salt Lake matured and the receding waters reached the present valley floor, marshes developed at the mouths of rivers and streams, and unexcelled habitats were created for water birds. Early records of the bird life of these marshes are vague as to the species, but they give a clear impression of the vast hordes of waterfowl that must have supplied food for generations of Indians.

Following Jim Bridger and the few adventurous trappers that searched the Bear River and other mountain streams for beaver and other fur animals, came Capt. John C. Fremont and his exploration party. On September 3, 1843, Captain Fremont visited the delta of the Bear River. In his official report he gave the following description:

The Bear River marshes are famous for their green-winged teal, among the most beautiful of ducks and the smallest American waterfowl.

"The waterfowl made this morning a noise like thunder. A pelican (*Pelecanus onocrotatus*) was killed as he passed by, and many geese and ducks flew over the camp. Descending the river for about three miles in the afternoon, we found a bar to any further travelling in that direction—the stream being spread out in several branches, and covering the low grounds with water, where the miry nature of the bottom did not permit any further advance. We were evidently on the border of the lake, although the rushes and canes which covered the marshes prevented any view; and we accordingly encamped at the little delta which forms the mouth of Bear River; a long arm of the lake stretching up to the north between us and the opposite mountains. The river was bordered with a fringe of willows and canes, among which were interspersed a few plants; and scattered about on the marsh was a species of *Uniola,* closely allied to *U. spicata* of our sea coast. The whole morass was animated with multitudes of waterfowl, which appeared to be very wild—rising for the space of a mile round about at the sound of a gun, with a noise like distant thunder. Several of the people waded out into the marshes, and we had tonight a delicious supper of ducks, geese, and plover."

A few years later Capt. Howard Stansbury, making a reconnaissance of a new route through the Rocky Mountains, arrived at Bear River Bay on October 22, 1849. It was covered, he wrote, "by immense flocks of wild geese and ducks among which many swans were seen, being distinguishable by their size and the whiteness of their plumage. I had seen large flocks of these birds before, in various parts of our country, and especially upon the Potomac, but never did I behold anything like the immense numbers here congregated together. Thousands of acres, as far as the eye could reach, seemed literally covered with them, presenting a scene of busy, animated cheerfulness, in most graceful contrast with the dreary, silent solitude by which we were immediately surrounded."

After the fur trappers and the explorers and the gold seekers came permanent colonists. When the Mormon pioneers arrived in the valley of the Great Salt Lake in 1847 and established their settlement, the country was inhabited only by Indians and was part of the region belonging to Mexico. At the close of the Mexican War in 1848 it became part of the United States. The Territory of Utah was established in 1850. In 1869 the rails of the first transcontinental railroad were joined within sight of the present refuge, and the rapid advance of civilization into the wilderness began.

WATER, AND CONFLICT FOR WATER USE, dominate the history of the area. The first need of the permanent settlers was the production of life-sustaining crops. On the valley floor the poorly drained soils contained a high concentration of soluble salts, and cultivation was necessarily restricted to better drained lands near the base of the mountains. Here irrigation was necessary. Although good agricultural land was at a premium, water was even more scarce in these arid lands of the Great Basin.

Little by little, every possible source was utilized to its fullest extent. The Bear River, in its 600-mile course from the Uinta Mountains through parts of Utah, Wyoming, and Idaho to Great Salt Lake, is said to be the most completely utilized river in the world. The Bear River Valley canal and irrigation system, one of the

Although less abundant than the redhead, gadwall, or mallard, shovellers are seen in small numbers and may be recognized instantly by their large bills, highly specialized for surface feeding. Shovellers winter chiefly in the Southern States and Mexico.

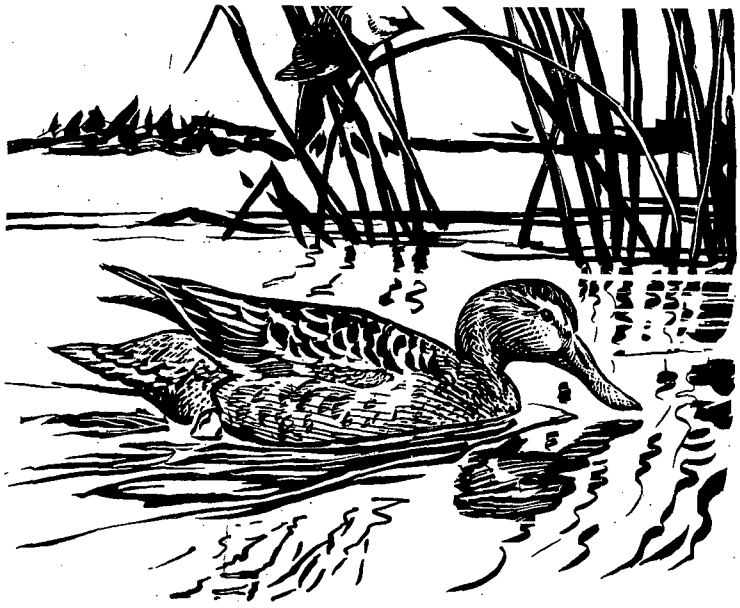
largest diversions of water from the Bear River, was completed in 1891 and the first water was diverted from the river the following spring. This and later diversions greatly reduced the summer flow, and after a few years little remained of the once extensive marsh areas.

Irrigation took its heavy toll of available water; drainage, drought, and power projects took more. The watersheds were overgrazed by sheep and cattle. Ponds, sloughs, and potholes fluctuated, became temporary, and finally dried away.

The loss of waterfowl habitat was one enemy of the waterfowl; the market gunner was another. Residents of the Valley probably contributed unwittingly to the destruction of their valuable wildlife resource. To the early settlers it must have seemed that the millions of waterfowl and other forms of wildlife that had congregated there through the ages would forever remain sufficiently abundant to satisfy all demands. From 1877 to 1900 more than 200,000 ducks were killed annually on the Bear River marshes for eastern markets. The great flocks of the waterfowl began to dwindle.

Disease was still another menace. Following the reduction of water levels and the crowding of great concentrations of birds into smaller areas, losses from botulism, a disease resembling food poisoning, were first noticed about 1900. More and more ducks sickened as the epidemic spread over the stagnant waters of the shallow alkali flats and in 1910 about half a million died around the mouth of the Bear River and in the Willard Spur area during the late summer.

THE FIRST EFFORTS TO SAVE THE WATERFOWL were made by sportsmen. Several duck clubs organized around the turn of the century acted to save at least scattered remnants of the once vast marsh area. They purchased or leased a large part of the remaining marshes around the mouth of the river. The Bear River Club, which was organ-



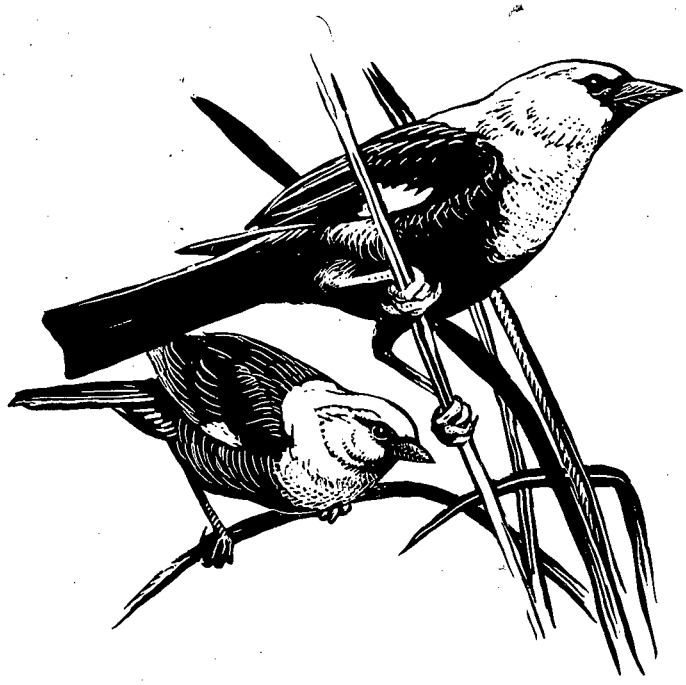
ized in 1901, owns approximately 8,000 acres of choice marshland in the area known as the North Bay. This club, its membership made up of sportsmen from all parts of the country, has aided waterfowl conservation by preserving areas where the birds can nest and feed.

Other, larger, areas had to be added, however, and steps taken control disease. Through efforts of the Utah Fish and Game Commission, western sportsmen's organizations, and Federal officials who had studied the situation, a program of attack was developed in 1926 that ultimately led to the establishment of the Bear River Migratory Bird Refuge by a special act of Congress on April 23, 1928. The nearly 65,000 acres acquired under this act were to be "maintained as a refuge and breeding place for migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916." The act provided that "at no time shall less than 60 per centum of the total acreage of the said refuge be maintained as an inviolate sanctuary for such migratory birds."

The refuge so established embarked on a triple program: to devise means of curbing the heavy loss of bird life from botulism; to provide a suitable resting and feeding area for the birds during spring and fall migrations; and to give food and shelter to birds that breed in the locality.

Today any visitor at the refuge can see some of the means by which this program was translated into action. Near the headquarters a dam across the river helps distribute and regulate the variable water supply. Canals lead off across the marshes, delivering the limited water supply to the higher ground and to the various marsh areas on the refuge. Nearly 40 miles of earthen dikes with gravel beach lines, most of them topped with roadways, divide the refuge into five impoundment areas, each comprising about 5,000 acres. The dikes exclude the salty waters of the lake and impound fresh water from the river. They have also brought about the drying of extensive shallow waters and mud flats beyond the dikes—areas which were centers for outbreaks of botulism.

The water of mountain streams brought down by the Bear River freshened the marshes once they were cut off from the salty lake. Favorite duck foods were planted in the bays impounded by the dikes, and food and cover plants were established along the banks. A small "duck hospital" was established; there sick ducks by the thousand were treated by the injection of an antitoxin, were banded, and released. A striking example of recovery from botulism was provided by one "patient." A pintail, after treatment for botulism, was released August 15, 1942. It was found 83 days later at Palmyra Island, a tiny pinprick on a map of the Pacific Ocean, 3,600 miles from Bear River.



One of the most colorful summer residents of the marshes is the yellow-headed blackbird.

The success of the program may be judged by the visitor as he looks out over the refuge from the tower or drives along the roadways on the dikes. Everywhere he looks there are birds. From the headquarters building he may watch the snowy egrets, in gleaming white plumage, fishing near the dam that spans the river. Almost any time a party of western grebes may be seen swimming up and down the canals, suddenly vanishing from sight, and as mysteriously reappearing. A flock of avocets may be moving over a shallow mud flat, swinging their long, upcurved beaks from side to side like so many wielders of scythes, providing one of the greatest shows of the refuge. Stately lines of pelicans, rising and dipping, move over the marshes, their bodies white against the blue background of the mountains. But for sheer numbers all others are eclipsed by the waterfowl whose flocks dot the water or, in flight, form shifting patterns against the sky.

MIGRANT WATERFOWL MOVE INTO THE MARSHES beginning in August. By the end of the month or in early September the Bear River Refuge is host to a million and a half to two million waterfowl. Among them is one of the largest concentrations of whistling swan to be found in the United States; flocks totaling 15,000 frequently are seen. Thousands of geese, both the Canada and snow, visit the refuge during migration. There are also a number of records of the rare Ross' goose. Predominating in the fall flights are pintails, whose numbers often exceed a half-million birds. The green-winged teal is nearly as abundant. As many as 100,000 canvasbacks have visited the refuge.

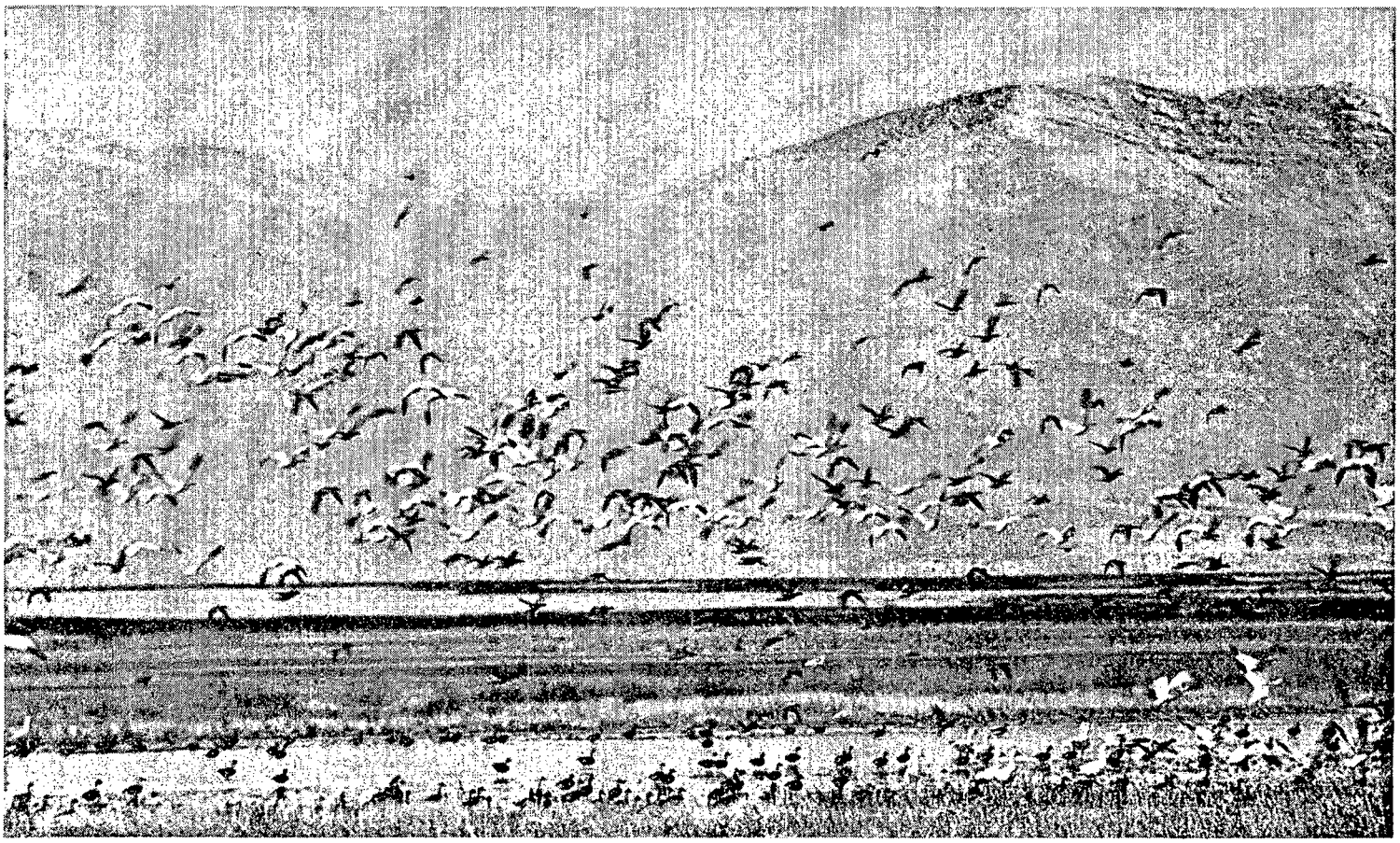
Many of these birds remain into the winter, leaving the refuge only as cold weather freezes over the water areas. Upon leaving Bear River, about half of the birds migrate west into California, some move south to Arizona and New Mexico, while others move eastward into Colorado, Texas and Mexico. With the spring they return, but the concentrations of birds then are smaller, and their stay shorter. Courtship activities are often seen among the migrants, and the nesting of some species, particularly the Canada goose, begins early.

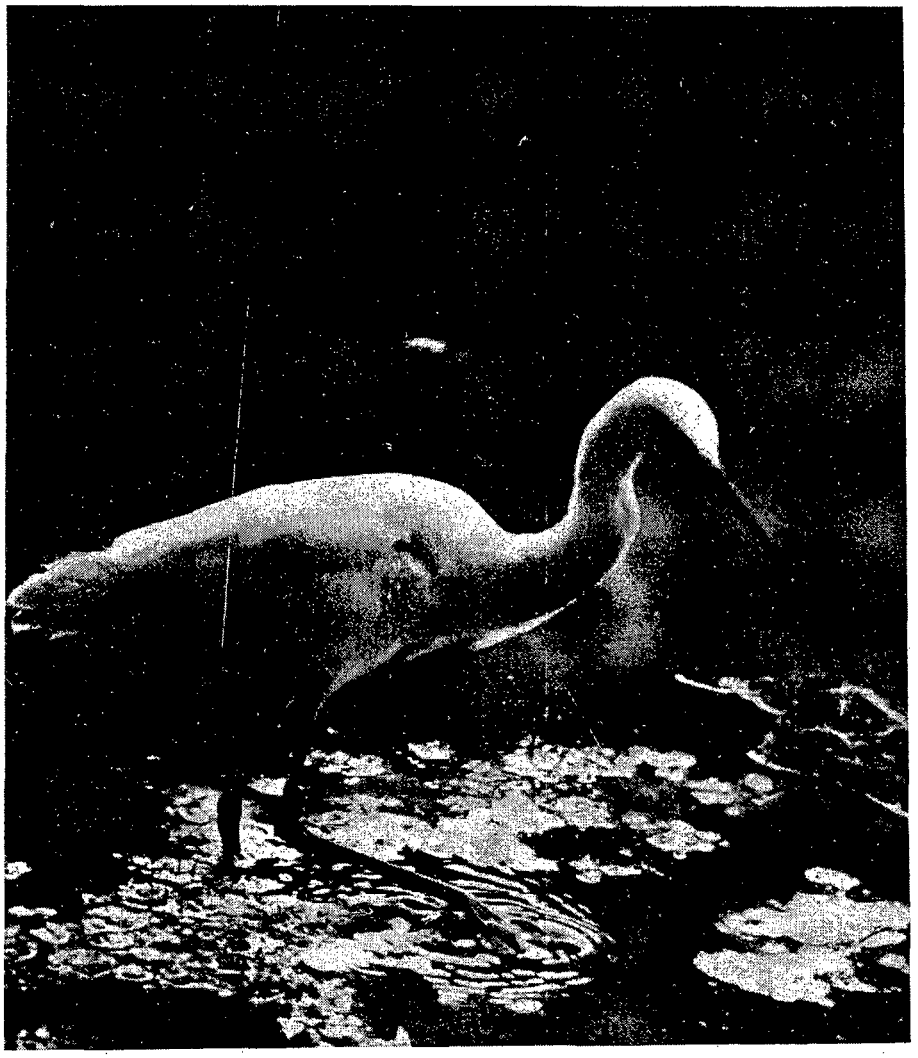
These marshes are teeming with life even in the summer, the quieter season between migrations. Of the 198 species of birds recorded on the refuge, about 60 are known to nest there. The Bear River marshes are among the greatest producers of waterfowl in the United States.

Western grebes, most accomplished of avian swimmers and divers, glide up and down the canals. They build floating nests of grass and weeds and raise 4 or 5 young. Baby grebes often ride on the mother's back, nearly or completely hidden among her feathers.

At Bear River the black-necked stilt (above typically a bird of the Tropics, finds one of it most northern nesting grounds.

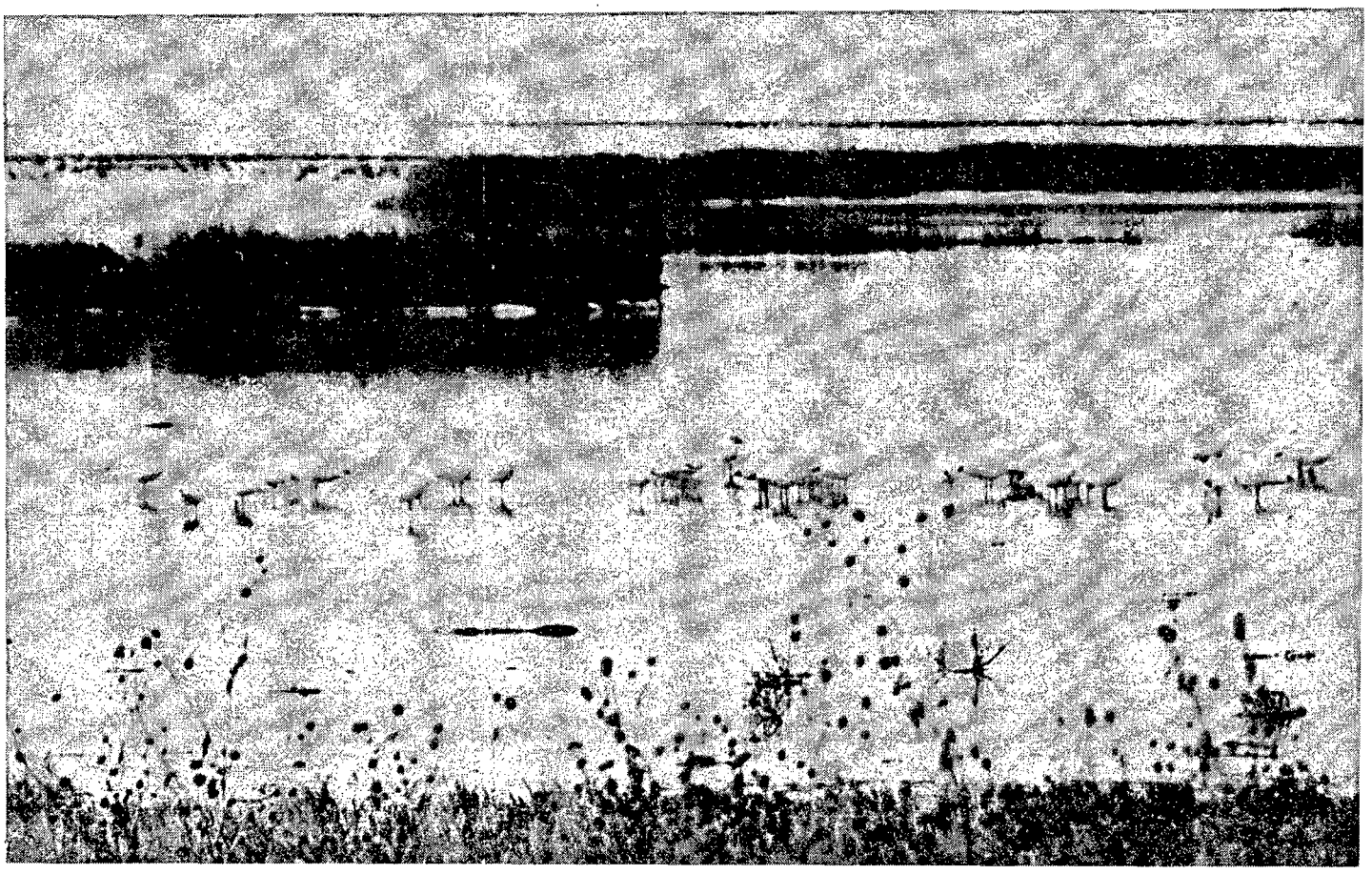
During the fall migration of the waterfowl, the waters of the Bear River Refuge and the sky above them are never empty of wings.





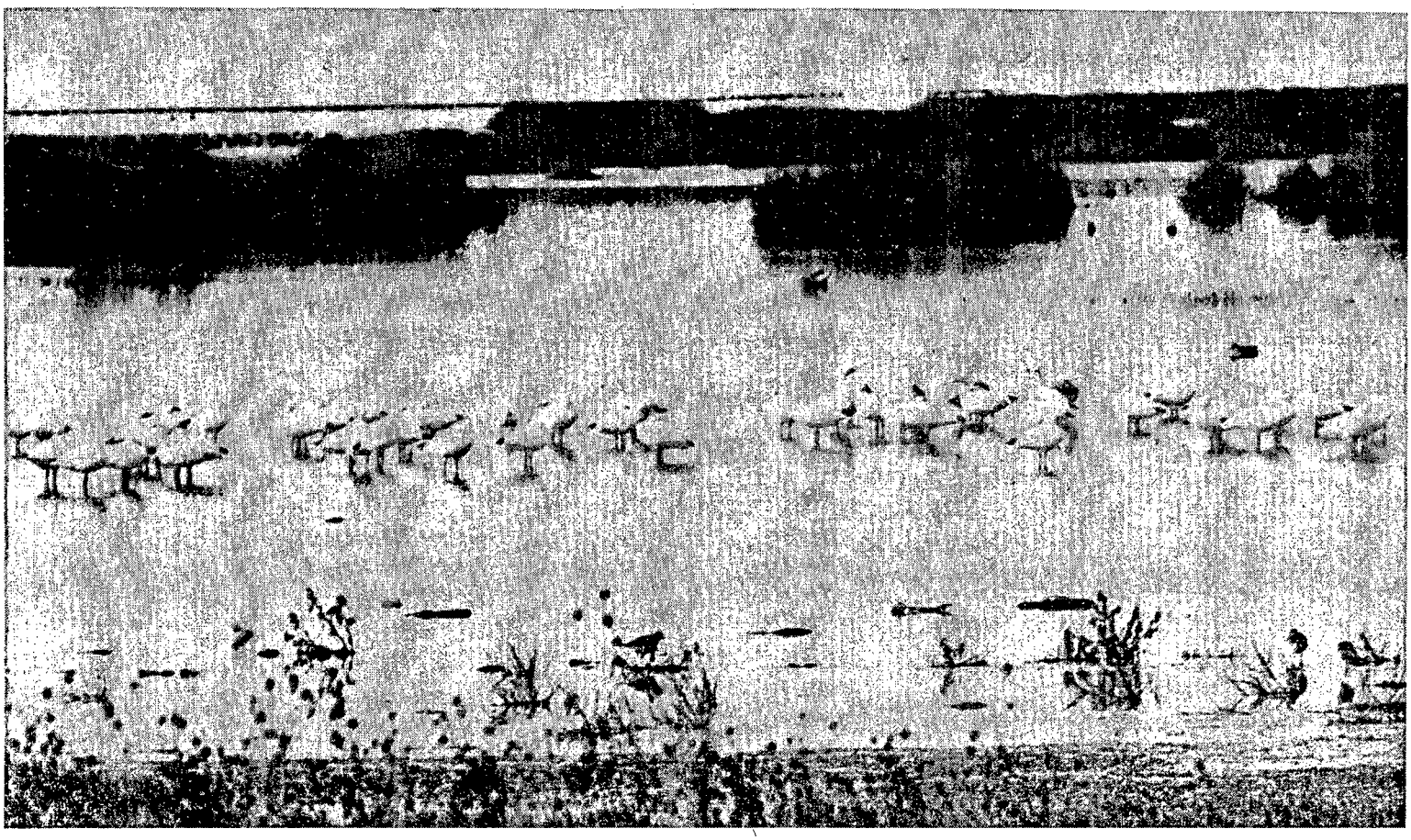
The two smaller herons of Bear River, the snowy egret (shown here) and the black-crowned night heron of shorter, stockier build, are often found fishing below the spillway near the refuge headquarters.

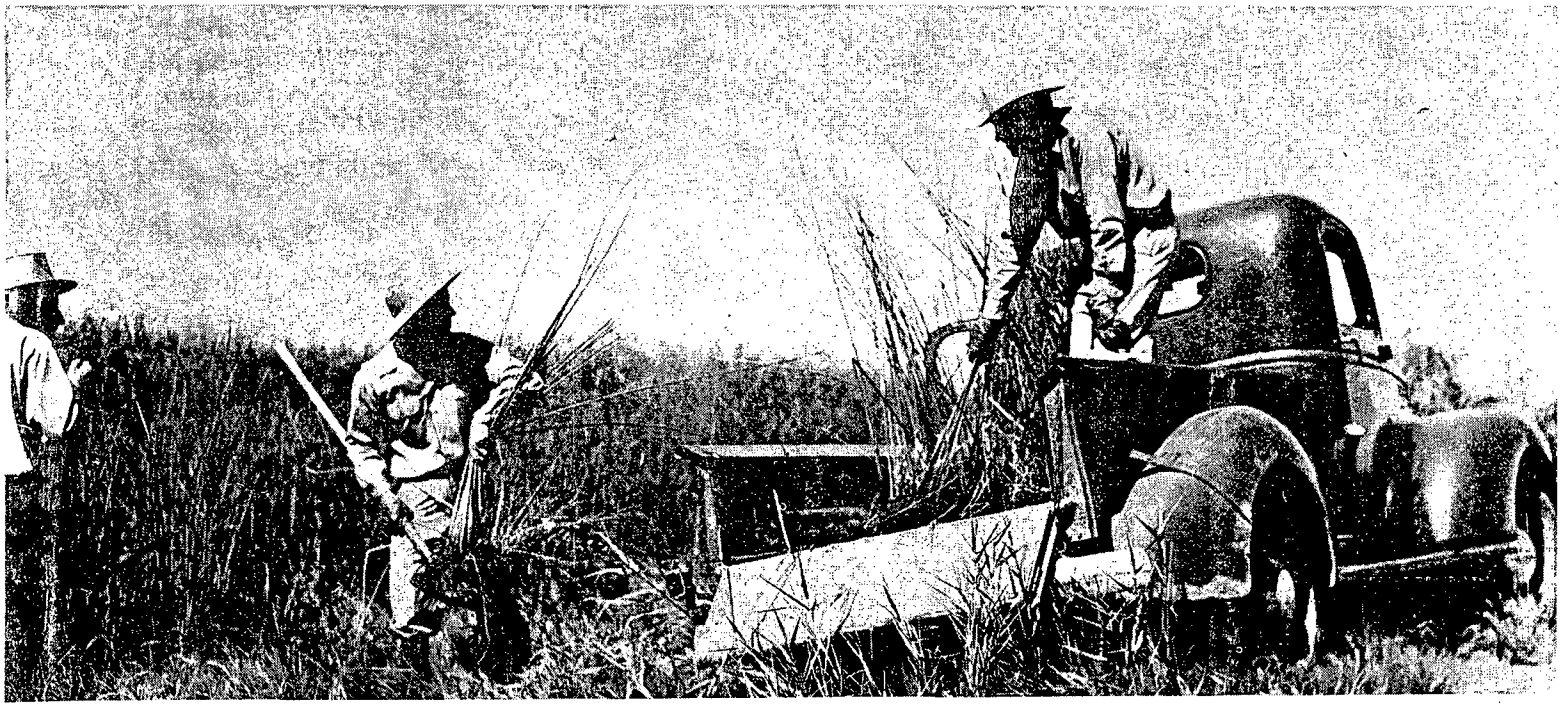
Pure white geese with black wing tips that show best in flight are the lesser snow goose, an Arctic nester which swings down across central and western Canada and the United States to its winter range in California and on the Gulf coast.



Stately great blue herons may be seen standing motionless along the canal banks, nearly hidden among the rushes, as they watch for fish.

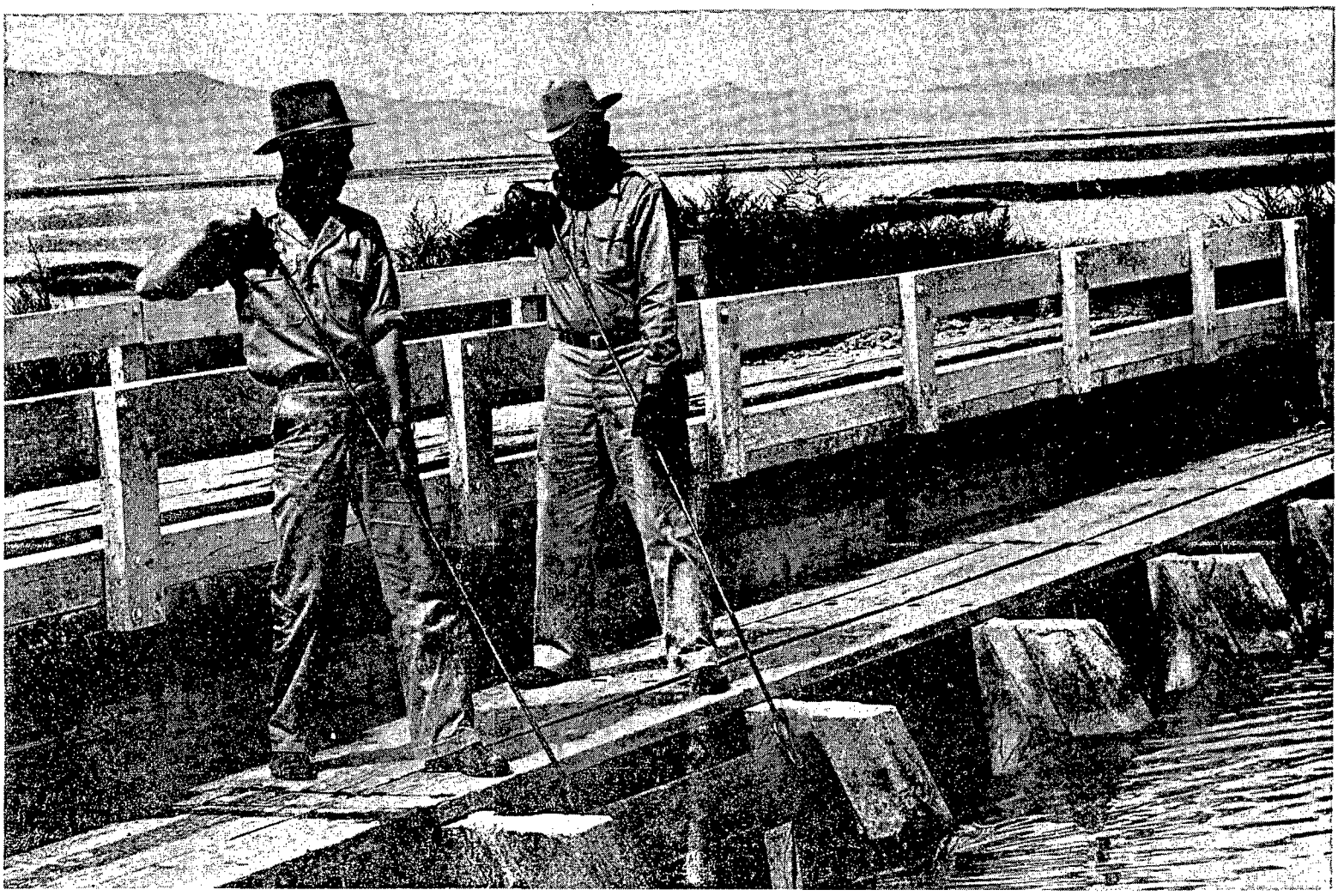
Thousands of white pelicans regularly visit the refuge, coming from nesting colonies on Gunnison and Bird Islands in Great Salt Lake. Their community feeding, as a number of the great white birds move through the water together, is one of Bear River's unforgettable spectacles.





Among the activities that made the refuge a haven for birds was the planting of vegetation for food and cover. Foundation planting of carefully selected species has controlled erosion along the canal banks and provided seed stock from which these desirable plants spread.

A research station operated at Bear River for several years developed a means of controlling duck sickness or botulism through the proper manipulation of water levels. Findings of the Bear River Station are widely applicable to other areas where botulism occurs.



All along the water margins ducks may be flushed from their nests—gadwalls and redheads, mallards and pintails and cinnamon teal; and in spring the Canada geese pilot their little convoys of goslings up and down the canals and across the ponds.

Many other birds breed there, too. California gulls, the bird that the Mormons honored by erecting a statue, raise six to seven thousand young each year, and from the grass-lined nests of the avocets come two to three thousand young. Other nesters included the western grebe, Wilson's phalarope, Brewster's egret, Franklin's gull, white-faced glossy ibis, black-necked stilt, yellow-headed blackbird, and several terns, grebes, herons, and small shore birds.

In restoring conditions favorable for birds in a great marsh area such as Bear River, it follows that other forms of wildlife will benefit as well. A good duck marsh is also a good muskrat marsh, and these animals are plentiful at Bear River. Local trappers take the surplus under permit. In all about two dozen species of mammals live on the refuge. The weasel is fairly common along the channel banks and over most of the higher marsh area; mice are its principal food. The skunk population is kept in check to prevent loss of waterfowl eggs during the nesting season. There are small numbers of marmots, ground squirrels, and jack rabbits; the cottontail rabbit is common about the headquarters area. Despite the scarcity of willows and other trees, a few pairs of beavers are living along the main channels of the marsh. With patience and persistence, the visitor to the refuge may see still another member of the mammal population—the coyote. Especially in the fall, one of these animals may sometimes be seen running along the dikes or through the marsh.

The white-faced glossy ibis, a bird of open marshes, is widely distributed from Utah and Oregon southward. At Bear River several hundred pairs nest, forming one of the largest conveniently visited colonies in the country.

THE IMPORTANCE OF THE BEAR RIVER REFUGE is far more than local. The millions of feathered visitors that congregate there during migration will spread out widely over the continent. Banding has taught us much about where they go. Out of some 36,000 birds that have been marked with numbered metal bands at Bear River, nearly 3,000 have later been recovered. The returns have come from distant places as well as nearby. Birds from Bear River have gone to Alaska, Canada, Mexico, Honduras, and Palmyra Island in the mid-Pacific. They have been recovered in 29 States, principally west of the Mississippi River.

In the great system of waterfowl flyways, Bear River stands on the borderline between the Central and the Pacific, and contributes birds to each. A flyway is much more than a migration route; it may be defined as "a vast geographic region that has extensive breeding grounds and wintering grounds connected with each other by a system of migration routes." The Central flyway lies east of the Rocky Mountains and includes most of the Great Plains. The Pacific flyway includes the Rocky Mountains and the Pacific Coast.

Although most of their birds belong to the Pacific flyway, the Bear River marshes also produce many ducks for the Central. When these broods reach maturity they join the ducks moving down this flyway by two routes: one eastward through the Green River Valley of Wyoming, another southeastward through the San Luis Valley of Colorado, thence to wintering grounds along the coasts of Texas and Mexico.

The long Pacific flyway, that extends from Alaska and the Aleutians all the way to Central America and the northern countries of South America, claims most of the ducks and geese of the Bear River Refuge. Migrants that have come down from the north stop there in the fall for food and to rest from the long flight, then they move on, most of them, to the west and south. Some will provide targets for the guns of hunters in Nevada, California, and Arizona. Among those that survive many will spend the winter in the great interior valleys of California, where the Sacramento and other National Wildlife Refuges provide rice and other food plants especially grown for their benefit. Others will continue south to the Salton Sea National Wildlife Refuge or into the marshy valleys of Mexico to feed until once more the migratory urge calls them northward.

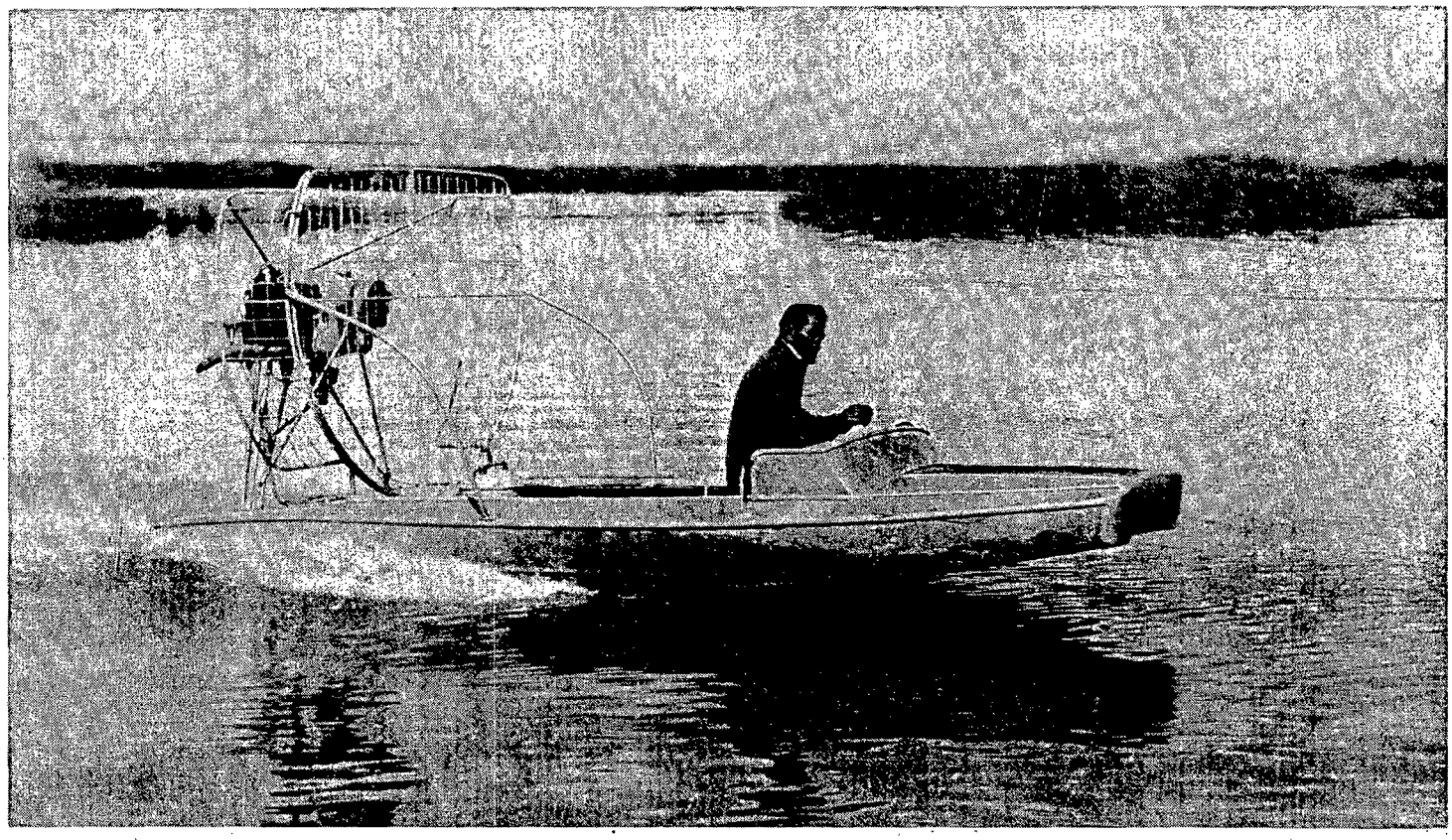
THE REFUGE HEADQUARTERS ARE LOCATED near the mouth of the Bear River about 15 miles west of the town of Brigham and near the center of Bear River Valley, with the Promontory Mountains on the west and the Wasatch Range on the east. These mountains rise abruptly from the valley floor, which is at an elevation of 4,200 feet above sea level, and extend upward to 9,700 feet at the highest peaks.

Located at the headquarters are an administration building, a research laboratory, four residences, a combination garage and storage building, a service building, a boathouse, a building for housing a water-filtering system and a power plant, and a steel observation tower 100 feet in height.

Visitors may reach the refuge headquarters, which are open to the public daily from 9 a. m. to 5 p. m., by traveling due west from Brigham, Utah, over a hard-surfaced road. This city has a population of 6,000, has available hotel and auto court accommodations, and is located on U. S. Highways 30–S and 91.

After free registration at the refuge headquarters, a panoramic view of the refuge may be had from the tower. Visitors are permitted to drive their cars around Unit No. 2, one of the five large artificial lakes and marsh areas. This is a trip of 12 miles over a gravel road constructed on top of the artificial dikes that impound and distribute the waters from the Bear River.

This refuge offers unusual photographic opportunities. The abundance of birds, their lack of any fear of people, and the opportunity of



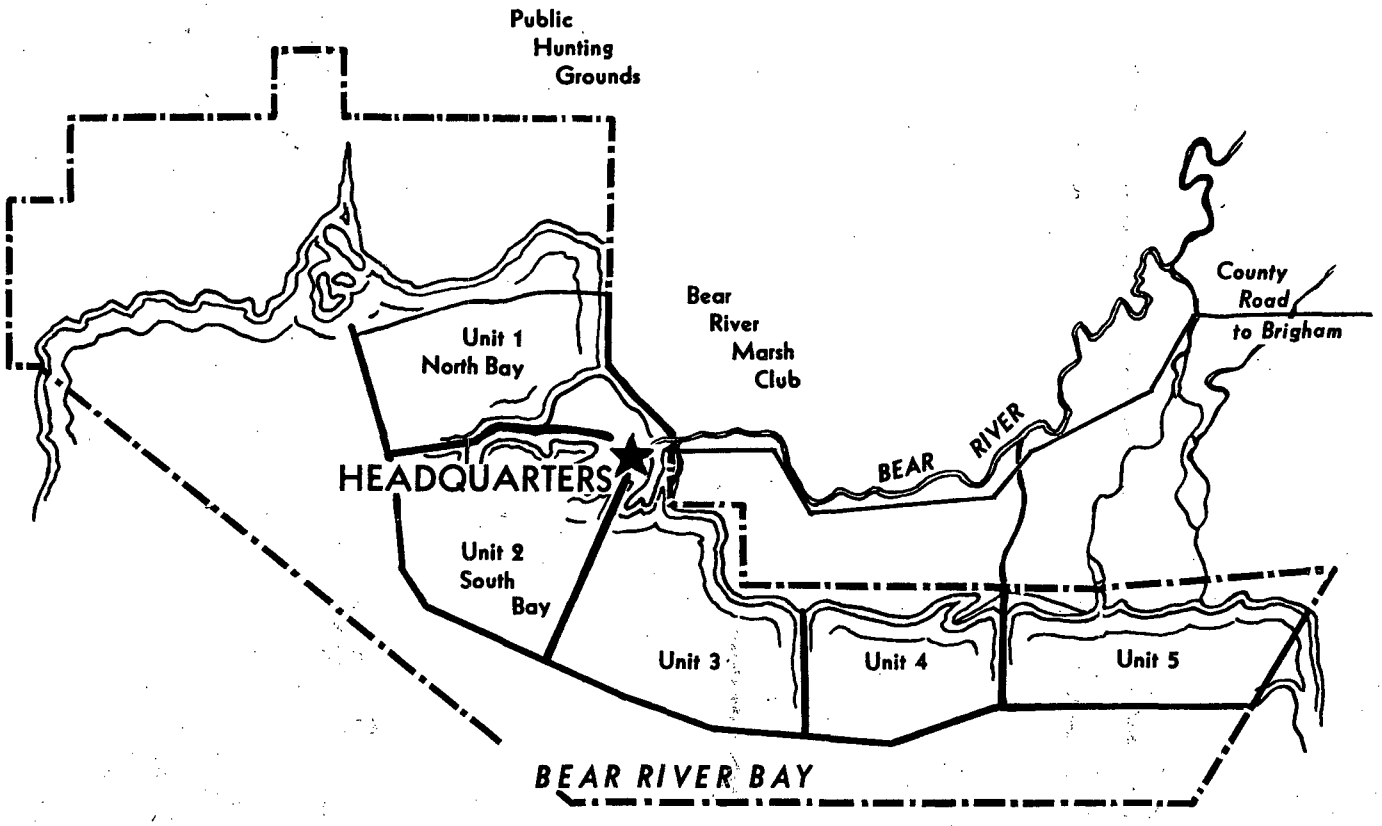
The air boat, with its flat-bottomed aluminum body and airplane propeller, was developed at Bear River to allow easy and rapid travel on the very shallow waters over the mud flats. Now this type of boat is used in many parts of the country for travel in marshes and other still, shallow waters.

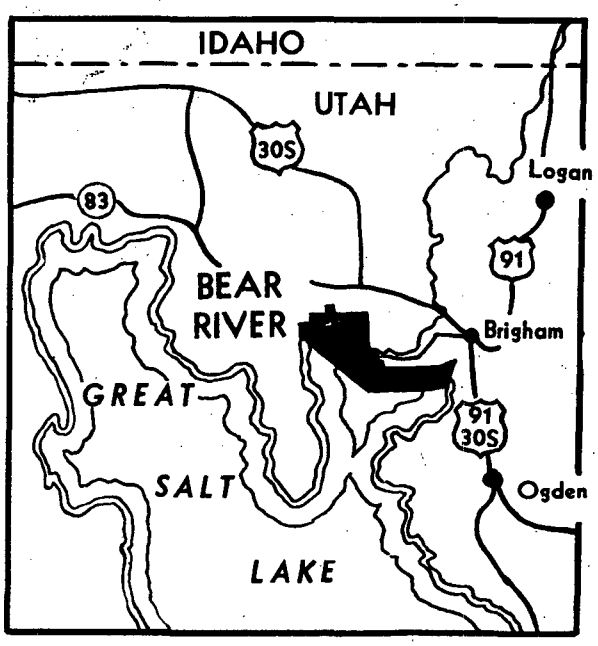
seeing them while driving, provide conditions probably unequalled elsewhere. During the spring, summer, and fall, many different species of birds, varying in size from the tiny marsh wren to the large white pelican, may be observed from the car windows on the trips around Unit No. 2.

Permission is not required for amateur photographing of wildlife on the refuge done during the course of a tour. Photographing involving use of a blind or special travel, or requiring several days, may be authorized by a permit issued by the refuge manager. Fishing on the refuge, in compliance with State laws, and carried on so as not to disturb wildlife, is permitted on certain waters and at times announced by the manager.

Hunting on the portion of the refuge declared open by the Secretary of the Interior is in accordance with all State and Federal laws. No permit is required but hunters register at headquarters and report on their success when leaving.

Information on permits, hunting, fishing, and trapping, together with copies of the regulations governing these activities, may be obtained by addressing the Refuge Manager, Bear River Migratory Bird Refuge, Brigham, Utah.





BEAR RIVER MIGRATION BIRD REFUGE AND ITS LOCATION

U. S. GOVERNMENT PRINTING OFFICE : 1950—O—890873