WETLANDS of the UNITED STATES

UNITED STATES DEPARTMENT OF THE INTERIOR
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WETLANDS of the UNITED STATES

THEIR EXTENT AND THEIR VALUE TO WATERFOWL AND OTHER WILDLIFE

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Office of River Basin Studies

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PREFACE

Undisturbed marshes, swamps, and overflow lands have many inherent values and a variety of uses. This report is confined to the use of these natural wetlands by wildlife. Millions of Americans rely on wild animals to furnish them with healthful outdoor recreation.

Other values of wetlands include the storage of ground water, the retention of surface water for farm uses, the stabilization of runoff, the reduction or prevention of erosion, the production of timber, the creation of firebreaks, the provision of an outdoor laboratory for students and scientists, and the production of cash crops such as minnows (for bait), marsh hay, wildrice, blueberries, cranberries, and peat moss. Some wetlands provide good fishing.

This report points out relative values of different types of wetlands to wild game in general and to waterfowl in particular. It locates and describes areas that should be protected and improved to meet the needs of a stable or increasing waterfowl population. The information is presented with the fervent hope that it will assist and stimulate the establishment of more comprehensive land-use programs and policies. The inventory was financed largely by funds derived from the sale of Federal Duck Stamps.

The wetlands data on which this report is based were gathered by the U. S. Fish and Wildlife Service with the cooperation of various State fish and game agencies. Much of the assessment of waterfowl values was made by State biologists for their respective States.

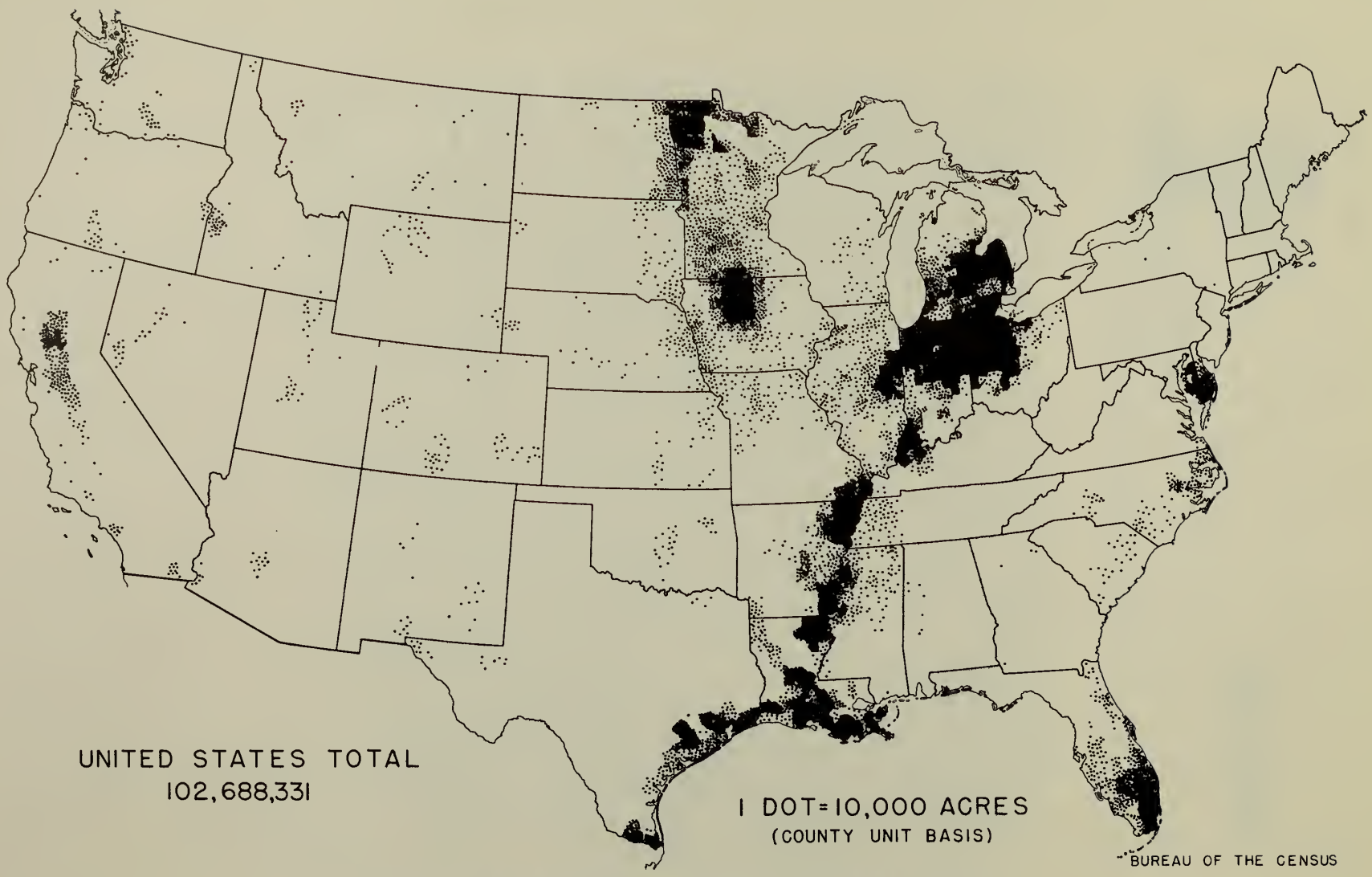


Figure 1.—Agricultural land (acreage as of Jan. 1, 1950) in drainage enterprises.

THE PROBLEM OF SAVING WETLANDS

The great natural wealth that originally made possible the growth and development of the United States included a generous endowment of shallow-water and waterlogged lands. The original inhabitants of the New World had utilized the animals living among these wet places for food and clothing, but they permitted the land to remain essentially unchanged.

The advent of European settlers brought great changes in the land, and aquatic habitats were particularly vulnerable to the settlers' activities. Kenney and McAtee wrote in 1938:

> Among the assets of mankind, wildlife receives its true appraisal only in advanced stages of civilization, when, owing to the heedless destruction of earlier times, it has been seriously if not irreparably reduced. Under pioneer conditions the rules for the treatment of wildlife are immediate exploitation of the useful and drastic destruction of the useless, and these rules tend to remain in effect long after the original motives are gone. In the earlier stages of settlement no one thinks of allotting any land for the use of wildlife; the effort is to wrest every possible acre from nature and make it yield an income. There is no vision to see, there is no time to learn, that land units with their natural occupants, as exemplified by a beaver meadow, a muskrat marsh, a duck lake, a deer forest, or an antelope mesa, are productive entities that under certain circumstances may be worth far more than anything man can put in their place and that once destroyed may never be reestablished. [7] [1]

THE NATURE OF WETLANDS

The term "wetlands," as used in this report and in the wildlife field generally, refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, and river-overflow lands. Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are included in the definition, but the permanent waters of streams, reservoirs, and deep lakes are not included. Neither are water areas that are so temporary as to have little or no effect on the development of moist-soil vegetation. Usually these very temporary areas are of no appreciable value to the species of wildlife considered in this report.

Most wetlands can be drained or filled to create suitable land for agricultural, industrial, or residential expansion. Others lie in potential impoundment sites where permanent deep-water environments can be developed. If either type of project is carried out, however, the food and cover plants required by waterfowl and other wetland wildlife no longer grow in abundance. These aquatic plants need waterlogged or shallow-water soils in order to thrive.

Apparently, a great many people still think that until one of these two courses is followed, any wetland area is just so much wasteland—an unfortunate occurrence in the land-economist's classification of productive land uses. So long as this belief prevails, wetlands will continue to be drained, filled, diked, impounded, or otherwise altered, and thus will lose their identity as wetlands and their value as wildlife habitat.

COOPERATIVE PLANNING

State and Federal agencies engaged in conflicting programs of wetland destruction and wetland preservation must work together to develop unified wetland-use programs that are both acceptable to the landowner and beneficial to the Nation.

It is one-sided planning, for example, if a flood-control agency neglects wildlife values as it plans for the elimination of river-overflow areas, when these areas are used by millions of ducks during the winter season.

In land-use planning, an agency dealing with drainage projects would be subject to criticism if its plans to remove water from extensive marshlands or scattered potholes were developed without regard for the fact that, individually or collectively, they provide essential habitat for thousands

[1] Italic numbers in brackets refer to items in the List of References on page 47.

of duck broods, as well as homes for economically important muskrats and other fur animals.

Total-resource planning would be equally ineffective if the wetland preservationists sat on the sidelines and objected to all drainage and flood-control projects without appreciating the requirements of these other interests or offering to cooperate in a plan to help preserve the best wildlife wetlands.

Within the past decade, there has been an increased awareness on the part of game and fish administrators and the general public that the preservation of aquatic habitats must be a cooperative endeavor. Fish and wildlife agencies, because of limited funds and personnel, could never hope to do an adequate job by themselves. They need the help of other land-use agencies whose primary responsibilities lie outside the fish and game field. Cooperative planning with these agencies can go a long way in preserving and improving conditions for wetland-inhabiting fish and wildlife—by providing that proper attention is given to their habitat needs.

The ultimate importance of waterfowl and other wetland wildlife in furnishing recreation for the growing population of our country will depend on the extent to which wetlands are preserved as wildlife habitat in connection with the use and development of other resource needs. In many instances, wildlife must be a byproduct of more essential land and water uses; in others, wildlife production should be the primary objective of land use. In any case, advance planning must be done before it is too late.

As a basic step to such planning, the Fish and Wildlife Service, with full cooperation of the State game agencies, began an extensive inventory of the wetlands in the United States to determine (*a*) the location and extent of wetlands in each of the 48 States, (*b*) the wetland types in each area or group of areas, and (*c*) their relative usefulness to wildlife, particularly waterfowl, in the States where they are found. More than 74 million acres of wetlands were delineated, classified, and evaluated. The inventory covered both private and public lands.

Detailed information on local wetland areas is contained on county maps and tables filed in the Regional Offices of the Fish and Wildlife Service, which are located in Portland, Oreg., Albuquerque, N. Mex., Minneapolis, Minn., Atlanta, Ga., and Boston, Mass. These maps and data are available for cooperative planning with State and Federal conservation agencies.

This report presents the general results of the inventory from a national point of view, and lays the groundwork for a greater appreciation of the problems, challenges, and opportunities connected with the preservation and improvement of wetlands for wildlife use.

A CENTURY OF WETLAND EXPLOITATION

Some understanding of what is likely to happen to the wetlands in the next hundred years can be gained by looking at changes during the past century. Reviewed here are some of the highlights of national legislation affecting the status of wetlands and the results of some previous wetland surveys. Land-use activities resulting in wetland reclamation or modification (principally through drainage) are also evaluated.

SWAMP LAND ACTS OF 1849, 1850, AND 1860

The sentiment in Congress during the middle of the 19th century was that public domain had little value until it became settled, thereby ceasing to be public domain. Wetlands were actually considered a menace and hindrance to land development.

As first passed (1849), the Swamp Land Act granted to Louisiana all swamp and overflow lands then unfit for cultivation, the object being to help in controlling floods in the Mississippi River Valley. In 1850, the act was made applicable to the other 12 public-domain States. In 1860, its provisions were extended to Minnesota and Oregon.

The original purpose of the grants was to enable the States to reclaim their wetlands by the construction of levees and drains. The States were supposed to carry out a program of reclamation that not only would lessen destruction caused by extensive inundations but also would eliminate mosquito-breeding swamps. As of June 30, 1954, a total of 64,895,415 acres of wetlands had been patented to the 15 States affected (table 1). Minor adjustments are still going on, although it is unlikely that the figure will ever reach 65 million acres. Swamplands never were ceded to the other 19 public-land States.

The 13 original States retained all unsold land within their boundaries when the Federal Government was first organized; Texas retained all its unsold land at the time of annexation. The extensive coastal marshes of these 14 States, therefore, were never owned by the Federal Government.

Table 1.—Acreage granted to States for swamp reclamation

[Action authorized by Swamp Land Acts of 1849, 1850, and 1860]

State	Acres	State	Acres
Alabama	441, 289	Minnesota	4, 706, 503
Arkansas	7, 686, 575	Mississippi	3, 347, 860
California	2, 192, 875	Missouri	3, 432, 481
Florida	20, 325, 013	Ohio	26, 372
Illinois	1, 460, 164	Oregon	286, 108
Indiana	1, 259, 231	Wisconsin	3, 360, 786
Iowa	1, 196, 392		
Louisiana	9, 493, 456	Total	64, 895, 415
Michigan	5, 680, 310		

It would be pointless to trace in detail the use and misuse of lands granted to the 15 States under the Swamp Land Acts. A few examples from Iowa may suffice. In this State the land was turned over to the counties. It was bartered for all sorts of considerations, such as public buildings, bridges, and like purposes foreign to the intent of the acts granting the land. Some counties went beyond this and bargained with immigration companies, selling the land to a company for 25 to 75 cents an acre, with the provision that the company put settlers on the land. In other cases, the land was sold by the county commissioners to themselves for nominal considerations. Other counties gave their wetlands to railroad companies [*6*].

Of approximately 65 million acres of wetlands given to the States, nearly all are now in private ownership. The landowners can do with them as they wish. It is unfortunate that water-conservation and waterfowl-protection areas were not selected and set aside for public benefit at numerous locations before the lands were transferred from Federal ownership. If this had been the case, the Government would not now be in the position of buying these "wastelands" at high prices.

PREVIOUS INVENTORIES

The first attempt at a national inventory of remaining wetlands was made in 1906. The U. S. Department of Agriculture was requested by the Congress to seek information on the extent, character, and agricultural potentialities of the wetlands of the nation. To supplement and verify existing data on the subject, a questionnaire was sent to one or more persons in each county in States east of the 115th meridian. In his letter requesting the information, the Chief of Irrigation and Drainage Investigations of the Office of Experiment Stations stated:

> This office is being called upon by Members of Congress and others interested in the matter for information as to the amount and location of swamp and overflowed lands in the United States that can be reclaimed for agriculture. These frequent inquiries, together with the fact that numerous bills were introduced in both Houses of the last Congress for the drainage of swamp lands, show that the reclamation of these lands is fast becoming a matter of national importance. [*17*]

Eight of the public-land States in the arid West were excluded from the inventory, as were all coastal lands overflowed daily by tidewater. Obviously, the inventory was not a complete picture of wetlands existing at that time. Rather it was an inventory of wetlands that probably could be easily reclaimed. It was estimated at the time that 79 million acres of swamp and overflowed land could be made fit for profitable agriculture. This was broken down into categories arranged according to agricultural capabilities under existing conditions as follows:

	Acres
1. Permanently wet and not fit for cultivation, even in favorable years, unless cleared or protected	52, 700, 000
2. Wet pasture for livestock, though forage often of inferior quality	6, 800, 000
3. Subject to periodic overflow by streams, but at times produce crops	14, 700, 000
4. Too wet for profitable crops during above-normal rainfall periods, but usable during seasons of light or medium rainfall	4, 800, 000

Most drainage projects since that time have reclaimed lands in the last three categories. Although some attempts have been made to drain wetlands in the first category, such projects have generally been the least successful from the agricultural standpoint.

The second inventory of wetlands, conducted in 1922, was recorded in the 1923 Yearbook of Agriculture [*5*]. It was conducted by the Bureau of Agricultural Economics of the U. S. Department of Agriculture and was based on data furnished by the U. S. Bureau of Public Roads, on soil-survey reports, on topographic maps of the U. S. Geological Survey, on various State reports, and on results of the 1920 census of drainage. This inventory is the most complete nationwide survey of wetlands ever conducted and is the basis, even today, of most reclaimable-wetland estimates.

The 1922 inventory showed 91,543,000 acres, of which 7,363,000 acres were listed as tidal marsh and the remainder as inland marsh, swamp, and overflow land. After subtracting 16 million acres of very deep peat and some coastal-marsh areas, the investigators believed that 75 million acres of wetlands would be suitable for crops after drainage. Of this amount, about two-thirds would have to be both drained and cleared of trees or brush (swamps and timbered overflow lands), and one-third required only drainage (herbaceous marshes).

Two recent estimates of wetland acreage appear in publications of the U. S. Department of Agriculture. From a drainage reconnaissance survey, technicians of the Soil Conservation Service estimated that in 1940 there were 97,332,000 acres of "wet, swampy and overflow land outside organized drainage enterprises." [*16*]

In the latest (1953) U. S. Department of Agriculture publication on the subject, the statement is made:

> Our country includes within its boundaries 125 million acres of undeveloped wet and swamp lands which are subject to overflow. With proper drainage and protection, an estimated two-fifths of this area, or 50 million acres, would be physically suitable for crop or pasture use. [*15*]

EVIDENCES OF WETLAND LOSSES

The several wetland inventories just referred to are not directly comparable. Acreages granted to the States under the Swamp Land Acts apply to only 15 States. The inventory of 1906 excluded eight States in the West as well as tidewater marshes. The 1922 inventory was the most complete and no doubt represents areas of natural marsh, swamp, and overflow lands which, at that time, had been little changed by drainage or by flood-control projects.

The two recent reconnaissance surveys by the U. S. Department of Agriculture represent many millions of acres not ordinarily thought of as wetlands—such as crop and pasture lands that can be made more productive by removing waterlogged tracts.

It is difficult, therefore, to arrive at reliable figures representing the actual reduction in original wetlands through drainage and flood-control activities since this country first started its agricultural and industrial expansion. Table 2 attempts to do this for seven selected States, where data from three previous wetland summaries and the current inventory by the Fish and Wildlife Service appear comparable. These same States were particularly active with wetland-reclamation projects, inasmuch as they include nearly 40 percent of all land in drainage enterprises today; yet they contain only 16 percent of the land area of the United States.

Table 2 suggests that 17 million acres of original wetlands have been lost in only seven States. The U. S. Department of Agriculture estimates [*15*] that, in the country as a whole, 45 million acres were reclaimed by a combination of clearing, drainage, and flood control on land in publicly organized drainage and flood-control enterprises. Forty million acres more are listed as reclaimed by drainage and flood protection alone, although admittedly there was considerable duplication in the areas measured. Also, some of this land reported as "improved" for cropland and pasture was probably suited to such purposes before the advent of the reclamation projects. However, it seems reasonably safe to state that at least 45 million acres of our primitive marshes, swamps, and seasonally flooded bottomlands are now devoted to crops, pasture, and other dry-land uses.

The Soil Conservation Service has estimated the original, natural wetlands of this country at 127 million acres. Assuming a minimum loss of 45 million acres, we now have in this country about 82 million acres of land that is too wet for crop or pasture use—lands on which drainage or flood-control operations so far have had little effect on their original wet condition. This figure corresponds to information gathered during the current inventory by the Fish and Wildlife Service, in which 74.4 million acres were delineated and an estimated 5 to 7 million acres were bypassed.

ORGANIZED DRAINAGE ENTERPRISES

Spokesmen for the preservation of waterfowl habitat have often turned to acreage figures of drainage enterprises as a good source of information on the loss of waterfowl wetlands. Drainage, it is true, has been and will probably continue to be the greatest single destroyer of duck habitat. However, not all improved land in present drainage enterprises represents former marshes and swamps. Much of it was essentially dry land to begin with. Also, much land now in drainage enterprises is still in its original wet condition.

In 30 States where 50,655,190 acres are listed as "land drained," 12,400,059 acres of this total are classed as unfit for cultivation because of poor drainage. Losses to crops occur frequently on an additional 9,176,046 acres classed as having only fair drainage. Thus, there appear to be good opportunities to preserve and develop waterfowl habitat by working in cooperation with active drainage enterprises which still have vast acreages of natural marshes and swamps within their districts.

In connection with the 1930 census of drainage, which listed a countrywide total of about 84 million acres in organized drainage enterprises, the statement is made that of this amount 31,600,000

Table 2.—Change in wetland acreage since 1850

State	Swamplands patented to States since 1850	USDA inventory of 1906	USDA inventory of 1922	Current FWS inventory [1]
	Acres	*Acres*	*Acres*	*Acres*
Arkansas	7, 686, 575	5, 912, 300	4, 220, 000	3, 748, 800
California	2, 192, 875	3, 420, 000	1, 179, 000	457, 200
Florida	20, 325, 013	19, 800, 000	16, 846, 000	15, 266, 400
Illinois	1, 460, 164	925, 000	600, 000	176, 700
Indiana	1, 259, 231	625, 000	778, 000	267, 100
Iowa	1, 196, 392	930, 000	368, 000	117, 000
Missouri	3, 432, 481	2, 439, 600	1, 085, 000	322, 000
Total	37, 552, 731	34, 051, 900	25, 076, 000	20, 355, 200
Percent reduction since 1850		9. 3	33. 2	45. 7

[1] Figures in this column do not agree with State-total figures in table 6 because acreages of open-water types are excluded in order to represent coverage similar to the 1850, 1906, and 1922 inventories.

acres had been fit to raise a normal crop prior to drainage and 19,100,000 acres fit to raise a partial crop [*1*]. Thus, more than 50 million of the 84 million acres, or about 60 percent of the land then in organized drainage enterprises, could be classed as "fair" to "good" for agriculture before any drainage improvements were undertaken. Obviously, we cannot use drainage-enterprise figures to show the extent of waterfowl-habitat losses unless we take into account these before-and-after conditions.

More than one-fifth of this country's cropland is in drainage enterprises. Farmers in the humid parts, and in some of the semihumid parts, of the United States (including the two Dakotas) drain to take surplus rainfall off some of their lands. Most of this is gravity drainage, although pumps are sometimes used. In the Western States where irrigation is practiced, drainage is mainly for the purpose of taking seepage water off irrigated lands and carrying away alkali salts.

Figure 1 shows the location and relative abundance of agricultural land in drainage enterprises in 1950. In addition to the acreage depicted there, approximately 50 million acres outside organized districts have been improved by farm drainage [*15*]. There is no indication of how much of this acreage was essentially dry land before drainage improvements.

Table 3 gives drainage-enterprise statistics for certain years when census figures were available. Forty States now have organized drainage enterprises.[1] Because of differences in organization and management, it was necessary in the 1950 census to arbitrarily divide the 40 States into two groups: the 10 "county-drain" States[2] and the 30 "drainage-district" States.

Of the total acreage in the 30 drainage-district States, 31 percent was organized between 1940 and 1949, 7 percent between 1930 and 1939, 14 percent between 1920 and 1929, 33 percent between 1910 and 1919, 10 percent between 1900 and 1909, and 5 percent before 1900.

OTHER DESTRUCTIVE FORCES

Agricultural drainage and flood control have doubtless been the greatest destroyers of wetland habitat in the country as a whole, but other factors, operative particularly in coastal marshes, have significantly reduced both the quantity and the quality of wetlands useful to wildlife.

A system of intracoastal canals and connecting waterways to oil fields has eliminated thousands of acres of marshes. Inlets cut to the Atlantic Ocean and the Gulf allow salt water to invade fresh lagoons and marshes, thereby reducing their wildlife value. At low tides, the marshes traversed by these canals suffer from abnormally low water tables, the full effects of which occur during periods of extreme drought. As Cottam and Bourn point out, "Such extremes and not the means in water relations determine ecological trends and wildlife values of a particular marsh area" [*4*].

Ditches for mosquito control and for production of saltmarsh hay along the Atlantic Coast from

[1] States with no organized drainage enterprises are the six New England States, Pennsylvania, and West Virginia.

[2] The county-drain States are Delaware, Indiana, Iowa, Kentucky, Michigan, Minnesota, North Dakota, Ohio, Oklahoma, and South Dakota.

Table 3.—Growth and condition of land in drainage enterprises for specified years

[In acres. Data from publications by Miller, 1950; U. S. Bureau of the Census, 1950; and Wooten, 1953. See under List of References]

Kind of land	1920	1930	1940	1950
All drainage States:				
Land in enterprises	65, 495, 000	84, 408, 000	86, 967, 000	102, 673, 000
Improved land [1]	44, 288, 000	63, 514, 000	67, 514, 000	82, 138, 000
Land available for settlement	3, 120, 800	4, 204, 100	4, 569, 000	(2)
Thirty drainage-district States:				
Land in enterprises	22, 281, 300	36, 688, 000	39, 872, 000	46, 546, 000
Good drainage (no loss of cultivated crops)	(2)	26, 444, 000	30, 270, 000	24, 970, 000
Fair drainage (frequent loss of cultivated crops)	(2)	5, 903, 000	3, 430, 000	9, 176, 000
Poor drainage (unfit for cultivation)	(2)	4, 341, 000	6, 172, 000	12, 400, 000
Land improved or reclaimed by drainage	(2)	29, 587, 000	29, 362, 000	41, 759, 000
Land protected against overflow	(2)	3, 786, 000	6, 150, 000	3, 516, 000
Land improved by removal of alkali or seepage	(2)	3, 315, 000	4, 360, 000	1, 271, 000

[1] Improved lands are regularly tilled or mowed, cleared for pasture, or used for farm sites, ditches, or roads. Much of this land was essentially dry before drainage.

[2] Not available.

Maine to Virginia have affected 90 percent of this region's total original acreage of tidewater marshlands. Such projects remove many of the open-water areas that are of particular value to waterfowl. Shrubby growths of groundselbush and marsh elder largely replace the marshes' natural grass associations, and invertebrate animals that are important food items for waterfowl, shore birds, and fish are drastically reduced [*3*].

Both coastal marshes and interior marshes and swamps are being dissected by more and more roads that drain or fill wetlands and induce further exploitation of adjacent areas. Expansion of cities, industrial sites, and resorts is often accomplished at the expense of good wetland-wildlife habitat. Wetlands are often filled in to allow development of airports and beach properties; such developments received tremendous impetus immediately after the end of World War II. Some types of pollution also take a toll of wetlands habitat by adversely affecting vegetation. In the case of oil pollution, waterfowl are directly affected.

It must be kept in mind that as human populations continue to expand, the total wetland acreages will become smaller, and the job of preserving and developing wetlands for wildlife will become correspondingly bigger and more expensive. Never before in the Nation's history has it been so necessary to plan for the setting aside of land and water areas to serve the future needs of fish and wildlife, as well as to provide for the recreational needs of people who depend on these resources.

WETLAND SOILS

*The more we use each individual type of soil for the purpose for which it is best adapted, the richer our nation and the more contented its people will be. * * * A land resource undiminished by repeated use represents the best in soil conservation.*—Louis A. Wolfanger [*14*].

Soils provide the physical setting for generation after generation of man, lower animals, and plants. Wetland soils—a conspicuous feature of that setting—in many cases can be "improved" for man, for cultivated plants, and for domestic animals, or they can be left in their natural wet condition for wild plants and wild creatures. Geographic variations in climate, landform, and native vegetation largely determine the nature of the soil and hence the nature of acceptable land uses.

It may prove helpful, then, to take a brief look at wetland soils from the point of view of these geographic variations. Since it goes without saying that all wetland environments have some inherent wildlife values, which in many cases can be enhanced through habitat development, most of this discussion centers around past agricultural use—and, in many cases, misuse. Some wet soils have proved to be excellent cropland after being drained. Others have been completely unsuited to that purpose and should never have been drained.

As experience is gained in the field of soil capabilities, estimates of undeveloped wetlands that are physically feasible to drain for agricultural use have become progressively lower. Perhaps the day is near when a combination of soil science and greater wildlife-value appreciation will result in the setting aside of more and more wetland sites for wildlife use.

Some pedologists look upon soil as predominantly mineral matter found in subaerial rather than subaquatic situations. If this definition is accepted, those high-organic materials that are formed essentially from aquatic vegetation are actually not soils at all. Rather, they serve as the parent material from which future soils will develop. For soil-classification purposes, however, mineral soils are usually differentiated from the so-called organic soils associated with wetland environments.

Most types of waterlogged soils are grouped in two suborders known as hydromorphic and halomorphic. Hydromorphic soils are found in association with fresh-water marshes, swamps, seep areas, and flats. Halomorphic soils are the saline and alkali soils of imperfectly drained arid regions and the coastal salt flats of the humid belt. Alluvial soils underlie the remaining wetlands. Aside from alluvial areas and those upland depressions where water collects only for temporary periods, most wetlands delineated in this inventory are underlain by soil material known as peat or muck.

PEATS AND MUCKS

The U. S. Department of Agriculture Soil Survey Manual describes the formation and nature of peat and muck as follows:

> In moist situations where organic matter forms more rapidly than it decomposes, peat deposits are formed. These peats become, in turn, parent material for soils. If the organic remains are sufficiently fresh and intact to permit identification of plant forms, the material is regarded as *peat*. If, on the other hand, the peat has undergone sufficient decomposition to make recognition of the plant parts impossible, the decomposed material is called muck. Generally speaking, muck has a higher mineral or ash content than peat, because in the process of decomposition the ash that was in the vegetation accumulates. [*12*]

Peat and muck cover a total area in the United States estimated at 79 million acres [*11*]. They exist under a wide range of climate and vegetation, but the most extensive areas are in the Atlantic and Gulf Coast marshes, Southeastern Coastal Plain, New England, the Great Lakes States, the Pacific Northwest, and the Pacific Coastal Valley Areas.

Northern areas.—Northern peats and mucks are found in a cool-temperate, humid region ex-

tending from northeastern Maine and northwestern New Jersey to Minnesota and Illinois.[3] They are also found scattered through northern Idaho and northern and western Washington on pitted plains, in stream valleys, and along borders of lakes. Native vegetation includes swamp forests of spruce, tamarack, and arborvitae in the north, and various conifers, maple, elm, and ash further south; reeds and sedges; and sphagnum moss and heath shrubs.

Peatlands in the northern sections of the region are not usually regarded as favorable for cultivated crops. They have not reached the advanced stage of decomposition of peat areas further south and are subject to late spring and early fall frosts. Many attempts at drainage have turned out to be expensive failures because the peat went through a period of shrinkage, and winds picked up the dry, fluffy particles from fields unprotected by windbreaks. This dry organic matter burns readily, and smoldering fires have destroyed many tons [*14*]. However, some of the drained, dark-brown or black granular muck soils in the southern part of this area have produced fairly good vegetable crops.

Southeastern Coastal Plain.—Extensive areas of woody and fibrous peat and muck occur in the flat seaward part of the southeastern Atlantic Coastal Plain. They occupy level upland terraces and border practically all lakes and streams near sea level. This region has abundant rainfall and high temperatures that favor peat decomposition. Native vegetation is mainly cypress and tupelo-gum forests, and cane.

The most common types of fibrous peat are derived from underground stems and roots of former stands of cane, sedges, rushes, and grasses accumulated in water basins or on land with a rising water table. There are also large areas of woody-fibrous peat, known as pocosins, which developed from a mixed open growth of cane and sedges interspersed with shrubs, such as gallberry and waxmyrtle.

There is little agricultural development of the organic soils in this region, and there is little probability of extensive use in the future. Growing of timber and utilization as a hunting and fishing area are among the more permanent uses of these lands. In areas such as the Dismal Swamp of Virginia and the Okefenokee Swamp in Georgia, the layers of woody peat have retarded the flow of surface waters with the result that the waters have been impounded in natural lakes.

Gulf Coastal Plain.—Peat and muck areas in the warm and humid Gulf Coastal Plain are typified by the Everglades of Florida. Some marshes enclose water basins, others border ponds and wooded streams, and still others are built up on sandy plains or on bedrock near sea level. The climate is subtropical and humid, rainfall is heavy, and plants grow luxuriantly. Marshes are characterized by tall sedges, grasses, and rushes. Cypress and tupelo gum are predominant in the swamp forests.

Good-quality muck has developed in a narrow belt bordering the southern shore of Lake Okeechobee, where sugarcane and vegetables such as onions, cabbages, tomatoes, peppers, and beans are grown.

Throughout many centuries the layers of peat along the northern border of the Everglades impounded waters from the Kissimmee River basin, gradually giving rise to Lake Okeechobee. Plans are now under way to devote a large part of the Everglades to water conservation and wildlife management. These projects would help conserve surface waters, replenish ground water and artesian wells, and provide an increasing army of sportsmen with a good place to hunt and fish—all of which are essential to Florida's great tourist industry.

Pacific Coastal Valley areas.—In the semiarid Pacific valleys, peat and muck developed in the marshes of the Klamath Plateau of northern California and southern Oregon and in the delta lands at the confluence of the San Joaquin and Sacramento Rivers—about 50 miles inland from San Francisco. Rainfall is low, and summers are hot. Native vegetation is (or was) mostly reeds, sedges, rushes, and aquatic plants typical of shallow-water areas.

Drainage has been extensive in these two regions. At first, some of the drained areas under cultivation and irrigation in the Klamath district produced good yields of alsike clover, rye, barley, and tame grasses, but yields eventually declined as evaporation lowered the ground-water level and salts in injurious quantities accumulated at the surface.

The delta areas of California originally consisted of a number of peat islands. At present, most of these islands are under cultivation and are protected from overflow by levees. Yields are good

[3] This and subsequent descriptions of geographical areas are taken largely from the 1938 Yearbook of Agriculture.

to poor, depending on the type of peat. Under virgin conditions, the surface elevation of the peat islands was approximately at sea level. Since reclamation, most of them have been subsiding, and in some places cultural practices and occasional fires have lowered the present land surface to 8 or 10 feet below sea level.

In these inland areas of the Pacific slope, about 100,000 acres of drained but unproductive peat areas are now administered by the U. S. Fish and Wildlife Service for use by waterfowl. Most of the original wet conditions have been restored, and these areas now make excellent waterfowl refuges.

Coastal marshlands.—Coastal marshlands occur mostly in tidal channels at the mouths of rivers, in quiet waters of lagoons, and behind barrier islands. There are about 9 million acres of these marshes, most of them along the Atlantic and Gulf coasts. They vary from highly saline to fresh, and their vegetation varies accordingly. It includes cordgrasses, saltgrass, bulrushes, spikerushes, cattails, and some shrubs.

Several types of peat occur, each with distinct characteristics and suitabilities for agriculture. Generally, the surface materials consist of coarse, fibrous, yellowish-brown peat, which has gradually accumulated over black, clayey mud flats or loose, gray sand.

Experience, both in this country and abroad, shows that some types of coastal marshes, when drained and used for hay or grain crops, undergo decomposition and a long-continued shrinkage. Ditches become more and more ineffective, and further drainage can be accomplished only through an increased use of pumps and dikes.

ALLUVIAL SOILS

Alluvial soils occur in all parts of the United States on flood plains, first bottoms, or low terraces along rivers. They are composed of the recently deposited water-borne materials that are little changed by their new environment.

Some of the most productive soils of the world are alluvial in origin. Since they need protection from high-water stages of rivers, many areas are provided with levees and major drainage facilities which greatly reduce their wildlife value.

Alluvial soils of the Northeast, the Prairies and Great Plains, and the arid West are now largely under controlled management for agriculture. Row crops are grown on the better soils, and land that is still poorly drained is used for hay and pasture.

The largest area of alluvial soils in the United States is along the Mississippi River below the mouth of the Ohio. Flood-control and drainage projects have reclaimed much of this area for agricultural use, but millions of acres still remain unprotected from overflow—much of it is forested with oak, hickory, gum, ash, and cypress. Such areas are heavily used by migrating and wintering waterfowl, because overflow periods and availability of mast crops usually coincide with the seasonal movement of ducks.

Since 1880, approximately 8 million acres of agricultural land have been developed for farming in the 75 counties of the lower Mississippi Delta. Most of this development was preceded by drainage, but protection from floods was influential in stimulating land development [*16*]. This trend can be expected to continue in the future. Recent estimates indicate that nearly 6 million acres of fertile but undeveloped alluvial lands in Louisiana, Mississippi, and Arkansas are physically suitable, with improvements, for crop production and pasture [*16*].

FUTURE OUTLOOK

Interior wetland soils suitable for future agricultural development are often in the areas that are used most heavily by waterfowl and other wildlife. Landform and native vegetation, singly or in combination, are probably responsible for this seemingly direct relation. Except for the alluvial valleys of the South, the best waterfowl wetlands are in grassland regions rather than forested regions, and where the relief is level to slightly rolling rather than strongly rolling or mountainous. The best agricultural lands also are found where such conditions are extant.

As an example, most of Minnesota's present-day drainage is in the flat to gently rolling grassland region of the State, where soils are inherently more fertile. This is also the region where most of the remaining wetlands are rated high in waterfowl value. High soil fertility and high wildlife production seem to go hand in hand where wetlands are concerned. This close tie-in between soil fertility and wildlife use has been noted for other game species—notably farm game and white-tailed deer.

Widespread drainage, of course, can upset this direct agriculture-waterfowl relation. Since the

best agricultural lands are the ones receiving the most drainage, waterfowl habitat on such lands often becomes locally scarce. The birds are then forced to use less desirable locations. Population densities of breeding ducks in the Dakotas appear to be a case in point. The highest breeding-pair counts are recorded in the glaciated, hillier parts of the Dakotas, where drainage is uncommon.

The problem areas of the future are indicated in a general way in table 4. These estimates by the U. S. Soil Conservation Service [*16*] show the location, by States, of nearly 21 million acres of undeveloped wet soils that are considered physically feasible to drain and convert to cultivation. They include lands both inside and outside organized drainage enterprises. There is every indication that competition between agricultural and wildlife interests over the use of wetland soils will continue to be intense in the years ahead.

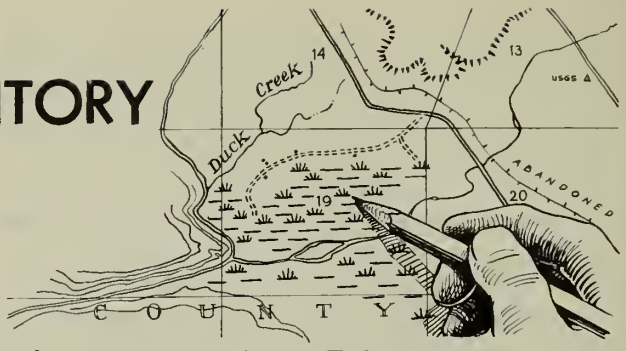
The current inventory by the Service and the States can furnish guidelines to show where the wildlife agencies should be prepared to go into action and where other land-use agencies need to lend a hand in a balanced program for dedicating wetland soils to their best permanent uses.

Table 4.—Estimated acreage of fertile, undeveloped land that is physically feasible to provide with drainage in selected humid sections of the United States, 1948

[States excluded are Arizona, California, Colorado, Idaho, Montana Nevada, New Mexico, Utah, and Wyoming. Data from Wooten and Purcell, 1949]

State	Acres	State	Acres
Albama	683,000	New Hampshire	18,000
Arkansas	1,865,000	New Jersey	60,000
Connecticut	22,000	New York	100,000
Delaware	34,000	North Carolina	1,157,000
Florida	1,970,000	North Dakota	29,000
Georgia	1,721,000	Ohio	95,000
Illinois	69,000	Oklahoma	35,000
Indiana	135,000	Oregon	61,000
Iowa	56,000	Pennsylvania	90,000
Kansas	30,000	Rhode Island	4,000
Kentucky	170,000	South Carolina	966,000
Louisiana	2,769,000	South Dakota	88,000
Maine	64,000	Tennessee	242,000
Maryland	63,000	Texas	3,928,000
Massachusetts	19,000	Vermont	18,000
Michigan	690,000	Virginia	514,000
Minnesota	874,000	Washington	137,000
Mississippi	1,272,000	West Virginia	15,000
Missouri	323,000	Wisconsin	316,000
Nebraska	22,000	Total	20,724,000

THE WETLANDS INVENTORY



The need for conducting a national wetlands inventory began to be apparent several years ago. It was common knowledge that drainage and other reclamation activities were steadily depleting the once-abundant wetlands available to wildlife, but there was no reliable and comprehensive information at hand to show the distribution, extent, and quality of the remaining wetlands in relation to their value as wildlife habitat.

More basic information on the relation of wetlands to wildlife was obviously a necessity, so the idea of conducting an inventory was kindled. In order that results might be most useful, it was agreed to place primary emphasis on wetlands considered susceptible to drainage or other land-use changes that destroy wildlife habitat. It is reemphasized here that permanent lakes, streams, and reservoirs were not included as wetlands.

The broad aim was to make the coverage as complete as time and manpower would permit. Aerial photographs, topographic maps of the U. S. Geological Survey, charts of the U. S. Coast and Geodetic Survey, type maps of the U. S. Forest Service, soil maps and land-use maps of Federal and State agencies, and county highway maps proved to be helpful sources of information on the locations of wetlands. With these, and with the help of State fish and game departments and other agencies, field work for the inventory was completed in June 1954. It included an estimated 90 percent or more of all wetlands used significantly by waterfowl. Information on use by other wildlife was also collected.

This national report contains some of the gross results, such as acreages by values for the 48 States (table 6), and the general distribution and relative importance to waterfowl of the 74.4 million acres of wetlands included in the inventory (map in pocket—pl. 21). More detailed information for specific States and counties is on file for reference purposes in the Fish and Wildlife Service's regional offices (see first chapter), where inventory reports for individual States have been made available in limited quantity.

AREAS COVERED

The shading on plate 21 indicates the general areas where wetlands included in this report are located. Fieldmen responsible for the inventory of a State had first to decide which regions of the State to cover in order to be certain of including at least 90 percent of the State's important waterfowl wetlands. In the North Central States (including the two Dakotas and the Lake States), virtually complete coverage of all wetlands, regardless of size, was considered essential in order not to neglect the all-important duck-breeding wetlands, which are widely scattered in these regions. The Southeastern States were given similar coverage, regardless of the importance of their wetlands to waterfowl.

Elsewhere in the country (Northeast and West), coverage was restricted to physiographic regions where good waterfowl habitat is most abundant. These were usually associated with inner basins, plateaus, high plains, and major rivers in the West, and with coastal regions and inland river drainages in the Northeast. In regions delineated for inclusion in the inventory, most wetlands less than 40 acres in size were excluded because they were too difficult to survey within reasonable time limits.

The portions of States not included in the inventory consist largely of small, scattered units of relatively low waterfowl value. Many of these units are in no danger of being disturbed by agricultural or industrial developments, and their inclusion in this inventory would have been prohibitively costly. An example of this prohibitive cost would be an attempt to appraise a high mountainous region containing unmapped meadows, beaver flowages, and wooded swamps.

Wetlands were recorded on county maps either as specific units or as general areas. In the Northeast and West, where only parts of States were studied and where only the larger areas were mapped, most wetlands were treated as specifically located units. This was true also of most States in the southeastern part of the country. But in the North Central States, the Lake States, and a few Southeastern States, where thousands of small scattered wetlands were encountered, fieldmen were compelled to collect acreage data and other information by sampling methods in order to complete their assignments.

Field sampling does not permit the recording of data on every specific area, but it does provide the basis for estimating the quantity and quality of a given wetland type in a given unit area—in this case, a county. In each county where this general coverage was followed, estimates of the amount, type, and quality of the wetlands were obtained. Also, certain of the larger and more important wetlands within the sampled units were covered and mapped as specific units.

CLASSIFICATION

It is important, both to wildlife biologists engaged in habitat preservation and to agricultural technicians making land-use recommendations for private lands, to understand the different ecological types of wetlands. Before the inventory was started, therefore, the Fish and Wildlife Service, through a committee of wetland ecologists, established and described 20 basic wetland types [*9*]. These types range from basins or flats that undergo only seasonal submergence (well-drained much of the summer) to lands that are waterlogged or flooded during most or all of the growing season.

Table 5 introduces the subject of classification by listing the 20 wetland types found in the country, with a brief description of the water depth and a total-acreage figure for each type. National totals show that 63.5 million acres are in the INLAND FRESH category. Totals by other categories (in millions of acres) are as follows: INLAND SALINE, 1.6; COASTAL FRESH, 4.0; COASTAL SALINE, 5.3.

EVALUATION

Value categories of high, moderate, low, and negligible were set up to show the relative importance of wetlands to waterfowl in each State. Opinions of State biologists, State game wardens, and Federal game-management agents were relied on heavily in reaching value determinations. These categories can be used as general guides by wildlife agencies and public land-use agencies to

Table 5.—Description and acreage of wetland types in the United States

Wetland category and type	Water depth [1]	Total acres
INLAND FRESH AREAS:		
1. Seasonally flooded basins or flats	Few inches in upland; few feet along rivers	23, 092, 000
2. Inland fresh meadows	Few inches after heavy rains	7, 518, 000
3. Inland shallow fresh marshes	Up to 6 inches	3, 969, 000
4. Inland deep fresh marshes	Up to 3 feet	2, 346, 000
5. Inland open fresh water	Up to 10 feet; marshy border may be present	2, 596, 000
6. Shrub swamps	Up to 6 inches	3, 813, 000
7. Wooded swamps	Up to 1 foot	16, 809, 000
8. Bogs	Shallow ponds may be present	3, 347, 000
INLAND SALINE AREAS:		
9. Inland saline flats	Few inches after heavy rain	1, 064, 000
10. Inland saline marshes	Up to 2 feet	272, 000
11. Inland open saline water	Up to 10 feet; marshy border	282, 000
COASTAL FRESH AREAS:		
12. Coastal shallow fresh marshes	Up to 6 inches at high tide	2, 213, 000
13. Coastal deep fresh marshes	Up to 3 feet at high tide	1, 631, 000
14. Coastal open fresh water	Up to 10 feet; marshy border often present	197, 000
COASTAL SALINE AREAS:		
15. Coastal salt flats	May have few inches at high tide	423, 000
16. Coastal salt meadows	May have few inches at high tide	956, 000
17. Irregularly flooded salt marshes	Few inches at wind tide	698, 000
18. Regularly flooded salt marshes	Up to 1 foot at high tide	1, 576, 000
19. Sounds and bays	Up to 10 feet at high tide	1, 114, 000
20. Mangrove swamps	Up to 2 feet	523, 000

[1] Refers to average conditions during growing season except for Type 1. In Type 1 bottomlands, flooding ordinarily occurs in late fall, winter, or spring. In Type 1 upland areas, depressions may be filled with water during heavy rain or melting snow, predominantly in early spring.

determine the relative worth of wetlands to waterfowl in each State.

Wetlands in the breeding-range States were appraised with special consideration of their suitability for production purposes. Wetlands in the southern tier of States were judged primarily on their relative values as wintering habitat. Migration and hunting use received first consideration in other States. Therefore, at the present time there is no common denominator for interstate comparisons of wetland values assessed during the course of the inventory, but in general the wetlands with the highest ratings in each State are the ones receiving the greatest duck use.

It is stressed that waterfowl values represent the relative importance of wetlands to ducks and geese as determined by individual State standards rather than by National standards. The *high* value category means that areas so indicated for a particular State constitute the best habitat in that State. Values then scale down to *negligible* according to the degree of attraction to waterfowl.

If National standards had been used, they would have been based primarily on the number of waterfowl using a unit of area during particular seasons of the year. Under such a system, States with comparatively few ducks and with relatively poor habitat would have their best habitat rated *low* or *negligible*. This would be unfair to the wildlife interests of those States because they naturally want to preserve the best habitat they have, regardless of how it compares with other sections of the country. Neverthless, a system based on National standards would have great usefulness for planning nationwide waterfowl programs, and probably such a system should eventually be developed.

The following statements on the meaning of values can be used as guides when drainage or other land-use changes are contemplated:

High.—Habitat of highest waterfowl use in present condition, the largest areas of which should be included in either Federal or State waterfowl-management programs, if feasible. If areas are small, numerous, and privately owned, wildlife use should receive top consideration by land-use agencies, and every encouragement should be offered to keep the land in a use-category that is favorable to waterfowl and other wildlife.

Moderate.—Habitat of significant waterfowl use in present condition. Many areas should be controlled or managed by Federal, State, or private waterfowl organizations. Wildlife use of areas should receive consideration in land-use planning at least equal to alternative uses.

Low.—Habitat receiving relatively low waterfowl use under natural conditions, but may be important locally as a shooting area for waterfowl or other game. Although loss of some of these areas might not be particularly harmful to waterfowl, public agencies should look upon them as possessing opportunities for habitat improvements which would help offset losses elsewhere. On the breeding grounds of the Plains States, innumerable areas are individually of low value but collectively they make definite contributions to the region's value for waterfowl.

Negligible.—Habitat receiving little or no waterfowl use, although values for other wildlife may be substantial. Extensive development, probably at considerable expense, would be required to increase waterfowl values in most areas, but opportunities for feasible development exist in others. Possibilities of such improvements should be explored. Drainage, or other land-use changes, would be least objectionable from a strictly waterfowl standpoint.

Those who use the present inventory are cautioned not to regard those wetlands classified in the two lower-value categories as automatically expendable, because such lands may have development potentials for wildlife. Another important point to consider is the value of distributing waterfowl widely by improving the quality of the poorer habitat in regions now supporting small populations of waterfowl.

Expansion of good-quality habitat will not only broaden the habitat base that now limits waterfowl populations and hunting opportunities, but it also will help prevent the build-up of concentration areas where crop depredations and disease outbreaks are more likely to occur. The inventory data, if used jointly in planning water-control facilities and waterfowl-management programs, can serve as an effective starting point for wetlands improvement as well as for wetlands preservation.

The values of wetlands to waterfowl as determined from the present inventory are shown, by States, in table 6. National totals show approximately 9 million acres of wetlands rated high, 13.5 million acres rated moderate, 24 million acres rated low, and 28 million acres rated negligible. Plate 21 (in pocket inside back cover) depicts the nationwide distribution of wetlands by waterfowl values.

Not included in table 6 or in plate 21 are 3,812,000 acres of overflow and seasonally flooded

Table 6.—Values of wetlands to waterfowl, based on State-unit determinations

[In acres. Values not comparable between States]

State	Acreage with value assessed as—				Total
	High	Moderate	Low	Negligible	
Alabama	26, 500	249, 600	1, 092, 200	230, 100	1, 598, 400
Arizona	16, 500	11, 400	500		28, 400
Arkansas	926, 600	699, 400	1, 496, 700	662, 700	3, 785, 400
California	317, 800	176, 200	57, 600	7, 700	559, 300
Colorado	35, 800	101, 600	211, 900	55, 100	404, 400
Connecticut	6, 900	8, 000	4, 800	3, 700	23, 400
Delaware	24, 600	40, 700	49, 600	16, 400	131, 300
Florida	423, 000	1, 659, 900	6, 585, 200	8, 517, 200	17, 185, 300
Georgia	20, 900	440, 400	1, 428, 900	4, 029, 300	5, 919, 500
Idaho	59, 300	23, 100	21, 400	5, 100	108, 900
Illinois	75, 700	196, 100	112, 700	42, 800	427, 300
Indiana	151, 600	68, 900	33, 600	29, 300	283, 400
Iowa	57, 100	51, 600		29, 400	138, 100
Kansas	120, 800	65, 900	17, 500		204, 200
Kentucky	84, 400	27, 400	34, 200	127, 100	273, 100
Louisiana	706, 800	1, 706, 200	1, 092, 500	6, 141, 800	9, 647, 300
Maine	108, 500	52, 200	140, 300	80, 300	381, 300
Maryland	112, 600	87, 800	51, 100	38, 500	290, 000
Massachusetts	46, 600	55, 700	80, 200	49, 200	231, 700
Michigan	310, 500	2, 013, 200	430, 100	463, 300	3, 217, 100
Minnesota	1, 274, 500	778, 800	2, 991, 600		5, 044, 900
Mississippi	316, 200	682, 200	854, 700	736, 300	2, 589, 400
Missouri	105, 700	93, 100	74, 000	104, 100	376, 900
Montana	29, 100	113, 300	45, 000		187, 400
Nebraska	197, 800	171, 000	281, 000		649, 800
Nevada	109, 100	70, 400	13, 000		192, 500
New Hampshire	5, 700	4, 800	1, 700	1, 300	13, 500
New Jersey	127, 500	109, 100	32, 400	900	269, 900
New Mexico	24, 500	12, 900	11, 100		48, 500
New York	99, 800	35, 700	55, 100	22, 200	212, 800
North Carolina	81, 100	38, 500	505, 200	3, 429, 800	4, 054, 600
North Dakota	554, 900	653, 600	314, 800		1, 523, 300
Ohio	38, 500	12, 300	19, 300	27, 800	97, 900
Oklahoma	18, 500	133, 800	127, 400		279, 700
Oregon	246, 000	76, 800	131, 900	17, 900	472, 600
Pennsylvania	8, 600	15, 100	15, 800	13, 400	52, 900
Rhode Island	1, 900	2, 100	4, 000	17, 400	25, 400
South Carolina	10, 900	194, 400	1, 495, 600	1, 676, 100	3, 377, 000
South Dakota	161, 400	414, 200	176, 400		752, 000
Tennessee	447, 600	128, 200	128, 600	123, 600	828, 000
Texas	586, 400	1, 597, 800	923, 500	633, 300	3, 741, 000
Utah	249, 400	342, 100	315, 800	267, 100	1, 174, 400
Vermont	6, 700	9, 500	13, 000	8, 900	38, 100
Virginia	28, 300	85, 900	177, 700	249, 200	541, 100
Washington	54, 300	53, 900	68, 100	56, 900	233, 200
West Virginia	1, 600		2, 200		3, 800
Wisconsin	389, 500	48, 200	2, 352, 900		2, 790, 600
Wyoming	11, 900	3, 500	14, 900		30, 300
Total	8, 819, 900	13, 616, 500	24, 087, 700	27, 915, 200	74, 439, 300

lands presently used for crops or pasture. Although these agricultural wetlands are identified on State wetlands maps by a special symbol and listed in State reports (as non-add items), they are not combined with other wet and waterlogged lands because the present inventory encompasses only natural wetlands that have been little altered by man's activities.

THE 20 WETLAND TYPES

This chapter describes the 20 wetland types in relation to their usefulness as habitat for waterfowl. Wetlands do not all fit neatly into definite type classifications. In this connection the Wetlands Classification Committee reports:

> Because of the infinitely varied and intergrading physical and chemical conditions that underlie the complex of wetlands in this country, it would be impossible to create a useful classification system that completely avoids overlapping of types recognized. Some degree of overlapping . . . is acknowledged, but it is believed that they are sufficiently distinct to serve satisfactorily in evaluations of wetlands. [*9*]

In practical use, however, the system has served its intended purpose effectively.

The 20 types of wetlands are grouped under four categories: INLAND FRESH AREAS (Types 1 to 8), INLAND SALINE AREAS (Types 9 to 11), COASTAL FRESH AREAS (Types 12 to 14), and COASTAL SALINE AREAS (Types 15 to 20). In each category, the types are arranged in order of increasing water depths during the growing season. Types 6, 7, and 20, and oftentimes Type 8, are characterized by growths of shrubs or trees. From the standpoint of acreage, Type 1 (Seasonally flooded basins and flats) is the most abundant, and Type 14 (Coastal open fresh water) is the least abundant.

Figure 2 names each type in numerical order and indicates its area and value as waterfowl habitat. In this figure, and in the type maps included in the plates at the end of the report, *Primary Importance* refers to wetland areas rated as high or moderate in value to waterfowl in the State inventories. The total acreage of primary importance in the United States is 22.4 million. Since this figure is derived by totaling values for individual States, it should not be inferred that the percentages used in figure 2 apply uniformly throughout the country. It is generally true, however, that the values of most individual types tend to be rather consistent from one part of the country to another.

Figure 3 shows the United States divided into eight flyway areas. The heavy lines running north and south are administrative boundaries of the four flyways commonly referred to in waterfowl management. The heavy east and west lines roughly divide each flyway into northern and southern halves. The eight resulting areas are convenient units for studying the abundance and importance of wetland types.

Most waterfowl breeding in the United States occurs in the four northern flyway areas, and most of the important wintering grounds are in the four southern ones. Although there is considerable overlapping of these seasonal activities, particularly in States along the line between north and south, wetlands in the four northern areas generally make their most important contribution to breeding waterfowl, and those in the southern areas are used principally for wintering. Wetlands in all eight flyway areas serve as habitat during migration; in some instances their primary value lies in this heavy use by migrant birds.

There follows a brief description of each wetland type, with mention of its more important physical and vegetative characteristics and a table of its acreage by flyway areas. At the end of the report are 20 plates which include for each of the wetland types a map showing its general location, abundance, and waterfowl value, and a photograph of an area representative of the type. The type-distribution maps are not comparable in acres-per-dot representation; they vary from 1 dot for 500 acres in Type 14 to 1 dot for 50,000

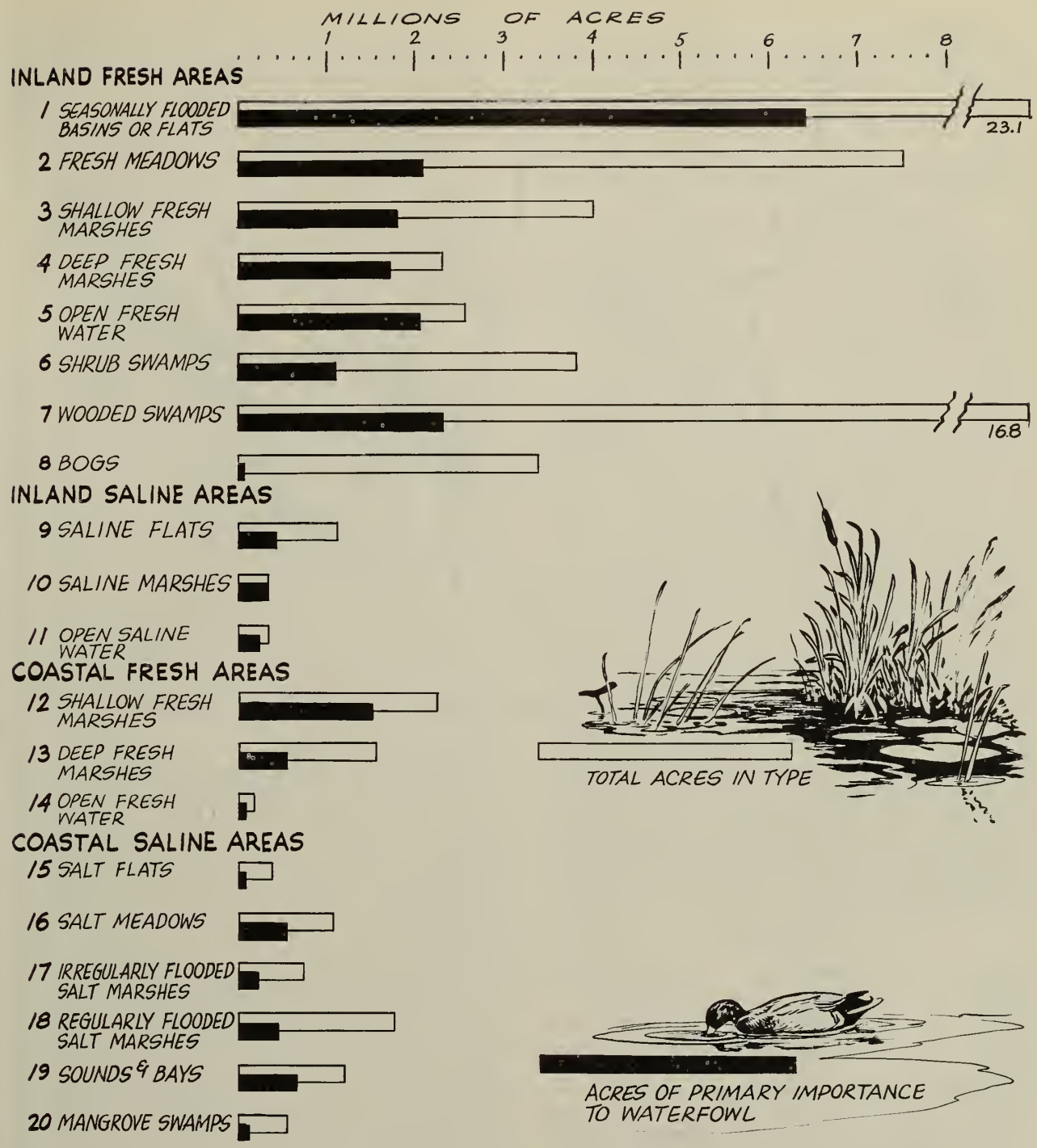


Figure 2.—Extent and present value of wetland types.

acres in Type 1. This variation is necessary because of the tremendous range in acreage totals among the 20 wetland types (see table 5). The dots are based on county acreage data; each dot is located in or close to the county to which it applies. When acreages for two or more counties are combined in order to equal the amount represented by one dot, the dot is close to the geographic center of the counties involved.

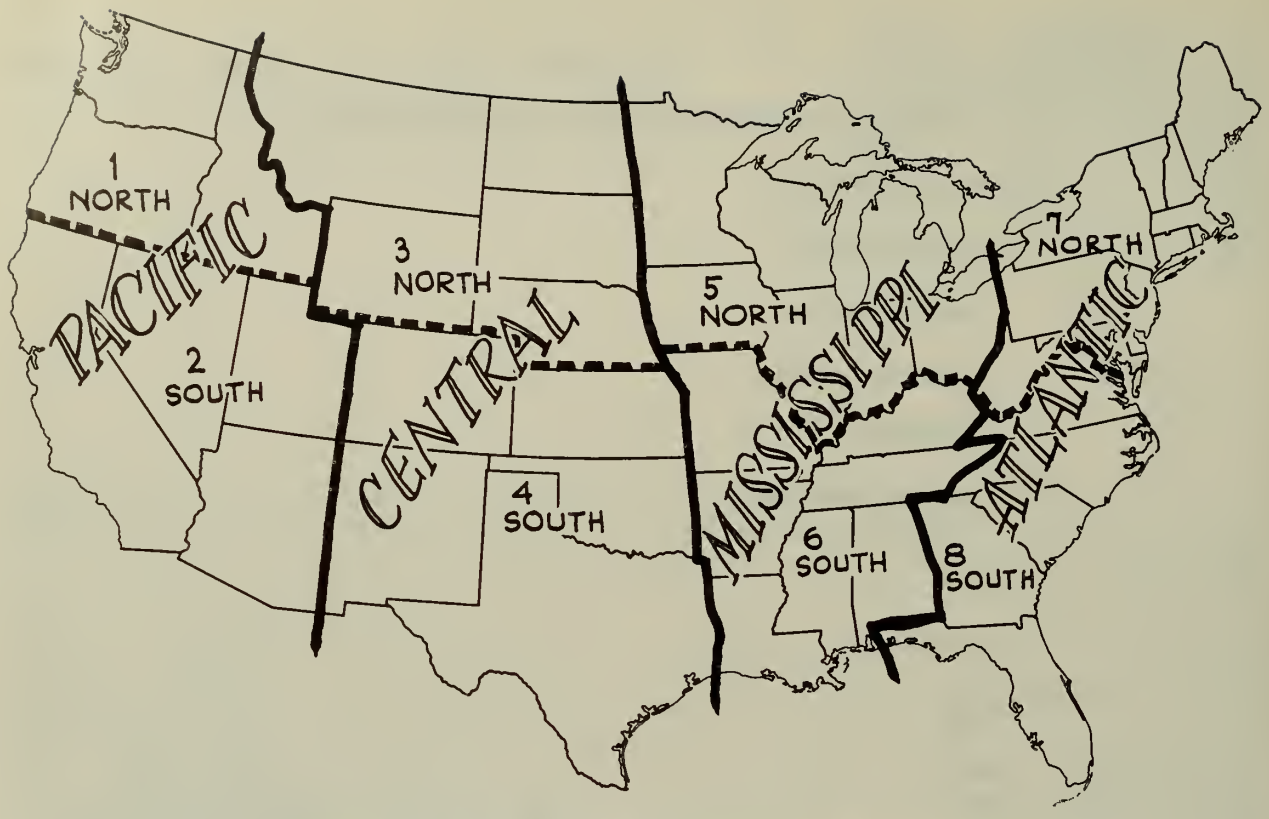
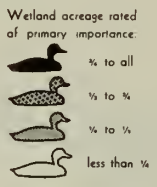


Figure 3.—Flyway areas used in analyzing the relative importance of wetland types to waterfowl.

The symbols used to show relative waterfowl values by flyway areas are standardized for all the type maps. These symbols show what proportion of the habitat of a particular type in a particular flyway area is judged to be of primary importance to waterfowl, as follows:



INLAND FRESH AREAS

Type 1.—Seasonally flooded basins or flats (pl. 1). The soil is covered with water, or is waterlogged, during variable seasonal periods but usually is well drained during much of the growing season. This type is found both in upland depressions and in overflow bottom lands. Along river courses, flooding occurs in late fall, winter, or spring. In the uplands, basins or flats may be filled with water during periods of heavy rain or melting snow.

Vegetation varies greatly according to the season and the duration of flooding. It includes bottom-land hardwoods as well as some herbaceous growths. Where the water has receded early in the growing season, smartweeds, wild millet, fall panicum, tealgrass, chufa, redroot cyperus, and weeds (such as marsh elder, ragweed, and cockleburs) are likely to occur. Shallow basins that are submerged only very temporarily usually develop little or no wetland vegetation.

Upland depressions included in the inventory are confined largely to the three Lake States, the two Dakotas, Montana, and the Panhandle of Texas. In the northern States the presence of this temporary water stimulates high waterfowl production by providing greater area for the establishment of territories by breeding pairs. When water occurs abundantly in the Panhandle, the temporarily flooded basins (playas) are used extensively by migrating and wintering waterfowl.

The overflow bottom lands in the southern part of the Mississippi Flyway provide a major wintering area for ducks as well as good shooting sites for hunters. Particularly in good mast years,

feeding ducks use bottom lands when they are flooded. Although there remain more than 10 million acres of overflow lands in Missouri, Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana, most of the wintering waterfowl in this flyway concentrate in certain key areas.

Flyway area:	*Acres*
1. Pacific north	102, 600
2. Pacific south	143, 400
3. Central north	357, 700
4. Central south	2, 856, 400
5. Mississippi north	1, 134, 000
6. Mississippi south	11, 945, 400
7. Atlantic north	1, 200
8. Atlantic south	6, 551, 400

Type 2—Inland fresh meadows. (pl. 2). The soil usually is without standing water during most of the growing season but is waterlogged within at least a few inches of its surface. Vegetation includes grasses, sedges, rushes, and various broad-leaved plants. In the North, representative plants are carex, rushes, redtop, reedgrasses, mannagrasses, prairie cordgrass, and mints. In Florida, cordgrasses and various species of paspalums and beakrushes are common. Meadows may fill shallow lake basins, sloughs, or farmland sags, or these meadows may border shallow marshes on the landward side. Wild hay oftentimes is cut from such areas.

Fresh meadows are used somewhat in the North by nesting waterfowl, but in most of the country their value is mainly as supplemental feeding areas. If shallow water can be impounded on them, their value can be increased considerably.

Flyway area:	*Acres*
1. Pacific north	43, 200
2. Pacific south	289, 500
3. Central north	578, 800
4. Central south	40, 700
5. Mississippi north	2, 383, 300
6. Mississippi south	68, 700
7. Atlantic north	30, 700
8. Atlantic south	4, 083, 700

Type 3—Inland shallow fresh marshes (pl. 3.) The soil is usually waterlogged during the growing season; often it is covered with as much as 6 inches or more of water. Vegetation includes grasses, bulrushes, spikerushes, and various other marsh plants such as cattails, arrowheads, pickerelweed, and smartweeds. Common representatives in the North are reed, whitetop, rice cutgrass, carex, and giant burreed. In the Southeast, maidencane, sawgrass, arrowhead, and pickerelweed are characteristic. These marshes may nearly fill shallow lake basins or sloughs, or they may border deep marshes on the landward side. They are also common as seep areas on irrigated lands.

Marshes of this type are used extensively as nesting and feeding habitat in the pothole country of the North Central States and elsewhere. In combination with deep fresh marshes (Type 4), they constitute the principal production areas for waterfowl. Florida and Georgia are the only States where the majority of the shallow fresh marshes are considered to be of lesser importance to waterfowl. Florida alone contains more than 2 million acres of this type.

Flyway area:	*Acres*
1. Pacific north	33, 700
2. Pacific south	64, 100
3. Central north	817, 600
4. Central south	84, 600
5. Mississippi north	758, 500
6. Mississippi south	15, 300
7. Atlantic north	35, 900
8. Atlantic south	2, 159, 900

Type 4—Inland deep fresh marshes (pl. 4). The soil is covered with 6 inches to 3 feet or more of water during the growing season. Vegetation includes cattails, reeds, bulrushes, spikerushes, and wildrice. In open areas, pondweeds, naiads, coontail, watermilfoils, waterweeds, duckweeds, waterlilies, or spatterdocks may occur. Water-hyacinth and waterprimroses form surface mats in some localities in the Southeast. These deep marshes may almost completely fill shallow lake basins, potholes, limestone sinks, and sloughs, or they may border open water in such depressions.

Deep fresh marshes constitute the best breeding habitat in the country, and they are also important feeding places. In the Western States they are heavily used by migrating birds, especially diving ducks. Florida and Texas are the only States in which the vast majority of these marshes are not rated as being of primary importance to waterfowl.

Flyway area:	*Acres*
1. Pacific north	92, 500
2. Pacific south	62, 500
3. Central north	686, 500
4. Central south	46, 800
5. Mississippi north	427, 700
6. Mississippi south	21, 500
7. Atlantic north	25, 700
8. Atlantic south	984, 100

Type 5—Inland open fresh water (pl. 5). Shallow ponds and reservoirs are included in this type. Water is usually less than 10 feet deep and is fringed by a border of emergent vegetation. Vegetation (mainly at water depths of less than 6 feet) includes pondweeds, naiads, wildcelery, coontail, watermilfoils, muskgrasses, waterlilies, spatterdocks, and (in the South) water-hyacinth.

In the pothole country of the North Central States, Type 5 areas are used extensively as brood

areas when, in midsummer and late summer, the less permanent marshes begin to dry out. The borders of such areas are used for nesting throughout the Northern States. Where vegetation is plentiful, they are used in all sections of the country as feeding and resting areas by ducks, geese, and coots, especially during the migration period.

Flyway area:	*Acres*
1. Pacific north	40, 500
2. Pacific south	51, 900
3. Central north	676, 800
4. Central south	87, 100
5. Mississippi north	1, 000, 200
6. Mississippi south	186, 500
7. Atlantic north	12, 000
8. Atlantic south	541, 500

Type 6—Shrub swamps (pl. 6). The soil is usually waterlogged during the growing season, and is often covered with as much as 6 inches of water. Vegetation includes alders, willows, buttonbush, dogwoods, and swamp-privet. Shrub swamps occur mostly along sluggish streams and occasionally on flood plains. They are used to a limited extent for nesting and feeding in the North and for roosting and feeding in some of the Mississippi Alluvial Valley States. Elsewhere, shrub swamps are little used except in a few special situations.

Flyway area:	*Acres*
1. Pacific north	11, 900
2. Pacific south	800
3. Central north	700
4. Central south	23, 500
5. Mississippi north	2, 912, 400
6. Mississippi south	164, 300
7. Atlantic north	77, 800
8. Atlantic south	622, 100

Type 7—Wooded swamps (pl. 7). The soil is waterlogged at least to within a few inches of its surface during the growing season, and is often covered with as much as 1 foot of water. Wooded swamps occur mostly along sluggish streams, on flood plains, on flat uplands, and in very shallow lake basins. In the North, trees include tamarack, arborvitae, black spruce, balsam, red maple, and black ash. In the South, water oak, overcup oak, tupelo gum, swamp black gum, and cypress are dominant. In the Northwest, western hemlock, red alder, and willows are common. Northern evergreen swamps usually have a thick ground covering of mosses. Deciduous swamps frequently support beds of duckweeds, smartweeds, and other herbs.

Wooded swamps often occur in association with shrub swamps, and waterfowl often use the two types interchangeably. In the Southeast, Type 7 swamps become particularly important in years when lack of sufficient fall and early winter rains leave overflow areas dry. At such times, wooded swamps represent the only shallow water available over wide areas. This type is particularly useful to the wood duck throughout the range of this species.

Flyway area:	*Acres*
1. Pacific north	18, 200
2. Pacific south	2, 100
3. Central north	
4. Central south	39, 000
5. Mississippi north	2, 906, 700
6. Mississippi south	2, 813, 800
7. Atlantic north	556, 000
8. Atlantic south	10, 473, 200

Type 8—Bogs (pl. 8). These are often called pocosins, bays, and savannahs in the South. The soil is usually waterlogged and supports a spongy covering of mosses. Bogs occur mostly in shallow lake basins, on flat uplands, and along sluggish streams. Vegetation is woody or herbaceous, or both. Typical plants are heath shrubs, sphagnum moss, and sedges. In the North, leather-leaf, Labrador-tea, cranberries, carex, and cottongrass are often present. In the South, cyrilla, persea, gordonia, sweetbay, pond pine, Virginia chainfern, and pitcher-plants are common. Scattered, often stunted, black spruce and tamarack may occur in northern bogs.

Bogs have the lowest waterfowl rating, countrywide, of all the 20 types. In northern New England, however, they assume considerable significance. In Maine alone, 25,500 acres are classed as being of primary importance to waterfowl.

Flyway area:	*Acres*
1. Pacific north	1, 400
2. Pacific south	1, 500
3. Central north	100
4. Central south	300
5. Mississippi north	477, 300
6. Mississippi south	46, 100
7. Atlantic north	87, 600
8. Atlantic south	2, 733, 500

INLAND SALINE AREAS

Type 9—Inland Saline flats (pl. 9). The soil is without standing water except after periods of heavy precipitation, but it is waterlogged to within at least a few inches of the surface during the growing season. Vegetation (often sparse or patchy) consists of salt-tolerant plants such as seablite, saltgrass, Nevada bulrush, saltbush, and burro-weed. Type 9 wetlands occur in undrained sumps in many parts of the arid West. Sometimes they cover extensive areas.

Saline flats, under natural conditions, are used very little during most seasons, but ducks and geese feed extensively in flats that become flooded in the fall and winter.

Flyway area:	Acres
1. Pacific north	43, 600
2. Pacific south	912, 500
3. Central north	3, 900
4. Central south	104, 100
5. Mississippi north	-------
6. Mississippi south	-------
7. Atlantic north	-------
8. Atlantic south	-------

Type 10.—Inland saline marshes (pl. 10). The soil is usually waterlooged during the growing season and is often covered with as much as 2 or 3 feet of water. This type occurs mostly in shallow lake basins. Vegetation is mainly alkali or hardstem bulrushes, often with wigeongrass or sago pondweed in openings.

Saline marshes are used heavily by nesting and feeding ducks and geese. They are extremely valuable to waterfowl in both the Pacific and Central Flyways. Throughout the range of this type, 98 percent of the saline marshes are considered to be of primary importance to waterfowl.

Flyway area:	Acres
1. Pacific north	98, 500
2. Pacific south	153, 700
3. Central north	5, 600
4. Central south	14, 700
5. Mississippi north	-------
6. Mississippi south	-------
7. Atlantic north	-------
8. Atlantic south	-------

Type 11.—Inland open saline water (pl. 11). These more permanent areas of shallow, saline water are often closely associated with Types 9 and 10. Depth of water is variable. Vegetation (mainly at water depths of less than 6 feet) includes sago pondweed, wigeongrass, and muskgrasses.

Type 11 is used very extensively by feeding ducks and geese wherever vegetation is plentiful. In the Pacific Flyway, where 93 percent of this type is located, it is of major importance during migration seasons. Throughout its range, 87 percent of these areas are considred to be of primary importance to waterfowl.

Flyway area:	Acres
1. Pacific north	154, 700
2. Pacific south	107, 600
3. Central north	15, 000
4. Central south	3, 600
5. Mississippi north	-------
6. Mississippi south	-------
7. Atlantic north	-------
8. Atlantic south	1, 800

COASTAL FRESH AREAS

Type 12—Coastal shallow fresh marshes (pl. 12). The soil is always waterlogged during the growing season. It may be coverd at high tide with as much as 6 inches of water. These marshes are on the landward side of deep marshes along tidal rivers, sounds, and deltas. Vegetation consists of grasses (reed, big cordgrass, maidencane), sedges (carex, spikerushes, threesquares, sawgrass), and various other marsh plants such as cattails, arrowheads, smartweeds, and arrow-arum.

Nationwide, these shallow fresh marshes rate the highest of the nine coastal types in their importance to waterfowl. They are used moderately for nesting in the North Atlantic and Pacific Coast States, and they constitute the most used wetland type along the Gulf Coast during the winter season.

Flyway area:	Acres
1. Pacific north	300
2. Pacific south	5, 300
3. Central north	---------
4. Central south	318, 300
5. Mississippi north	---------
6. Mississippi south	1, 578, 600
7. Atlantic north	150, 700
8. Atlantic south	160, 000

Type 13—Coastal deep fresh marshes (pl. 13). The soil is covered at average high tide with 6 inches to 3 feet of water during the growing season. These marshes occur along tidal rivers and bays, mainly on the Atlantic and Gulf Coasts. Vegetation is mainly cattails, wildrice, pickerelweed, giant cutgrass, and spatterdocks, often with pondweeds and other submerged growths in marsh openings. In the Gulf region, water-hyacinth, alligatorweed, and waterlettuce may produce surface mats.

More than 85 percent of the total of this type is found in Louisiana, where 422,000 acres are of primary importance to waterfowl and 984,000 acres are of lesser importance. This type, where suitable vegetation dominates, is used much in fall and winter by feeding waterfowl.

Flyway area:	Acres
1. Pacific north	10, 000
2. Pacific south	5, 400
3. Central north	---------
4. Central south	43, 800
5. Mississippi north	---------
6. Mississippi south	1, 418, 400
7. Atlantic north	36, 200
8. Atlantic south	117, 600

Type 14—Coastal open fresh water (pl. 14). Included in this type are shallow portions of open water along fresh tidal rivers and sounds that are

considered vulnerable to reclamation for agricultural or industrial uses. Vegetation is scarce, or absent, in stained or turbid waters. At depths of less than 6 feet, pondweeds, naiads, wildcelery, coontail, waterweeds, watermilfoils, and muskgrasses are common. In some localities of the Gulf region, water-hyacinth forms mats on the surface.

Nearly four-fifths of the acreage is on the Louisiana and Texas coasts, where 92,600 acres are of primary importance to waterfowl and 54,200 acres are of lesser importance. This type, although not abundant along the North Atlantic coast, is particularly valuable wherever present. It is also used heavily in the San Francisco Bay region.

Flyway area:	*Acres*
1. Pacific north	------
2. Pacific south	4, 500
3. Central north	------
4. Central south	46, 700
5. Mississippi north	------
6. Mississippi south	118, 500
7. Atlantic north	10, 600
8. Atlantic south	17, 000

COASTAL SALINE AREAS

Type 15—Coastal salt flats (pl. 15). The soil is usually waterlogged during the growing season. Sites vary from those submerged only by occasional wind tides to those covered fairly regularly with a few inches of water at high tide. These areas are on the landward side of, or as islands or basins within, salt meadows and salt marshes. Vegetation is often sparse or patchy and consists mainly of glassworts, seablite, saltgrass, and, in the South, saltflat grass and saltwort.

Many salt flats were too small and too intermixed with other coastal saline types to be included as a separate type in the inventory. This is particularly true in the North Atlantic States where all salt flats necessarily were bypassed. Salt flats do not assume much importance, except in the Puget Sound and San Francisco Bay areas where they are used for feeding. They are abundant on the Texas coast (351,000 acres), where 14 percent are of primary importance to waterfowl.

Flyway area:	*Acres*
1. Pacific north	2, 200
2. Pacific south	23, 500
3. Central north	------
4. Central south	351, 000
5. Mississippi north	------
6. Mississippi south	7, 000
7. Atlantic north	------
8. Atlantic south	39, 600

Type 16—Coastal salt meadows (pl. 16). The soil is always waterlogged during the growing season, but is rarely covered with tidewater. These meadows are on the landward side of salt marshes or bordering open water. Vegetation on the Atlantic and Gulf coasts includes mainly saltmeadow cordgrass, saltgrass, blackrush, and, in fresher parts, Olney threesquare and saltmarsh fleabanes. On the Pacific Coast, carex, hairgrass, and jaumea often are present.

Salt meadows are used as feeding areas in both the production and wintering zones. The presence of shallow potholes greatly increases the value of these meadows.

Flyway area:	*Acres*
1. Pacific north	7, 300
2. Pacific south	------
3. Central north	------
4. Central south	177, 000
5. Mississippi north	------
6. Mississippi south	27, 800
7. Atlantic north	344, 600
8. Atlantic south	399, 400

Type 17—Irregular flooded salt marshes (pl. 17). The soil is covered by wind tides at irregular intervals during the growing season. These marshes are along the shores of nearly enclosed bays, sounds, and rivers on the Atlantic coast from Maryland southward, including the Gulf coast. Vegetation is dominantly needlerush. Pure stands of needlerush make poor waterfowl marshes, but where wigeongrass occurs in ponds or channels within the marsh, adjoining growths of needlerush provide protective cover to feeding ducks. Because of this interspersion of Type 17 with open water, these irregularly flooded salt marshes usually rate fairly high in value.

Flyway area:	*Acres*
1. Pacific north	------
2. Pacific south	------
3. Central north	------
4. Central south	18, 400
5. Mississippi north	------
6. Mississippi south	33, 300
7. Atlantic north	53, 000
8. Atlantic south	593, 900

Type 18—Regularly flooded salt marshes (pl. 18). The soil is covered at average high tide with 6 inches or more of water during the growing season. These marshes are along the open ocean in eastern Virginia, southern South Carolina, Georgia, and eastern Louisiana. Elsewhere, the type is found mostly along sounds. Vegetation on the Atlantic and Gulf coasts is mainly saltmarsh cordgrass. On the Pacific coast, alkali bulrush, glassworts, and arrowgrass dominate.

Permanent, open water in these marshes may support wigeongrass, eelgrass, or sago pondweed.

This type is used very much by feeding ducks and geese, particularly along the Pacific and North Atlantic coasts where food-abundant ponds are present.

Flyway area:	*Acres*
1. Pacific north	8, 700
2. Pacific south	83, 600
3. Central north	-------
4. Central south	18, 900
5. Mississippi north	-------
6. Mississippi south	539, 200
7. Atlantic north	104, 400
8. Atlantic south	821, 300

Type 19—Sounds and bays (pl. 19). This type includes those portions of salt-water sounds and bays that are considered shallow enough to be diked and filled. On the Pacific and North Atlantic coasts, all water landward from the average low-tide line was included. In Texas, because of the small range between tide extremes, water less than 3 feet deep was arbitrarily classified in this type. Vegetation includes eelgrass, wigeongrass, sago pondweed, muskgrasses, and, in the Southeast, shoalgrass, manateegrass, and turtlegrass.

Sounds and bays are of particular value to wintering waterfowl in the San Francisco Bay area of California, on the Texas coast, and along the New England coast.

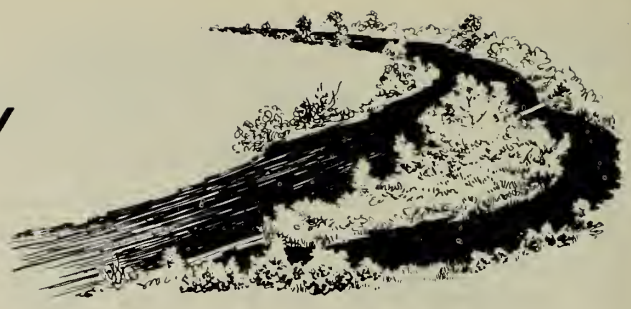
Flyway area:	*Acres*
1. Pacific north	145, 400
2. Pacific south	42, 500
3. Central north	-------
4. Central south	412, 900
5. Mississippi north	-------
6. Mississippi south	111, 900
7. Atlantic north	147, 400
8. Atlantic south	254, 700

Type 20—Mangrove swamps (pl. 20). The soil is covered at average high tide with 6 inches to 3 feet of water during the year-round growing season. This type is found only along the coast of the southern half of Florida; it is best developed on the western coast of that State from Cape Sable to Everglades City. Tree growth consists of much red mangrove and some black mangrove. Scattered areas of black mangrove in Louisiana were included with regularly flooded salt marshes.

The value of mangrove swamps for waterfowl is dependent on other wetland types associated with them. Except in localized situations where duck food is common, these swamps are sparsely used.

Flyway area:	*Acres*
8. Florida only	523, 000

USE OF THE INVENTORY



Drainage and other water-control projects affecting wetlands have a profound and frequently detrimental effect on both the quantity and the quality of these lands as waterfowl habitat. A few years ago it was impossible to estimate the net effects of such projects on waterfowl distribution and abundance, because there was not enough information. The present inventory makes it possible to know approximately how many acres of the different kinds of wetlands are used by waterfowl and to determine the relative value of these wet areas to ducks and geese in the individual States.

WATER-CONTROL AND LAND-USE PLANNING

Federal and State agencies responsible for flood control, drainage, and related land-use adjustments can use the inventory to gain a perspective on the status of waterfowl habitat in areas where their projects are being planned. It is increasingly important that design for such projects should include facilities and measures needed to protect or enhance the remaining wetland habitat for wildlife.

Providing waterfowl with the required amount of habitat does not require that every acre of wetland be retained in its original state. In their present condition, millions of acres of wetlands are of little or no importance to waterfowl. Many projects can be designed to accomplish their primary purposes and, at the same time, maintain, or even increase, waterfowl values. On the other hand, in some regions of the country (notably, the prairie pothole region of the North Central States) practically any amount of drainage of marshes or of temporary surface water deprives waterfowl of irreplaceable breeding habitat.

The Corps of Engineers, Department of the Army, regularly eliminates wetlands in connection with its responsibility for providing flood-protection works and major drainage facilities throughout the country. Congress, however, in the Coordination Act approved August 14, 1946, provided that the Corps of Engineers and other Federal water-control agencies should consult with the Fish and Wildlife Service and the States concerned to determine the effects of proposed projects on fish and wildlife resources, with a view to avoiding or mitigating any damaging effects on wildlife. The wetlands inventory data now available should help in the prevention of unnecessary drainage of choice wetlands habitat, although constant vigilance by construction agencies and conservation interests will be needed to achieve this end.

Equally important is a clearer recognition of the need for additional waterfowl habitat in areas where the inventory shows a dearth of wetlands attractive to ducks and geese. Obviously, the wetlands inventory provides only the first step in meeting such a need, but often the first step in planning water-control projects is the most important.

Broad land-use programs, such as those of the Agricultural Conservation Program Service (ACPS) of the U. S. Department of Agriculture, can also capitalize on the wetlands inventory. Through ACPS, the Federal Government provides cash assistance to farmers in order to encourage the adoption of soil- and water-conservation practices, including drainage, that might not otherwise be undertaken. In addition, Congress has provided for insured loans to farmers for drainage and other land-treatment measures. Such incentives should be curtailed when they encourage the drainage of wetlands that constitute essential waterfowl habitat.

The Soil Conservation Service provides the technical know-how for doing the work by planning on-the-ground conservation practices. Part of this vast soil-conservation program is a nationwide soil-classification survey that undertakes to show how different soils should best be used—whether for intensive cropping, regulated pasture, forestry, or wildlife production. The wetlands

inventory will show farm planners and administrators the location of wetlands of particular importance in the national waterfowl-conservation program. This knowledge can influence the choice of practices needed to preserve necessary wetlands habitat. At least, it will help to show where conflicting national interests occur and should lead to the establishment of policies that are more harmonious to all resource interests.

In the pothole area of the Dakotas and Minnesota, wildlife interests are hopeful that the tremendous value of potholes in duck production, as well as their value when managed as agricultural wetlands, will show the need for an agricultural policy that favors wetland preservation and opposes further drainage of surface waters.

Conservation of an adequate share of the wetland resource for wildlife will no doubt require more than the defensive action that has characterized most efforts so far. It will necessitate a forward-looking program aimed at establishing waterfowl and other wildlife habitat as permanent features of rural land-and-water-management programs.

FLYWAY MANAGEMENT

The inventory has potential use in planning overall flyway-management programs. Flyways are now generally accepted as practical, semi-natural areas where effective management of migratory birds can be applied. Since 1948, they have served as the basis for administrative action by the Fish and Wildlife Service in setting the annual hunting regulations. Lincoln states:

> The terms "flyway" and "migration route" have in the past been used more or less as synonyms but the modern concept of a flyway is that it is a vast geographic region with extensive breeding grounds and wintering grounds connected with each other by a more or less complicated system of migration routes. Each flyway has its own populations of birds, even of those species that may have a continental distribution. The breeding grounds of one or more flyways may (and usually do) overlap broadly, so that during the nesting season extensive areas may be occupied by birds of the same species but which belong to different flyways. [*8*]

Any plan for providing adequate habitat for large populations of waterfowl in a flyway must take into account both *breeding* and *wintering* habitat. Waterfowl are capable of migrating long distances without stopping, so providing habitat just for use during migration is not necessarily essential to the welfare of the birds, though it is highly important from the standpoint of the hunter.

Unless the birds are induced to stop on their southern journey, hunting opportunities will be extremely limited in some States. It has been repeatedly observed that southbound waterfowl will take up at least temporary residence if attractive habitat is available enroute, and certain species will spend the entire winter in new, more northerly environments if food supplies and water conditions are favorable. For hunting, the inclusion of so-called *intermediate* wetlands is necessary to the adequate management of a flyway.

How can the wetlands data be utilized in the development of a flyway-management plan? There are two kinds of management in connection with waterfowl programs, although the two are closely interrelated. One concerns the birds alone, and the other concerns the habitat on which the birds depend. The first embraces regulations governing hunting and the actions necessary to control or abate depredation and disease. The present discussion is related primarily to the second kind of management, which concerns habitat used by waterfowl for breeding, migration, and wintering.

Wetland reports for individual States include county data forms that show, in most cases, whether a particular wetland type makes its most important contribution as breeding, wintering, or migration habitat. Each of these three kinds of habitat can be represented on flyway maps to show where wetlands should be preserved or created to take care of the seasonal requirements of waterfowl. For example, there is a direct relation between the distribution and abundance of shallow and deep inland fresh marshes (Types 3 and 4) and the distribution and abundance of young ducks produced in the United States.

The annual breeding-ground censuses show that about three-fourths of all the ducklings produced in the United States come from the Prairie Pothole States of North Dakota, South Dakota, Minnesota, and Montana. The wetlands inventory shows that 76 percent of the Type 3 and Type 4 marshes in the northern States are in the four Prairie States where 75 percent of the young are produced. This relation demonstrates the real importance of these two types for breeding waterfowl. Indirectly, it also points to the need for preserving all water areas in the pothole region in order that Types 3 and 4 may realize their full potential.

The location of State, Federal, and private waterfowl-management areas can be studied in relation to the present distribution and value of wetlands to determine those regions where additional management areas should be developed. Work of this kind, of course, will have to be carried out by both State and Federal wildlife technicians whose responsibilities tie in directly with waterfowl management.

Flyway Councils, composed of representatives from each State in a flyway, are logical organizations to undertake habitat-adequacy investigations on a flyway basis. The wetlands inventory furnishes the framework for the undertaking. Some of the councils have already initiated preliminary studies along these lines. The Fish and Wildlife Service encourages and will lend its full support to such studies.

WETLAND PRESERVATION AND DEVELOPMENT

The Fish and Wildlife Service, in cooperation with State game and fish agencies, is now (1956) engaged in a wetland-preservation program. The wetland inventory serves as its basis, furnishing essential facts for planning intelligent action. Encouraging results are beginning to take shape, and it is expected that this program will eventually show lasting wildlife benefits. A few examples of activities along this line follow.

In the Northeastern States, all wetlands rated *high* or *moderate* in importance to waterfowl are being examined to determine their vulnerability to drainage, filling, or other land-use changes. Many of the lower-value wetlands also will be studied in this regard. In areas where the reduction of wildlife values is threatened by imminent land-use changes, further studies are being made to see if the losses can be prevented. Where threatened wetland is of outstanding importance to waterfowl, consideration is given to acquisition of the tract by the State or Federal Government for development and management as a permanent waterfowl-management area. If this is not feasible, efforts are made to preserve the area for its existing natural values as a part of sound community planning—recognizing water conservation, recreation, and wildlife as public assets. The growing awareness of these public values needs to be encouraged.

Field biologists of the Fish and Wildlife Service are stationed at strategic locations in North Dakota, South Dakota, and western Minnesota, where drainage of duck-producing marshes is a common agricultural practice. It is their job to try to preserve wetlands so they can be used by waterfowl, muskrats, pheasants, and other species. They are working with farmers, local planning and civic groups, and with State and Federal land-use agencies to find ways of preserving wetlands and developing an appreciation of wetland values.

In many cases, the biologists have found that farmers will retain their wetlands when they are shown that it can be profitable to do so. Fur farming, minnow raising, forage-crop production, and conservation of a water supply often are promising alternatives to drainage. Using surface water for irrigation is becoming more popular, and in some cases it can be done without materially reducing the value of the water areas for wildlife. Some farmers favor marsh development to attract more ducks, fur animals, and upland game, which enables them to rent attractive shooting and trapping sites.

The aim of the preservation program in the Dakotas and Minnesota is to create agricultural programs that will give more attention to waterfowl values in the future utilization of wetlands. This program is showing some encouraging results, but cash subsidies, extended credit, and engineering assistance for agricultural drainage are serious handicaps.

In the Southeast and Lower Mississippi Valley, the inventory is being used as an effective instrument for promoting an equal-partner relation with the U. S. Corps of Engineers in connection with future flood-control programs. This approach looks toward land-use planning that includes the retention and improvement of waterfowl habitat as one of the purposes of water-control planning. Programs in the Southwest and Far West are being developed with special attention to opportunities for wetlands development and management in connection with reclamation projects of the Bureau of Reclamation.

In the Northwest, biology-training schools for soil-conservation field workers are sponsored jointly by the Soil Conservation Service, the Fish and Wildlife Service, and State game and fish agencies. Schools such as these give agricultural fieldmen and administrators an opportunity to learn firsthand the various practices that are beneficial to wildlife in general and how these practices can be applied to lands and waters under their influence. The development and improvement of

wetlands for wildlife is given special attention. These schools appear to be meeting with immediate success.

ENCOURAGING LOCAL WETLAND PROJECTS

Community wetland projects throughout the nation can eventually pay big dividends in waterfowl management and in recreational development. Using the wetlands inventory as a guide, plans can be made for improving local marshes, ponds, and swamps which commonly are considered worthless.

To this end, the wetlands map of a county or watershed can be used to plan a waterfowl-management project in which local groups will take part. In addition to preservation of local habitat of high quality, the overall program can include such worthy projects as improvement of low-quality wetlands by impounding more water, by controlling weed plants, or by other means. Sportsmen's clubs, landowners, State and Federal wildlife biologists, agricultural and recreational planning groups, and possibly the Boy Scouts, 4–H clubs, and other youth groups, could be invited to participate in such projects, all contributing to the cause in proportion to their interest and resources.

In this connection, an encouraging forward step has been provided by an agreement developed subsequent to passage of the Watershed Protection and Flood Prevention Act of August 4, 1954 (Public Law 566, 83d Cong., 2d sess.). A Memorandum of Understanding between the Fish and Wildlife Service (Department of the Interior) and the Soil Conservation Service (Department of Agriculture) has been entered into for the purpose of encouraging the coordination and integration of fish and wildlife conservation with works of improvement carried out under this Act. In this cooperative program, it is agreed that the Fish and Wildlife Service and the State fish and game agencies may make such recommendations for fish and wildlife conservation as they deem practical during the planning stages of proposed projects. Approved measures for mitigating or preventing damages to fish and wildlife resources would become part of the watershed work plan. Inasmuch as drainage is one of the approved features of watershed management, the preservation of wetlands habitat will be a problem in some projects.

Since the adoption of acceptable measures for watershed work represents, and depends upon, the wishes of local people, wetland improvements for waterfowl will hinge largely on the information and attitudes of local interests. This fact points up the importance of education and teamwork on the part of State and Federal wildlife workers, sportsmen's clubs, and other organized groups interested in promoting wildlife conservation as a definite part of watershed-protection programs.

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PUBLIC WATERFOWL AREAS

The Fish and Wildlife Service and most State fish and game departments have wetland-improvement programs. Public waterfowl refuges or management areas have been established because good habitat is a fundamental requirement of waterfowl management. The availability and adequacy of wetlands, more than any other factors, govern the abundance and distribution of our waterfowl resource. This is becoming increasingly true as the destruction of waterfowl habitat continues throughout the country. Although there were a few public refuges before the drought years of the thirties, this abnormally dry period sounded the warning that a substantial amount of wetlands would have to be preserved and developed by public agencies to help alleviate the effects of future droughts on waterfowl populations.

ROLE OF REFUGES

The first objective of all waterfowl refuges is to protect and manage the resource so it can be continually used and enjoyed by all the people. The accomplishment of this goal requires the concerted effort not only of Federal and State agencies, but also of the private custodians of wetlands. As the Federal agency vested with the responsibility of managing waterfowl on a nationwide basis, the Fish and Wildlife Service believes the primary purpose of a Federal waterfowl refuge system is the preservation and improvement of waterfowl habitat in sufficient quantity and availability to perpetuate stable or increasing populations of waterfowl.

Although it is possible that several hundred major national waterfowl refuges could prevent the extinction of our waterfowl species, the maintenance of a harvestable annual crop can be assured only with the assistance of State refuges or management units and privately owned wetlands. The national refuge system is geared specifically to the protection of waterfowl habitat in strategic locations, whereas most State management areas are designed to supplement these refuges and provide for hunting opportunities on a sustained basis.

Waterfowl production attributable to wetlands lying within the United States is estimated at about 20 percent of the annual continental production. The maintenance of the 80 percent in Canada and Alaska is therefore an even greater problem, but the preservation of wetlands habitat needed for waterfowl reproduction, regardless of its location, is of utmost importance if waterfowl and waterfowling are to be perpetuated.

The value of public refuges within the breeding range of waterfowl in the United States increases appreciably with the advent of droughts. During these emergency periods, most of the smaller wetlands, normally preferred by nesting waterfowl, are devoid of water and are rendered useless to waterfowl. Then, public refuges in the breeding sections of the country provide a good share of the remaining acceptable nesting habitat because these areas are designed and managed to maintain adequate water.

The majority of the waterfowl produced in the arid regions of the country are from publicly managed areas. Refuges often prevent loss of production from surrounding wetlands by providing extensive marsh areas where adult birds can spend the flightless period safely and where young of the year can retreat when smaller nearby wetlands go dry late in the summer.

More than half of the national waterfowl refuges include wetlands used as nesting habitat, and most State waterfowl areas in the northern tier of States are valuable production areas. Production from public refuges will increase significantly as new refuges are established and as additional private wetlands are lost. However, it should be understood that privately owned marshes still produce the vast majority of the ducks raised in this coun-

try. Even with a vastly expanded refuge system, both State and Federal, breeding areas remaining under private ownership must continue to produce about the same number of ducks as at present if waterfowl populations are to remain near the present level.

Intermediate and wintering refuges are becoming more essential each year, especially in States where natural or man-made forces have seriously reduced the quality and quantity of good waterfowl wetlands. An increase in such refuge areas with attractive and adequate food supplies will help to distribute the birds equitably and to prevent crop depredations.

REFUGES UNDER PUBLIC CONTROL

There are now 205 national refuges established primarily for waterfowl; they cover about 3½ million acres. Wetlands comprise 1,350,000 acres, and 540,000 acres are of permanent water. Thus, nearly three-fifths of the total area of Federal waterfowl refuges is aquatic waterfowl habitat. The remaining acreage, consisting of uplands essential for protection and effective management of aquatic habitats, is utilized for growing supplemental food and meeting other needs.

Fifty-one Federal refuges are established primarily for purposes other than waterfowl management. These contain 350,000 acres of wetlands and 245,000 acres of permanent water. In total, there are preserved on national wildlife refuges 1,700,000 acres of wetlands and 790,000 acres of permanent water.

In addition, at least 1,500,000 acres in waterfowl areas are now administered by the States.

REFUGES AND HUNTING

The role of public refuges in the distribution and utilization of waterfowl during the hunting season is becoming increasingly important because these areas attract waterfowl and materially influence the distribution of the birds. The present trend seems to be toward narrower flight paths. This condition is not only detrimental to the birds—creating depredation and disease problems—but it restricts the areas where waterfowl hunting can be profitably undertaken. Future refuges and wetland-development projects, then, should be selected with a view to dispersing the birds more widely.

The need for sanctuary units on management areas open to hunting has been abundantly demonstrated. Sanctuaries that provide adequate food and cover will hold waterfowl in the general region for a longer period and will improve waterfowl-hunting opportunities on surrounding lands. Most of the management areas where hunting is permitted have sanctuary areas, and many privately managed hunting marshes have a place where waterfowl can retreat unmolested. Sanctuary areas are extremely important where the hunting pressure is excessive in relation to the availability of waterfowl habitat.

The task of providing an increasing number of gunners with an opportunity to harvest waterfowl is growing more difficult each year. Not long ago, sufficient hunting sites were available to accommodate the hunting pressure. In many sections of the country this is not so today. Some waterfowl habitats have been changed to dry-land uses, and others are closed to public access. If the sport of waterfowl hunting is to be extended in response to public demand, public agencies apparently will have to acquire and manage additional public hunting grounds.

The States have logically taken the lead in acquiring public hunting areas, and in the future this phase of their management program will receive increased attention.

The success of the present combined Federal-State projects points the way to future development of wetlands, especially where large areas are involved. On such joint endeavors, the Fish and Wildlife Service manages the sanctuary area and the State administers the public hunting area.

Although national waterfowl refuges have been established primarily to protect a basic breeding population, portions of more than 30 refuges were open to public hunting in 1955. Where the harvest of surplus birds is warranted, the Fish and Wildlife Service permits public waterfowl hunting on as many refuges as possible, consistent with applicable laws.

REFUGE MANAGEMENT

Basically, there are three components of waterfowl habitats—water, food, and cover. Public refuges are developed and managed to produce the maximum of these three essentials from each acre. Land-use practices on refuges vary with their primary function. Refuges where waterfowl nesting is the primary function strive for maximum interspersion of nesting habitat requirements. On intermediate and wintering refuges, development

for food production and cover receives primary attention.

There are no set rules for increasing the attractiveness of waterfowl habitats. Ecological conditions and the seasonal availability of water will govern the methods used. Because the quality of any waterfowl habitat is chiefly dependent upon the quality of the vegetation, both aquatic and upland, refuge management is largely plant management. Waterfowl utilization of a refuge—the only true measure of its value—is directly related to the abundance and availability of desirable food and cover plants.

By proper manipulation of water levels, plant successions may be controlled to obtain the maximum yields of desirable plants. Other marsh-management techniques used to control weed plants and to improve the value of desirable plants are controlled burning, use of herbicides, and removal of undesirable plants by mechanical means. The muskrat, properly managed, helps to create open-water areas in dense cattail marshes.

Land practices on upland areas of refuges are also geared to increase the carrying capacity for waterfowl. In some cases, controlled cattle grazing is helpful in maintaining suitable cover on nesting and territorial areas, particularly along shorelines. This is favorable to producing the desired "edge effect" without seriously impairing brood cover and food supplies. On migration and wintering refuges, moderate grazing that makes fresh, green shoots available to waterfowl (especially geese) is often beneficial. Removal of rank vegetation by controlled burning is also employed to improve nesting habitats and feeding areas.

To the chagrin of farmers, some species of waterfowl now seem to prefer cultivated crops to native foods. The mallard and pintail, especially, prefer cereal crops, and geese have taken a liking for green-row and forage crops. To prevent local depredation on adjacent farms and, in some cases, to supplement a shortage of natural foods, arable lands on many public refuges are devoted to crop production. Nearly 90,000 acres of land on national refugees today are farmed.

FUTURE OF REFUGE PROGRAMS

In the face of the ever-expanding conversion of wetlands to agricultural, industrial, and urban uses, the importance of preserving the remaining high-quality wetlands for waterfowl use is clear. The loss of each valuable wetland area, large or small, means one less unit where waterfowl can breed, rest, or winter; it may also mean one less hunting site.

It is estimated that, if our waterfowl population is to be maintained somewhere near the present level of abundance, at least 12.5 million acres of *intensively managed* habitat under State and Federal ownership will be required to provide sufficient habitat for the birds that now migrate and winter within the United States. This habitat will also produce hundreds of thousands of young birds each year, but most production must continue to come from north of the Canadian border.

The acreage of land and water in Federal waterfowl refuges must be more than doubled if the Fish and Wildlife Service is to meet its responsibility for the protection of waterfowl populations. With 3,270,000 acres now in Federal refuges, about 4 million additional acres are needed to reach the Service's share of the 12.5 million acre objective. It is the desire of the Service to have an important waterfowl refuge every 200 miles along the north-south axis of each of the four flyways.

There are approximately 100 areas in this country where a Federal refuge should be located. These include problem areas where essential waterfowl habitats must be protected or provided, where crop depredation problems are acute, or where disease abatement is necessary. Many of the new Federal refuges will be superimposed on other Federal water-use projects to develop optimum conditions for waterfowl.

The States, with approximately 1,500,000 acres of waterfowl refuges at present, will need to preserve and manage an additional 3,500,000 acres in order to reach their share of the minimum goal of 12.5 million acres of waterfowl habitat in public ownership.

It should be clearly understood that while the postulated 12.5 million acres of publicly managed habitat will preserve waterfowl populations for future generations, the future of waterfowl hunting as an important American sport is dependent largely on what happens to privately owned wetlands, particularly the duck-nesting marshes in the North Central States and in Canada and Alaska.

IMPROVING WETLANDS FOR WATERFOWL

Waterfowl habitat can be developed on sites where none existed before, and wetlands presently of low waterfowl value can oftentimes be improved for ducks and geese by relatively simple, inexpensive measures.

Wetland Types 1, 2, 6, 7, and 8 of the inland fresh series, Type 9 of the inland saline group, and Types 15, 16, and 17 of the coastal saline wetlands are the particularly water-deficient types. Collectively, these nine types comprise nearly 45 million of the 52 million acres (86 percent) classified as of low or negligible value to waterfowl. Wetland-improvement measures applied on an extensive scale to these types could pay big dividends in increased waterfowl use.

In relation to wetland types generally, Martin and associates state:

> Improvement possibilities have been demonstrated repeatedly in meadows, marshes, and ponds. Many of these wet areas have been made more attractive to waterfowl by means of low-cost construction enabling effective manipulation of water supplies. Swamps and bogs, on the other hand, generally have limited prospect for improvement, mainly because of difficulties in managing their water supplies satisfactorily and because of costs involved if woody growths are removed. The degree to which any particular wetland area can be made more productive for wildlife depends largely on local factors (water supply, terrain, soil, flora, fauna, etc.) which can be appraised best locally. [*9*]

Basically, there are two methods of creating or improving waterfowl habitat. The first method involves impoundment of surface water. Holding a fairly constant year-round water level helps establish submerged and emergent aquatic plants useful as duck food (fig. 4). If outlet controls are feasible and if the water supply is dependable, water can be drawn off during the growing season to favor the growth of heavy seed-producing plants, such as smartweed and millet. Reflooding in the fall makes the new food available to waterfowl.

The second type of wetland development is used where it is impossible or impractical to impound water. By means of so-called level ditches, for example, open-water areas are created in sites where the water table is at, or just below, the ground surface. Level ditches (fig. 5) and potholes (fig. 6) are made by dragline or by blasting. Openings thus created often can be successfully planted with desirable waterfowl foods, but usually planting is not required. These two methods of improving wetlands for waterfowl can be applied in both coastal and inland situations.

Temporary inundation of bottom-land timber, especially in the Alluvial Valley section of the Mississippi River, provides a most attractive winter habitat for ducks. Hardwood bottom lands can be artificially flooded by constructing low earth levees to impound large areas of shallow water. Water from streams can be diverted to the areas by temporary dam structures, by diversion ditches, or by pumping. Drains are installed in low places in the levees to allow complete drainage.

Bottom-land flooding has no adverse effects on timber if the water is drained away during the growing season. In fact, in many cases seasonal flooding may be beneficial to hardwood-timber growth and mast production. Such controlled flooding creates ideal waterfowl areas because water can be managed independently of natural flooding, which may not occur at the best time for waterfowl use.

Special mention should be made of the convenient opportunities for creating good-quality wetlands in connection with new highway construction. Waterlogged lowlands are often preferred places for constructing highways because the land is cheaper and modern road-building equipment is capable of constructing roads under wet-soil conditions. Instead of using open culverts in low places and at stream courses to drain areas that otherwise would be wet, water-control struc-

Figure 4.—Above: A typical bog (Type 8) in New Hampshire with a stream furnishing the only dependable surface water. Below: A dam has impounded shallow water over most of the former bog and made it into a good waterfowl pond (Type 5).

New Hampshire Fish and Game Department photos

Wisconsin Conservation Department photo

Figure 5.—Horicon Marsh in Dodge County, Wis., where level ditches at 100-foot spacings have increased muskrat production to about 18 per acre of marsh. Waterfowl use has also increased. Banks created by ditching make good waterfowl nesting sites.

tures can be installed to hold water on one side of the roadway. The wildlife areas thus created add interest and beauty to the highway.

The so-called 1,000-Acre Marsh near Delaware City, Del., is a classic example of what can be done when highway and wildlife interests work together. Here, a State road provided a dike into which a water-control structure was built. Cooperation of the highway department with local landowners made it possible to control water levels and maintain a valuable marsh that is now highly attractive to waterfowl and muskrats. Similar cooperation resulted in a highway pond above Portsmouth, N. H., where a new turnpike was used to cut off and impound a former salt marsh (fig. 7). The control gate in this case includes a small fishway.

Farm and stock ponds, small floodwater-detention reservoirs, cranberry ponds, and water stored for irrigation and domestic use often may double as wildlife habitats with little or no additional expense. Stock-water ponds in the western parts of the Dakotas and in the eastern part of Montana, for example, afford excellent nesting

Figure 6.—Pothole blasted by Wisconsin Conservation Department in Rat River Marsh, Winnebago County, Wis. Man-made water areas like this improve water-deficient marshes for both waterfowl and muskrats.

Wisconsin Conservation Department photo

New Hampshire Fish and Game Department photo

Figure 7.—Highway pond above Portsmouth, N. H., where new turnpike was used as a dam to impound a former salt marsh. Outlet structure, which includes a fishway, is shown at extreme lower right. The development resulted in substantial benefits to fish and wildlife.

Figure 8.—Fenced stock-water pond in eastern Montana. This is a new fence, and therefore there is little difference in vegetation inside and outside the fenced area. Stock cannot enter the enclosure, and rapid plant growth will occur. Planting to provide food and cover for waterfowl is the next step in development. Throughout eastern Montana, the State is improving these ponds, which were designed by the U. S. Soil Conservation Service.

Montana Fish and Game Commission photo

Figure 9.—Waterfowl-habitat improvement under New York's extensive program of marsh development. This marsh in Cattaraugus County was completed in August 1949. Top: Marsh before development, looking toward area to be flowed. Middle: Completed dam and spillway. Bottom: Flowed area as seen from spillway. Three weeks after flooding, 57 waterfowl were observed on this 9-acre marsh. Through 1955, more than 600 such areas have been created in New York State. They average 4 to 5 acres and support about 2 pair of breeding ducks per marsh.

New York Conservation Department photos

Indiana Division of Fish and Game photo

Figure 10.—Willow Slough State Game Preserve in Newton County, Ind., created in 1952 by a 1,200-foot dam that impounds 1,500 acres of shallow water over land formerly drained for agriculture. Peak populations of more than ¼ million ducks and 2,500 geese have been observed. One half of the area is left open for public waterfowl hunting. The lake also furnishes excellent opportunities for public fishing and trapping.

sites for ducks and receive a high degree of use. Partial fencing of ponds to protect the margins and to provide more favorable nesting cover enhances their value as duck producers (fig. 8).

The New York State Conservation Department has teamed up with farmers and Soil Conservation Districts in an extensive program of marsh developments aimed primarily at benefiting waterfowl and muskrats (fig. 9), although the accompanying water-conservation benefits and recreational opportunities contribute greatly to its popularity.

Another example of how wet areas may harmoniously serve two or more purposes is in rice production. In the major rice-producing States of California, Texas, Louisiana, and Arkansas, flooding of rice fields during late fall and winter results in attractive feeding grounds for ducks and geese. It also affords good waterfowl shooting. Such management for waterfowl usually can be accomplished without upsetting good rice-farming practices.

The public wildlife agencies, both State and Federal, are acquiring and improving wetlands about as fast as funds and manpower will permit (fig. 10). However, in the face of constant pressure for the reclamation of wetlands, private citizens all over the country must also lend a hand to help keep waterfowl numbers from declining. Although many examples of wetland-improvement projects by private groups could be cited, many more projects are needed in all parts of the country. This deserves the serious consideration of all enterprising sportsmen's groups and others who are in a position to do something really helpful for the sport of wildfowling.

There are several useful State publications on waterfowl and wetland management. Private individuals or clubs interested in initiating wetland-improvement projects should consult their State fish and game agency for recent information, as well as for engineering and other technical guidance. Engineering assistance from district offices of the U. S. Soil Conservation Service may

be available if the wetlands are developed in conjunction with farm plans.

The following publications will also be helpful:

Waterfowl Management on Small Areas, by C. E. Addy and L. G. MacNamara. Wildlife Management Institute, Washington, 1948.

Food of Game Ducks in the United States and Canada, by A. C. Martin and F. M. Uhler. U. S. Fish and and Wildlife Service, Research Report 30, 1951.

Duck Developments, by W. H. Turcotte. Mississippi Game and Fish Magazine, November 1954.

Ducks on Your Pond, by A. C. Martin. Sportsman's Club Bulletin No. 1, Sports Afield (Minneapolis, Minn.), 1946.

Improving Duck Marshes by Weed Control, by A. C. Martin. U. S. Fish and Wildlife Service, Circular 19, 1953.

Waterfowl Habitat Management in the Tennessee Valley, by John H. Steenis. U. S. Fish and Wildlife Service, Special Scientific Report—Wildlife No. 7, 1950.

Making Land Produce Useful Wildlife, by Wallace L. Anderson. U. S. Department of Agriculture, Soil Conservation Service, Farmer's Bulletin 2035, 1951.

"Management of Waterfowl", by R. E. Trippensee. In *Wildlife Management*, vol. II, chap. 16. McGraw-Hill, 1953.

CONTRIBUTIONS TO OTHER WILDLIFE

Primary emphasis in appraising values of wetland types has been on waterfowl because of the great interest in the sport of wildfowling and because waterfowl populations are no doubt more affected by wetland losses than are populations of any other group of game species. However, many wetlands in all sections of the country should be preserved solely on the basis of their value as habitat for wildlife other than waterfowl.

Sportsmen in pursuit of resident game and of migratory game birds not usually classed as waterfowl spend many more man-days afield than do the members of the waterfowling fraternity. Obviously, then, habitat for all forms of wildlife needs to be provided. Wetlands provide this habitat for scores of wildlife species.

The value of marshes and swamps for fur animals like muskrats, minks, and raccoons is well known because of the cash value of wild furs, which amounts to about $50,000,000 a year, even at today's low fur prices [*18*]. The use of wetlands by other game animals, however, is often not so obvious. Many a hunter has stalked a white-tailed deer for hours, only to have it seek the thick cover of an impenetrable wooded swamp. Woodcock hunters head for the alder swamps for their shooting. Pheasant hunters find good gunning along the wild, grassy cover of local marshes where fall and winter cover is available to the birds (fig. 11). Example after example of this kind could be cited.

Thirty-eight of the game and fur animals that inhabit wetlands are listed in table 7. The table also indicates the available wetland types preferred by each species. Table 8 presents the number of different species using each type in the 48 States. These tables obviously cannot give details about any one species or any one State. They are presented only to point out that wetlands receive a tremendous amount of use by game species other than waterfowl. Some game animals with limited geographic distribution, such as Franklin's grouse and the scaled quail, were omitted from the lists. At least 50 fur or game species in the United States, exclusive of waterfowl, inhabit wetlands to secure food, water, or cover.

In addition, literally hundreds of species of nongame mammals, birds, amphibians, and reptiles find essential or useful habitat in wetlands. Fish and shellfish are known to use coastal and inland marshes and associated shallow-water areas to a very significant extent. However, no specific information on use by nongame species or by fish was gathered as a part of the inventory.

Wetland reports for the individual States present detailed information on the wetland types used appreciably by each species, the degree of use (high, moderate, low, or negligible), season of use (spring, fall, year-round), and type of use (food, cover, nesting). These reports have been made available to Federal, State, and private organizations having an interest in wildlife and land use.

The beaver deserves special mention because of his beneficial influence on waterfowl, other wildlife, and water conservation. Beaver flows oftentimes impound water-deficient wetlands such as meadows (Type 2), shrub swamps (Type 6), and wooded swamps (Type 7) into wetlands with shallow surface water (Types 3 and 4), thus converting them into areas of more value to waterfowl (fig. 12). Waterfowl biologists in the timbered States are high in their praise of this important fur animal as a developer of better waterfowl habitat. Black ducks and wood ducks in the Northeastern and Lakes States are especially benefited.

Habitat used by all forms of wildlife should be preserved and improved whenever possible. Each time a drainage project, or any other wetland-reclamation project, is prevented or modified to protect wildlife values, benefits will accrue to both resident and migratory game.

Iowa Conservation Department photo

Figure 11.—Pheasant hunters in Emmett County, Iowa, take to the marshes where birds use marsh vegetation for protection.

Figure 12.—Beaver pond in Michigan, which is creating good waterfowl habitat. If flooded long enough, trees will die and herbaceous waterfowl food and cover plants will become established. Note beaver lodge in center.

Michigan Conservation Department photo

Table 7.—Use of wetland types by game and fur animals

Species	Number of States reporting use in wetland type—																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
SMALL GAME:																				
Gallinules	1	2	6	6	6	1	2				1	7	7	6	1	1	1	1		
Grouse, Pinnated	2	4	4	4	2	3	2	3	1	1	1									
Grouse, Ruffed	2	3	2	1	1	14	15	7												
Grouse, Sage	4	3	3	3	3	2	1	1	4	4	3	1	1			1		1	1	
Grouse, Sharp-tailed	6	7	7	5	3	3	3	3	2	2	1									
Hungarian partridge	4	2	2	1	1				1	1										
Mourning dove	20	9	5	3	3	12	14	8	1	2	1	1	1		2					
Pheasant	24	29	27	24	10	18	15	5	8	9	5	7	2			2		1		
Quail, Bobwhite	22	14	11	4	1	16	16	8				4				1				
Quail, Gambel's	3	3	1	1	1				1	1	1									
Quail, Valley	2	3	3	1	1	1	1	1	2	2	2									
Rails	8	12	14	14	3	4	6	4			2	12	11	4	5	9	8	10		1
Rabbit, Cottontail	26	21	17	7	4	24	28	11	3	2	1	9	2							
Rabbit, Swamp	10	4	3	3		5	9	4				4	3		1	4	3	3		
Snowshoe hare	1	7	2	2	3	11	10	9												
Snipe	14	17	14	8	5	14	14	8				10	5		3	4	3	4	3	
Squirrels (Gray and Fox)	16	3	1	1	1	17	21	6												
Wild turkey	10	2				8	12	5												
Woodcock	16	14	5	2	1	24	27	8				5	1							
BIG GAME:																				
Antelope	4	3	4	3	2	1	1	2	6	6	3									
Black bear	5	3	4	1	3	6	15	12												
Black-tailed deer	2	3	3	3	2	3	3	3	1	1	1	1	1		1	2		2	2	
Elk	2	3	1	1		2	2	2												
Moose		3	1	1	2	3	3	3												
Mule deer	7	8	7	7	3	4	3	2	5	5	4									
White-tailed deer	22	22	23	13	8	27	33	15				6	5		1	1	1	2		
FUR ANIMALS:																				
Beaver	22	20	19	24	30	25	28	12	4	6	6	4	4	1		1		2	1	
Bobcat	8	1				5	7	5				1	1							
Fox (Red and Gray)	16	17	15	4	1	16	22	11				10	5		1	8	2	7	1	
Mink	27	31	36	36	37	30	32	20	5	9	7	16	13	9		4	4	7	3	
Muskrat	18	22	32	36	42	27	27	10	7	11	8	16	16	11	1	10	5	11	3	
Nutria												1	1	1			1			
Opossum	15	8	6	2	2	11	12	6	1			4					1			
Otter	9	6	13	12	16	10	13	7				13	12	10		5		5	1	
Raccoon	23	26	27	20	25	26	32	16	3	5	2	17	12	11	2	11	6	10	5	
Skunk	14	12	8	6	3	12	14	10	1	1		4	4	1	1	1	1	1	1	
Weasel	5	7	5	5	1	6	7	5				2	2							
ALLIGATOR	2		2	2	3	1	4	1				3	3	1		1	1			

Table 8.—Number of game and fur species using wetlands

[Based on the 38 species listed in table 7]

State	State total	Number of species using wetland type—																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Alabama	16	13				2	3	10	1				5	2				6			
Arizona	9	8	8	3	3	2					4										
Arkansas	20	20				8		20													
California	11	11	11	11	10	5	10	10	4	6	6	5	4	4	4				1	1	
Colorado	10	8		6	6	3	10			2	3										
Connecticut	13	7	10	9	5	4	9	9					8	6	5		5		4		
Delaware	12							6					9	4	3		4		4		
Florida	20	16	6	8	4	3	11	13	11			2	7	6	1	1		4	4		1
Georgia	21	17	5	11	6	5	16	21	15				12	3	3	2	4	5	5		
Idaho	7	5	5	6	6	6	6	6	5	6	6	6									
Illinois	14	14	14	12	6	5	14	10													
Indiana	15	15	13	11	8	7	14	13													
Iowa	9	2	5	6	7	7		9													
Kansas	7	7	7	5	3	2				3	3										
Kentucky	7	6	1	2	2	2	7	7													
Louisiana	23	20					22	22	20				19	19	4	4	6	5	3		
Maine	11	8	9	6	5	6	10	10	8				5	4	4		3		3	3	
Maryland	7					2	7	7					4	2	2		2	2	2	2	
Massachusetts	15	12	13	11	9	5	14	14	3				10	9	4		3		3		
Michigan	23	23	23	23	23	23	23	23	23												
Minnesota	17	4	8	7	8	9	13	15	9												
Mississippi	21	19	13	9	6	6	19	20	11				11	7	5	4	6	6	5	1	
Missouri	14	14	14	12	6	5	14	10													
Montana	7	2	5	7	5	2															
Nebraska	9		6	8	7	7				5	8	8									
Nevada	9	9	9	9	9	9				9	9	9									
New Hampshire	18		11	11	13	4	16	17	11				9	6	4		8		6	5	
New Jersey	12		10	9	6	5	9	9	3				9	7	4		7		7	5	
New Mexico	10	10	8	2	1	2					1										
New York	19		12	12	8	4	16	17	11				8	6	5		7		6	1	
North Carolina	12	7				1		9	3				5	2	1			4	2		
North Dakota	8	3	3	6	8	8															
Ohio	19	18	16	17	14	8	14	11	8												
Oklahoma	13	12	11	7	3	4				3	1										
Oregon	7	6	6	6	6	6	6	6	7	7	7	6	6	6			6		6	6	
Pennsylvania	15		12	7	5	5	15	15	7				6								
Rhode Island	14		13	10	8	4	13	13					8	6	4						
South Carolina	18	15	8	7	4	3	14	16	16				7	4	3	1	2	3	3		
South Dakota	12	9	9	10	6	2															
Tennessee	21	20		11	6	6		19													
Texas	7	4	1			2		1					4	4							
Utah	6	6	6	4	4	3				4	4	3									
Vermont	17		10	10	7	4	15	16	11												
Virginia	21	20	7			5	15	16	20				12	10	4	5	5	3	3		
Washington	10		4	8	6	5	7	6	6	5	8	7				2	2		5	3	
West Virginia	10		6				9	9	4												
Wisconsin	12	5	6	6	8	8	12	11	7												
Wyoming	16	7	8	8	8	5	9	10	9	6	10	3									

SUMMARY OF CHAPTERS

The problem of saving wetlands is to prevent marshes, swamps, open shallow waters, and seasonally flooded lands from being drained, flooded, or filled, hence losing their value as wildlife habitat. These types of aquatic environments, collectively identified in this report as *wetlands*, furnish essential habitat for all waterfowl, most species of fur animals, and many species of farm game, forest game, and warm-water fish. Coordinated advance planning by all resource interests is the keynote to solving the problem. As an aid in such planning, the Fish and Wildlife Service, with the cooperation of State game agencies, conducted a wetlands inventory with emphasis on present usefulness of the lands as waterfowl habitat.

A century of wetland exploitation has taught many lessons in the use and misuse of wetlands. The Swamp Land Acts of 1849, 1850, and 1860 paved the way for transferring nearly 65 million acres of wetlands in 15 States from Federal to State administration for the purpose of expediting their drainage. Nearly all these lands are now in private ownership, and their use by wildlife is usually only a minor consideration. Although evidences of wetland losses as revealed by previous inventories are not completely reliable because they represent different types of coverage, it appears that at least 45 million of the original 127 million acres of natural wetlands have been drained or otherwise destroyed. Agricultural drainage (102 million acres now in organized enterprises) and flood control are the forces primarily responsible, but other activities such as canal construction, drainage for mosquito control, industrial expansion, and highway building have greatly reduced the wildlife values of some wetlands, particularly along the coasts.

Wetland soils have physical and chemical properties that are derived from the environment in which the soils originate. Climate, landform, and native vegetation largely govern the nature of this environment, hence also the nature of the soils and their potential uses. Most wetlands are underlain by organic soils known as peat and muck, or by recently deposited, water-carried alluvial soils. In general, alluvial soils have higher agricultural potentials than peat and muck. Many peat and muck soils have proved unproductive for agriculture after drainage; others are inherently fertile. In many areas, there appears to be a direct relation between potentially good agricultural wetlands and presently good waterfowl wetlands, suggesting that competition between agricultural and wildlife interests will become more intense in the years ahead.

The wetlands inventory reveals the location, classification, and evaluation of 74,439,300 acres of wetlands as waterfowl habitat. At least 90 percent of all wetlands of importance to waterfowl are included. From the standpoint of waterfowl value, the total acreage covered by the inventory is distributed as follows (in millions of acres): 8.9, high; 13.6, moderate; 24.0, low; and 27.9, negligible. Values are based on relative waterfowl use in the State where the wetlands are located. By wetland categories, the eight inland fresh types comprise 63,491,000 acres, the three inland saline types comprise 1,618,000 acres, the three coastal fresh types comprise 4,041,000 acres, and the six coastal saline types comprise 5,290,000 acres.

The 20 wetland types are ecological classifications designed to help recognize the relative importance to waterfowl of the many different kinds

of wetlands found in the United States. Type designations are also helpful in determining values for other forms of wildlife. As waterfowl habitat, the 11 types comprising the various kinds of marshes and open waters with emergent nonwoody vegetation are far more valuable to waterfowl than the 5 types that are only waterlogged or seasonally flooded, or the 4 types characterized by tree and shrub growths. However, no wetland type is altogether useless to waterfowl. Although most of the acreage of certain types, such as bogs, wooded swamps, and salt flats, are presently used very little by waterfowl in most localities, the small acreages that are now receiving waterfowl use may be all-important locally, and the little-used areas may have good possibilities for improvement. Such improvement may be the only way of holding waterfowl in a region where good habitat is scarce.

Use of the inventory in waterfowl management ranges all the way from formulating overall habitat-management plans by flyways to selecting individual wetlands for improvement as part of a watershed plan, or as a private duck marsh. As originally envisioned, the inventory was to act as a blueprint to show State and Federal land-use agencies the location and relative importance of wetlands that should be preserved or improved for waterfowl as soil and water conservation programs are carried forward. If effectively used for this purpose, the inventory will have far-reaching effects on keeping waterfowl populations at a harvestable level.

Public waterfowl areas, both State and Federal, offer permanent habitat for ducks and geese—habitat free from land-use changes and usually free from the damaging effects of severe droughts. A well-integrated system of public refuges and shooting areas throughout the country is essential if waterfowl are to be properly protected, distributed, and harvested. Public areas are needed for protection in the breeding and wintering regions and for a combination of protection and distribution of hunting opportunities in areas used during the migration period. The Fish and Wildlife Service estimates that public wildlife agencies should eventually administer 12.5 million acres of habitat, of which 7.5 million acres would be federally owned and 5 million acres State owned. That objective is now about 40 percent realized. The future of waterfowl hunting as a major American sport, however, depends on continuing the productivity of privately owned wetlands, particularly the breeding areas in the North Central States, in Canada, and in Alaska.

Improving wetlands for waterfowl on both private and public lands must receive greater attention in future years. Millions of acres of low-value wetlands can be made more attractive to ducks and geese by relatively simple and often inexpensive water-control measures. Despite concerted efforts to preserve wetlands on private property, economic pressures in some regions will eventually result in the conversion of more good duck habitat to croplands or to industrial and housing-development sites. In such regions, those wetlands not in high demand for other uses will have to be developed to their full waterfowl potential in order to maintain the present distribution and abundance of ducks and geese.

Contributions to other wildlife are far more extensive than most people realize. The use of marshes and swamps by such species as the muskrat, beaver, mink, and raccoon is common knowledge, but it is less well known that many species of small game and big game utilize wetlands to satisfy seasonal requirements. Altogether, at least 50 fur and game species in the United States, exclusive of waterfowl, inhabit wetlands to secure food, water, or protective cover. Wooded swamps (Type 7), although generally low in waterfowl value, are used by more resident-game species than any other type of wetland. In fact, the 5 types most used by other wildlife (Types 7, 6, 1, 8, and 2, in that order) are fairly low in waterfowl value, since none of these 5 types is among the 10 types used most by waterfowl. When determining the feasibility of a wetland reclamation project, values of resident game and fur animals deserve at least equal ranking with waterfowl values.

GLOSSARY OF PLANT NAMES

These are the common and scientific names of plants mentioned in this report.

Alders, *Alnus*
  Red alder, *A. rubra*
Alkali bulrush, *Scirpus paludosus*
Alligatorweed, *Alternanthera philoxeroides*
Arborvitae, *Thuja occidentalis*
Arrowheads, *Sagittaria*
Arrowgrass, *Triglochin maritima*
Arrow-arum, *Peltandra virginica*
Ash, Black, *Fraxinus nigra*

Balsam, *Abies balsamea*
Basket willows, *Salix viminalis* and others
Beakrushes, *Rhynchospora*
Black ash, *Fraxinus nigra*
Black mangrove, *Avicennia nitida*
Black spruce, *Picea mariana*
Blackrush, *Juncus gerardi*
Blueberries, *Vaccinium*
Bulrushes, *Scirpus*
  Alkali bulrush, *S. paludosus*
  Hardstem b., *S. acutus*
  Nevada b., *S. nevadensis*
Burreed, Giant, *Sparganium eurycarpum*
Burro-weed, *Allenrolfea occidentalis*
Buttonbush, *Cephalanthus occidentalis*

Canary-grass, Reed, *Phalaris arundinacea*
Cane, *Arundinaria*
Carex, *Carex*
Cattails, *Typha*
Chainfern, Virginia, *Woodwardia virginica*
Chufa, *Cyperus esculentus*
Cockleburs, *Xanthium*
Coontail, *Ceratophyllum demersum*
Cordgrasses, *Spartina*
  Baker cordgrass, *S. bakeri*
  Big c., *S. cynosuroides*
  Prairie c., *S. pectinata*
  Saltmarsh c., *S. alterniflora*
  Saltmeadow c., *S. patens*
Cottongrass, *Eriophorum*
Cranberries, *Vaccinium* (*Oxycoccos*)
Cutgrass, Rice, *Leersia oryzoides*
Cutgrass, Giant, *Zizaniopsis miliacea*
Cyperus, Redroot, *Cyperus erythrorhizos*
Cypress, *Taxodium*
Cyrilla, *Cyrilla racemiflora*

Dogwoods, *Cornus*
Duckpotatoes, *Sagittaria* (tuberous species)
Duckweeds, *Lemna*, *Spirodela*

Eelgrass, *Zostera marina*
Elm, *Ulmus americana*

Fall panicum, *Panicum dichotomiflorum*
Fleabanes, Saltmarsh, *Pluchea*

Gallberry, *Ilex glabra*
Giant burreed, *Sparganium eurycarpum*
Giant cutgrass, *Zizaniopsis miliacea*
Glassworts, *Salicornia*
Gordonia, *Gordonia lasianthus*
Grass, Saltflat, *Monanthochloe littoralis*
Grasses, Gramineae
Groundselbush, *Baccharis halimifolia*
Gums, *Nyssa*
  Swamp black gum, *N. biflora*
  Tupelo g., *N. aquatica*

Hairgrass, *Deschampsia*
Hardstem bulrush, *Scirpus acutus*
Heath shrubs, Ericaceae
Hemlock, Western, *Tsuga heterophylla*
Hickory, *Carya*

Jaumea, *Jaumea*

Labrador-tea, *Ledum groenlandicum*
Leather-leaf, *Chamaedaphne calyculata*

Maidencane, *Panicum hemitomon*
Manateegrass, *Cymodocea manatorum*
Mangrove, Black, *Avicennia nitida*
Mangrove, Red, *Rhizophora mangle*
Mannagrasses, *Glyceria*
Maple, Red, *Acer rubrum*
Marsh elder, *Iva frutescens*
Millet, Wild, *Echinochloa crusgalli*
Mints, Labiatae
Muskgrasses, *Chara*

Naiads, *Najas*
Needlerush, *Juncus roemerianus*

Oak, Overcup, *Quercus lyrata*
Oak, Water, *Quercus nigra*
Olney threesquare, *Scirpus olneyi*
Overcup oak, *Quercus lyrata*

Panicum, Fall, *Panicum dichotomiflorum*
Paspalums, *Paspalum*
Persea, *Persea*
Pickerelweed, *Pontederia*
Pine, Pond, *Pinus serotina*
Pitcher-plants, *Sarracenia*
Pond pine, *Pinus serotina*
Pondweeds, *Potamogeton*
  Sago pondweed, *P. pectinatus*
Prairie cordgrass, *Spartina pectinata*

Ragweed, *Ambrosia*
Red mangrove, *Rhizophora mangle*
Red maple, *Acer rubrum*
Redroot cyperus, *Cyperus erythrorhizos*
Redtop, *Agrostis alba*
Reed, *Phragmites communis*
Reed canary-grass, *Phalaris arundinacea*
Rice, *Oryza sativa*
Rice cutgrass, *Leersia oryzoides*
Rushes, Juncaceae

Sago pondweed, *Potamogeton pectinatus*
Saltbush, *Atriplex*
Saltflat grass, *Monanthochloe littoralis*
Saltgrass, *Distichlis*
Saltmarsh cordgrass, *Spartina alterniflora*
Saltmarsh fleabanes, *Pluchea*
Saltmeadow cordgrass, *Spartina patens*
Saltwort, *Batis maritima*
Sawgrass, *Cladium jamaicense*
Seablite, *Suaeda*
Sedges, Cyperaceae
Shoalgrass, *Halodule wrightii*
Smartweeds, *Polygonum* (*Persicaria* section)
  Dotted smartweed, *P. punctatum*
Spatterdocks, *Nuphar*
Sphagnum moss, *Sphagnum*
Spikerushes, *Eleocharis*
Spruce, Black, *Picea mariana*
Swamp black gum, *Nyssa biflora*
Swamp-privet, *Forestiera*
Sweetbay, *Magnolia virginiana*

Tamarack, *Larix*
Tealgrass, *Eragrostis hypnoides*
Threesquares, *Scirpus americanus* and *olneyi*
  Olney threesquare, *S. olneyi*
Tupelo gum, *Nyssa aquatica*
Turtlegrass, *Thalassia testudinum*

Virginia chainfern, *Woodwardia virginica*

Water oak, *Quercus nigra*
Water-hyacinth, *Eichhornia crassipes*
Waterlettuce, *Pistia stratiotes*
Waterlilies, *Nymphaea* (*Castalia*)
Watermilfoils, *Myriophyllum*
Waterprimroses, *Jussiaea*
Waterweeds, *Anacharis*
Waxmyrtle, *Myrica cerifera*
Western hemlock, *Tsuga heterophylla*
Whitetop, *Scolochloa festucacea*
Wigeongrass, *Ruppia maritima*
Wild millet, *Echinochloa crusgalli*
Wildceleryy, *Vallisneria spiralis*
Wildrice, *Zizania aquatica*
Willows, *Salix*
  Basket willow, *S. viminalis* and others

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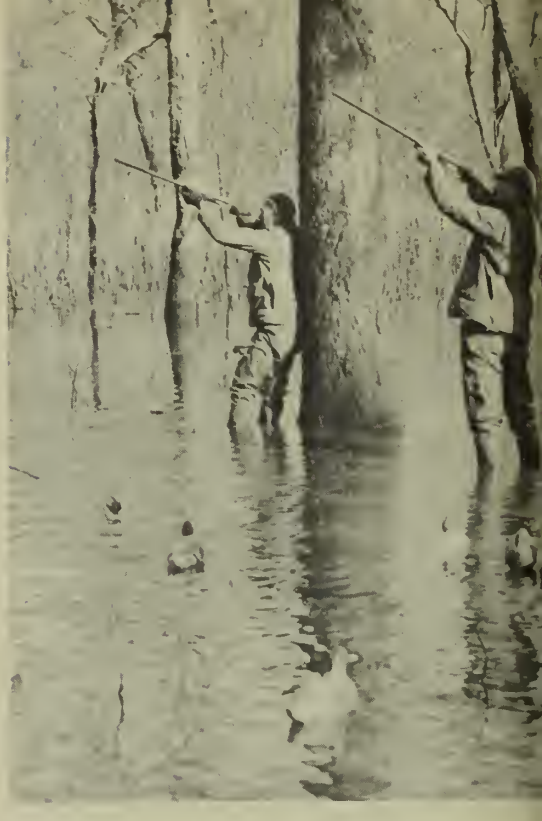
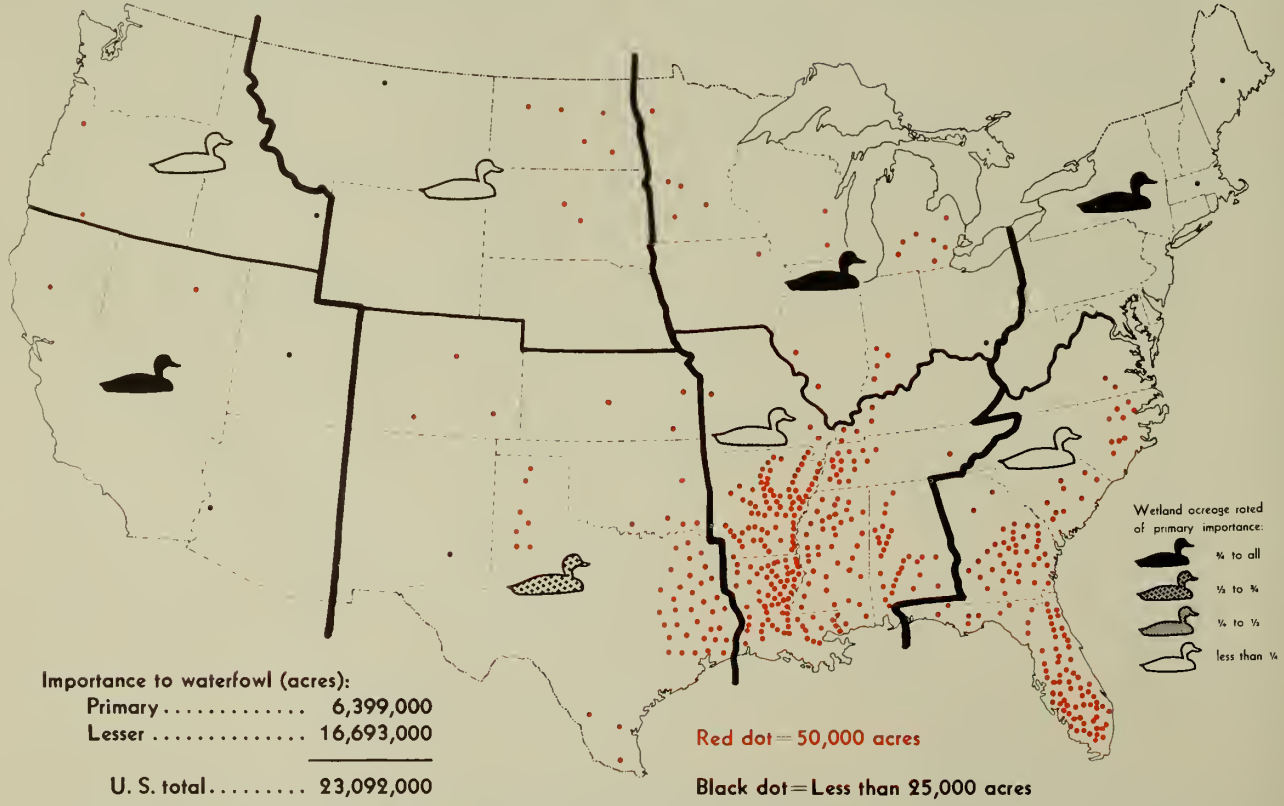
Iowa Conservation Department photo

Missouri River lowland in Iowa. The white specks are blue and snow geese making heavy use of this temporary water.



White River bottom lands in Arkansas. This is high-value winter habitat for waterfowl and furnishes excellent hunting.

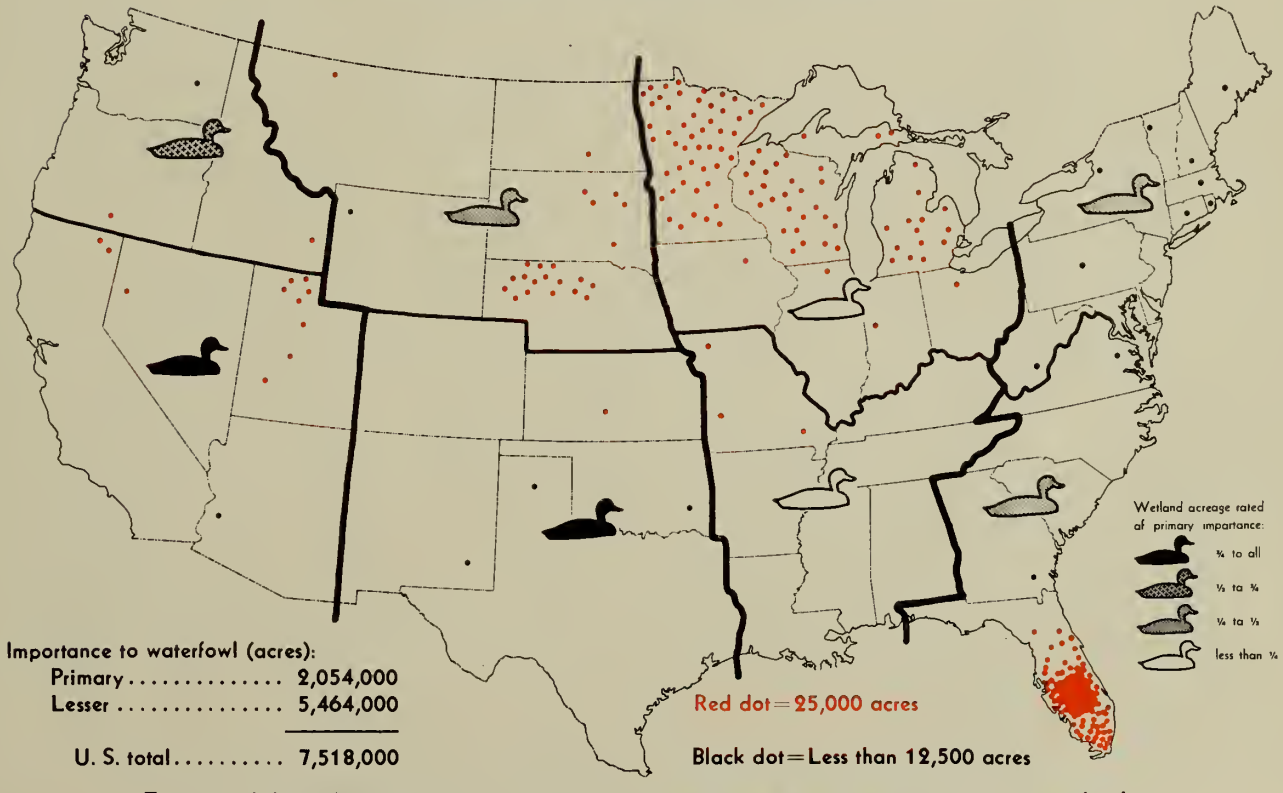


Importance to waterfowl (acres):

Primary	6,399,000
Lesser	16,693,000
U. S. total	23,092,000

Type 1—Seasonally flooded basins or flats: Distribution, abundance, and importance to waterfowl.

Meadow in Charles Mix County, S. Dak. Used by breeding waterfowl in early spring, but by midsummer is dry and produces tall slough grasses.

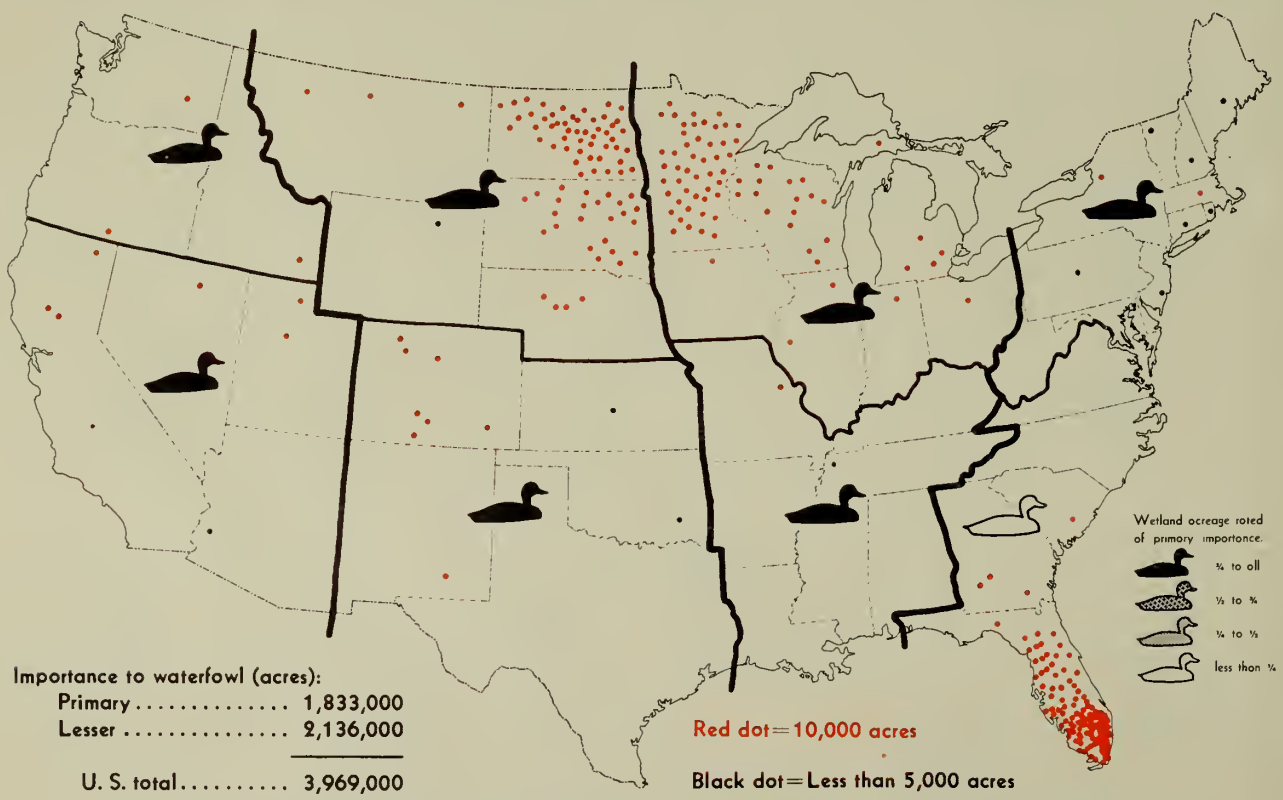


Importance to waterfowl (acres):

Primary	2,054,000
Lesser	5,464,000
U. S. total	7,518,000

Type 2—Inland fresh meadows: Distribution, abundance, and importance to waterfowl.

Marsh in Bennett County, S. Dak. Twenty-five ducks (mallards, pintails, and gadwalls) were flushed from this marsh by photographer on April 7, 1954.

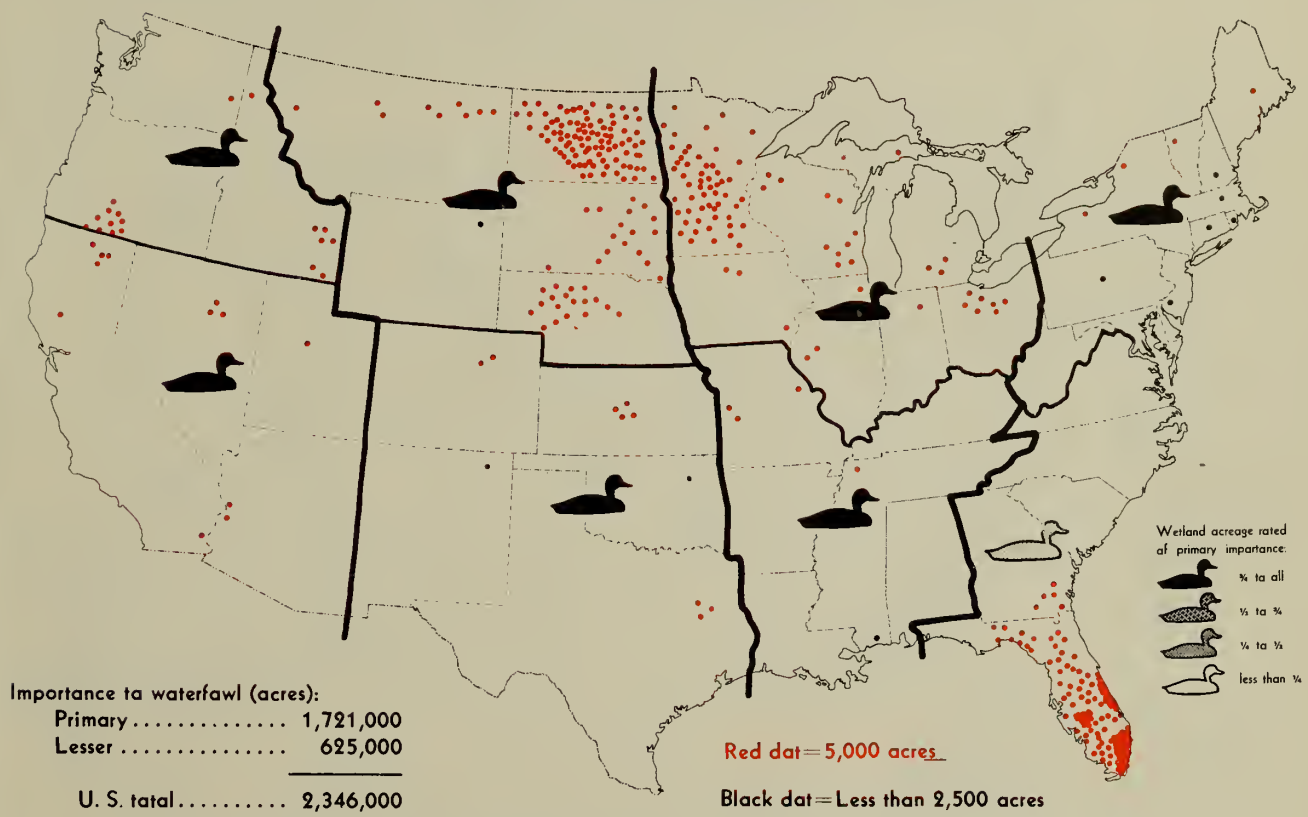


Type 3—Inland shallow fresh marshes: Distribution, abundance, and importance to waterfowl.

PLATE 3

Iowa Conservation Department photo

Marsh in Dickinsan Caunty, Iowa. Very few such large marshlands are left. This is excellent productian and feeding habitat.



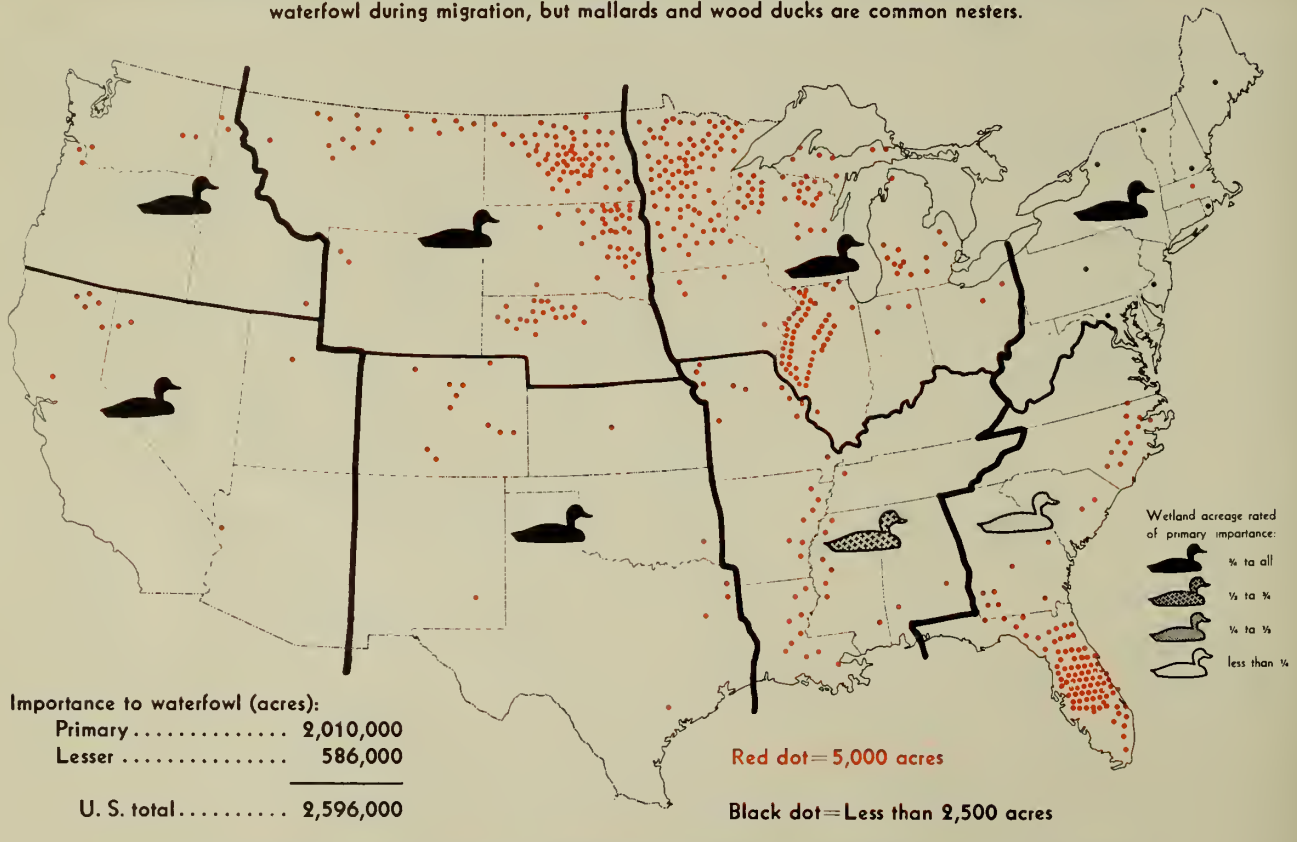
Importance ta waterfawl (acres):

Primary	1,721,000
Lesser	625,000
U. S. tatal	2,346,000

Type 4—Inland deep fresh marshes: Distribution, abundance, and importance to waterfowl.

PLATE 4

Arm of Lake Pend Oreille, northern Idaho. Principal value of this area is for resting and feeding by waterfowl during migration, but mallards and wood ducks are common nesters.



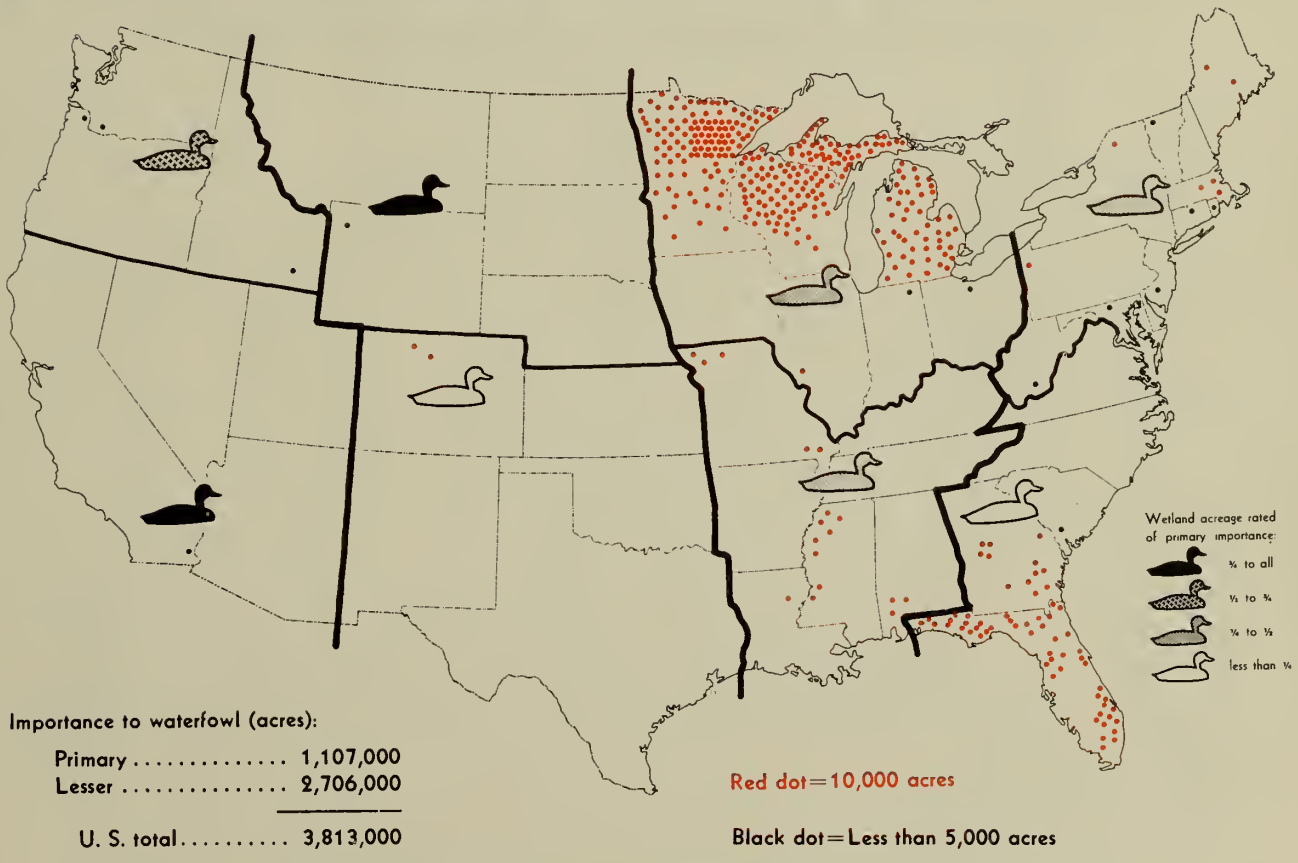
Importance to waterfowl (acres):

Primary	2,010,000
Lesser	586,000
U. S. total	2,596,000

Type 5—Inland open fresh water: Distribution, abundance, and importance to waterfowl.

PLATE 5

Swamp in central Michigan. Black ducks nest in this type of habitat.



Importance to waterfowl (acres):

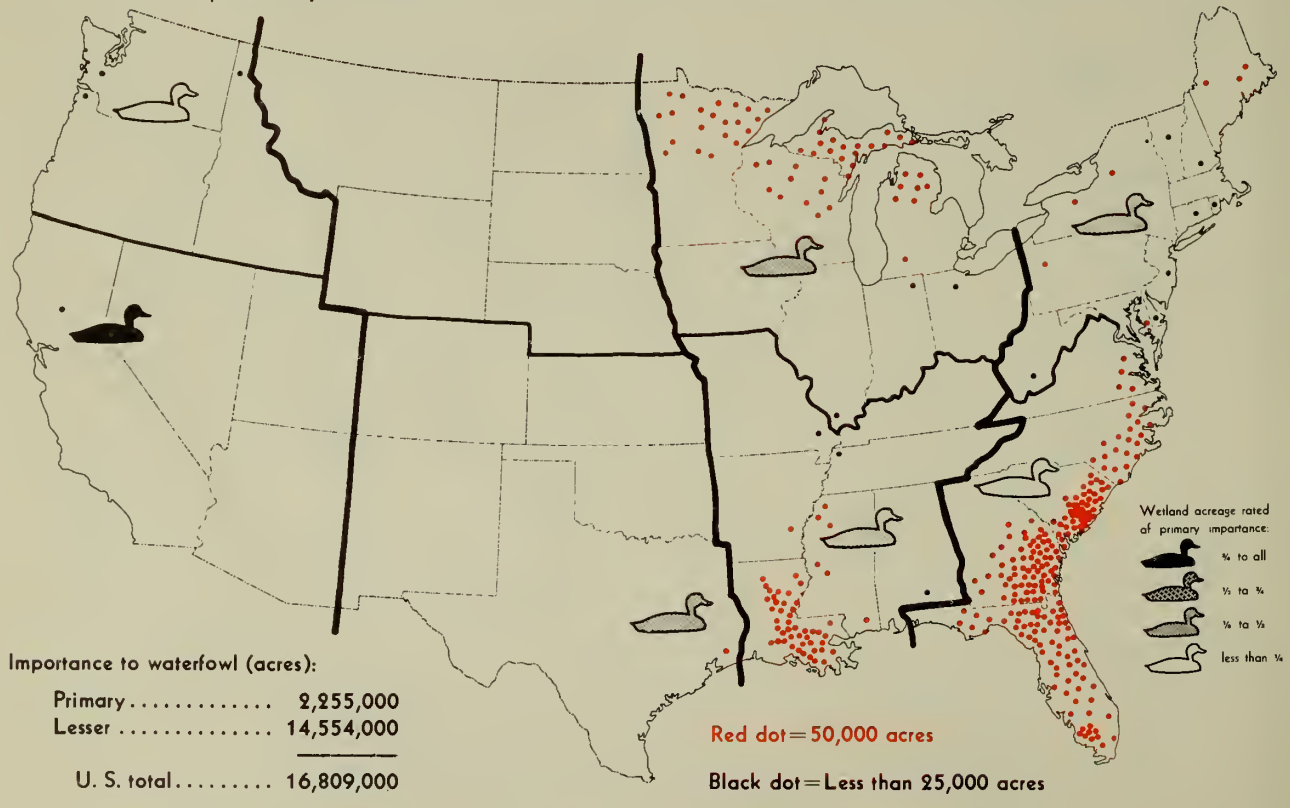
Primary	1,107,000
Lesser	2,706,000
U. S. total	3,813,000

Type 6—Shrub swamps: Distribution, abundance, and importance to waterfowl.

PLATE 6

382770 O—56——5

Tupelo gum and cypress growing in spring-fed limestone sink in Decatur County, Ga. Areas like this are usually deficient in waterfowl foods but are used by resting and roosting waterfowl, particularly wood ducks.



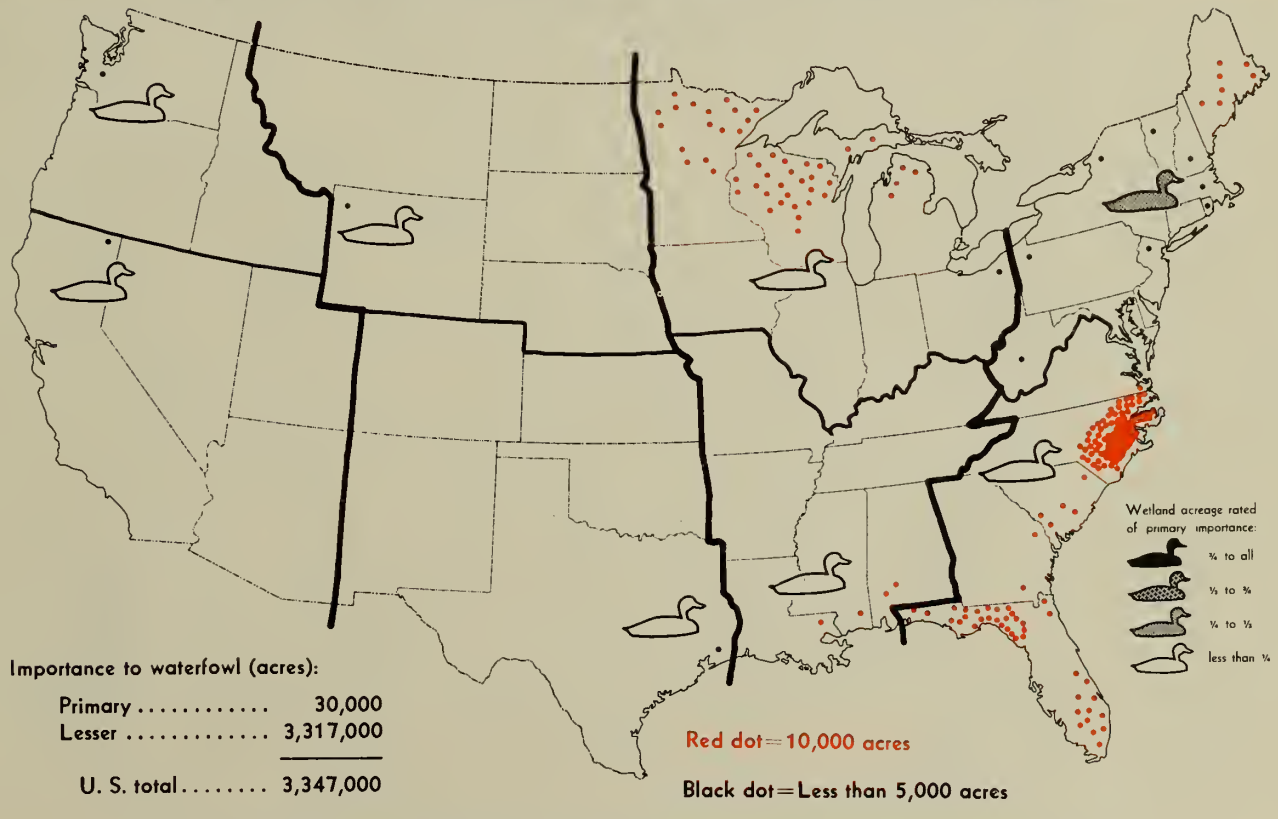
Importance to waterfowl (acres):

Primary	2,255,000
Lesser	14,554,000
U. S. total	16,809,000

Type 7—Wooded swamps: Distribution, abundance, and importance to waterfowl.

PLATE 7

Bog in northern Wisconsin supporting mostly leather-leaf and Labrador-tea. Waterfowl value is very low. Ducks would use the area more if streams and shallow ponds were present.

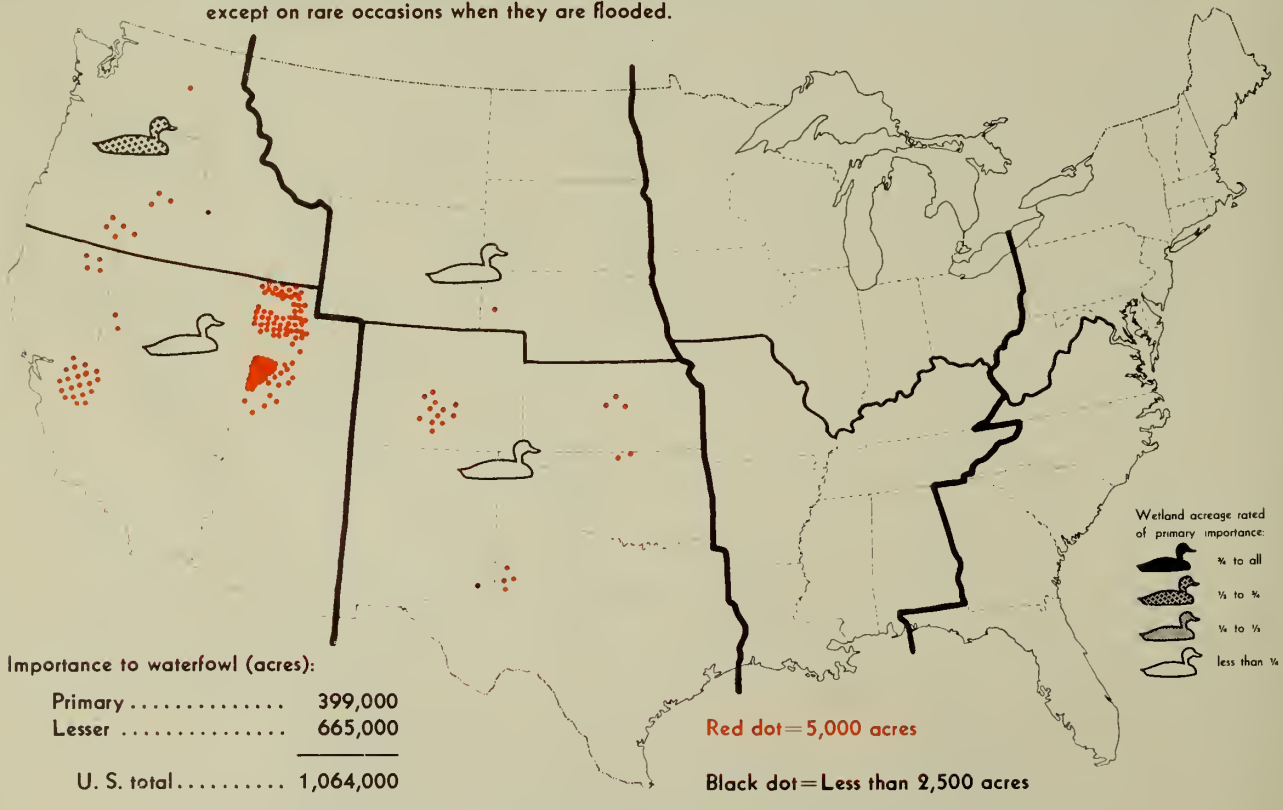


Importance to waterfowl (acres):

Primary	30,000
Lesser	3,317,000
U. S. total	3,347,000

Type 8—Bogs: Distribution, abundance, and importance to waterfowl.

Former saline flat on Bear River National Wildlife Refuge in Utah. Thirty-nine miles of dikes now surround 65,000 acres of flats where duck use has increased as a result of controlled water levels. Under natural conditions, most flats have too little water to be of much value to waterfowl except on rare occasions when they are flooded.

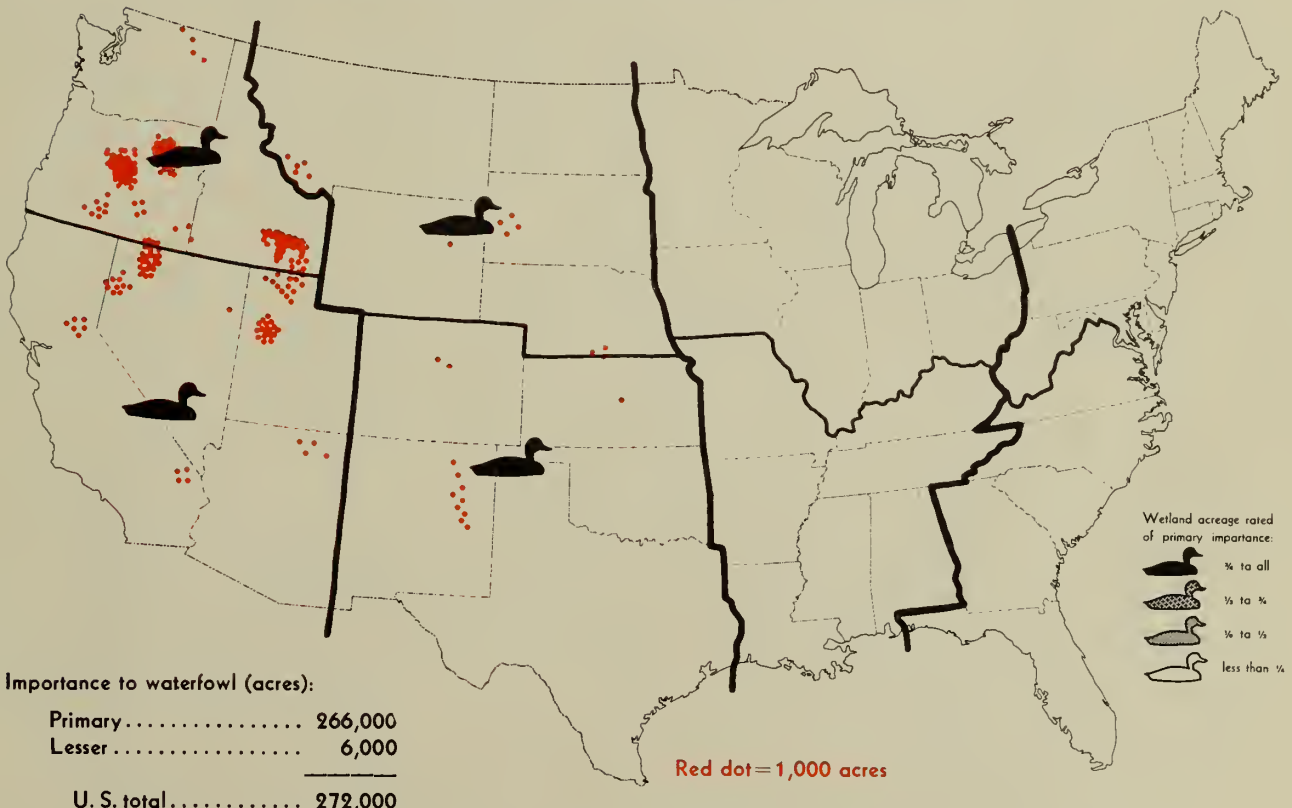


Importance to waterfowl (acres):

Primary	399,000
Lesser	665,000
U. S. total	1,064,000

Type 9—Inland saline flats: Distribution, abundance, and importance to waterfowl.

Marsh on Stillwater National Wildlife Refuge in Nevada, dominated by cattails and bulrushes, with pondweeds, widgeongrass, and muskgrass in open spots. This excellent marsh is used for resting and feeding during migration and is also used for nesting and wintering.

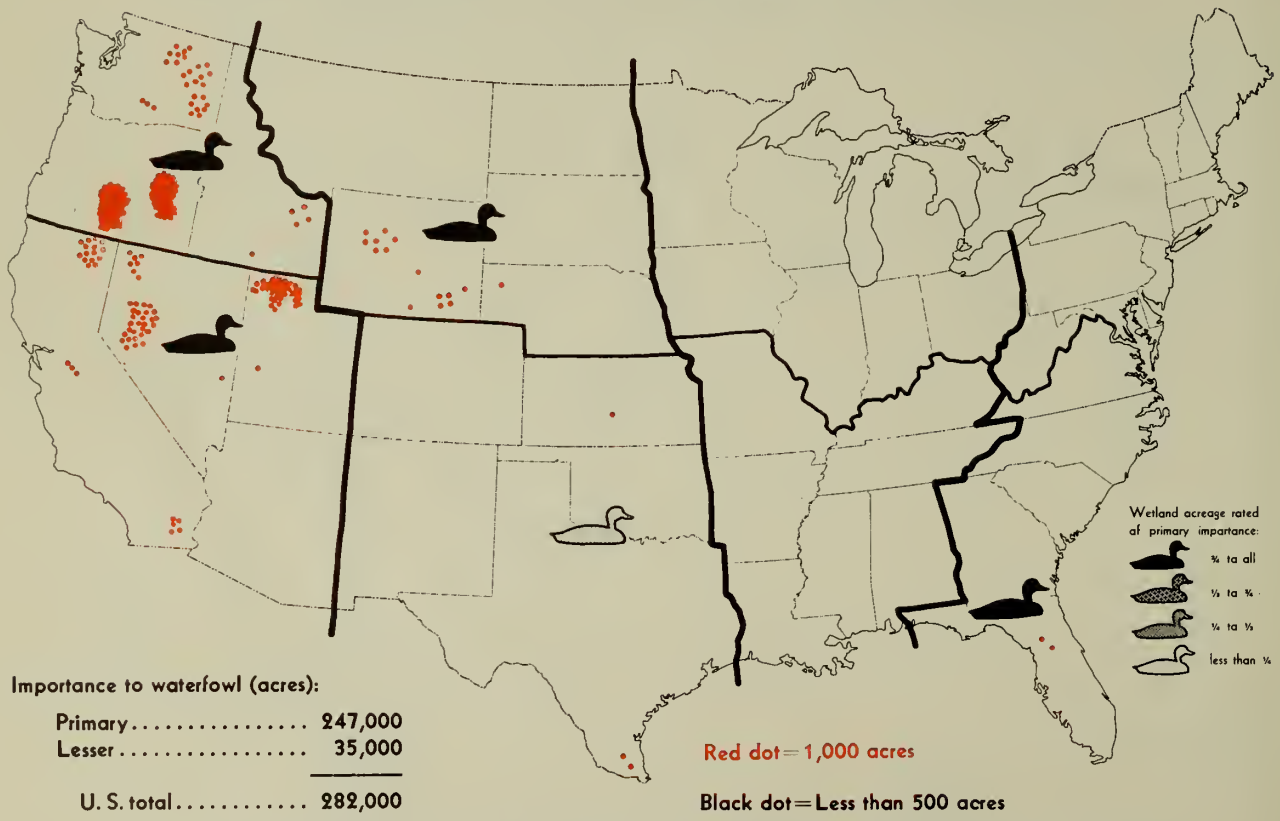


Importance to waterfowl (acres):

Primary	266,000
Lesser	6,000
U. S. total	272,000

Type 10—Inland saline marshes: Distribution, abundance, and importance to waterfowl.

Area in Carson Sink of western Nevada owned privately by the Canvasback Gun Club. This aerial view shows extensive interspersion with saline marsh. Open water is used primarily as waterfowl resting areas during migration.



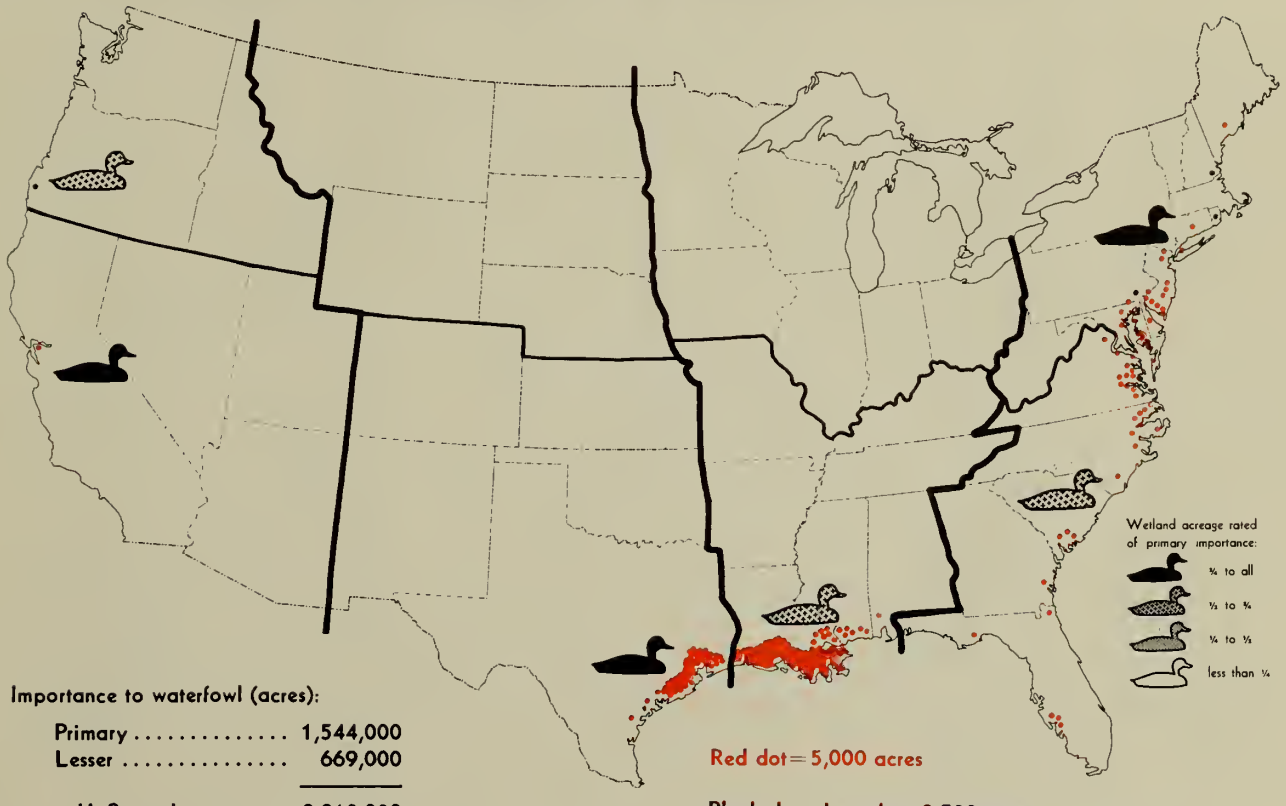
Importance to waterfowl (acres):

Primary	247,000
Lesser	35,000
U. S. total	282,000

Type 11—Inland open saline water: Distribution, abundance, and importance to waterfowl.

PLATE 11

Marsh in Vermilion Parish, La. Arrowhead is dominant vegetation. This area is heavily used by wintering waterfowl.



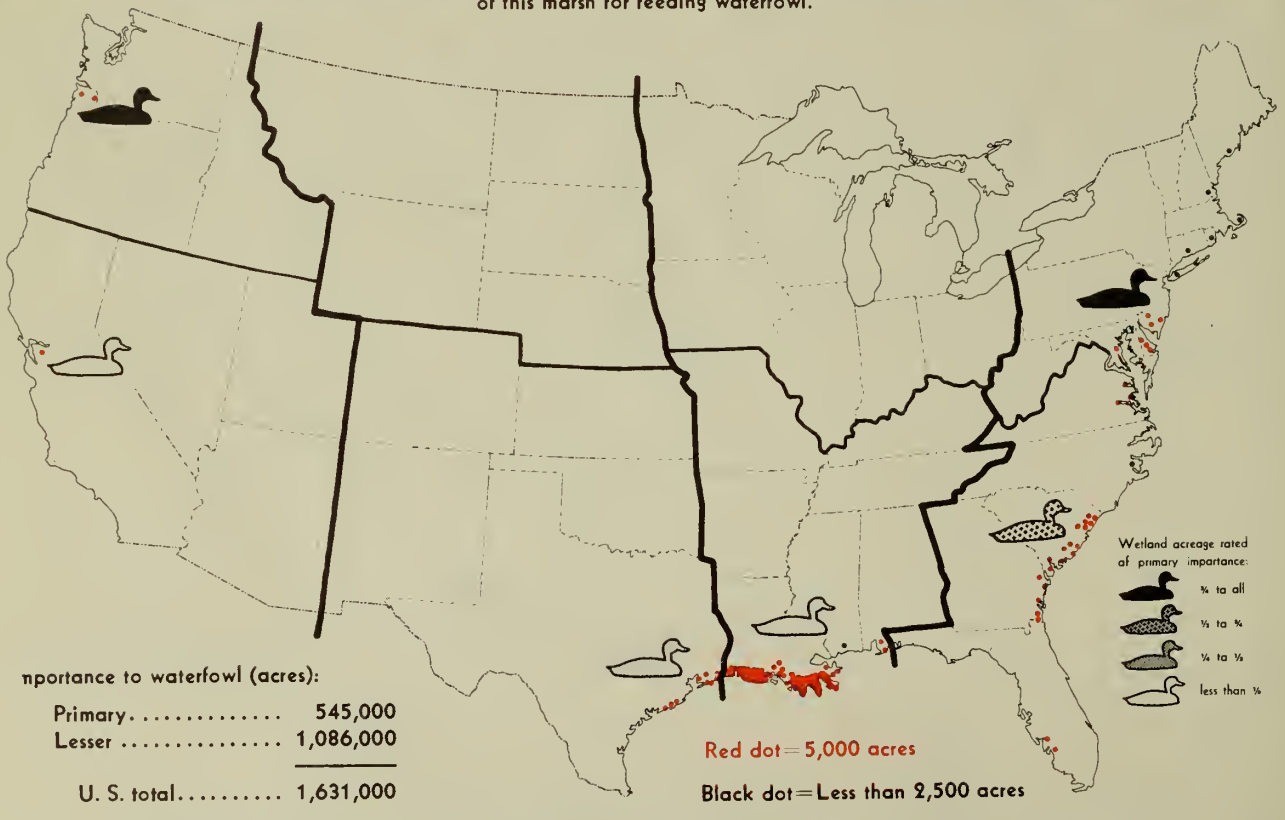
Importance to waterfowl (acres):

Primary	1,544,000
Lesser	669,000
U. S. total	2,213,000

Type 12—Coastal shallow fresh marshes: Distribution, abundance, and importance to waterfowl.

PLATE 12

Marsh in Arlington County, Va. Presence of wildrice, a preferred duck food, attests to the high value of this marsh for feeding waterfowl.



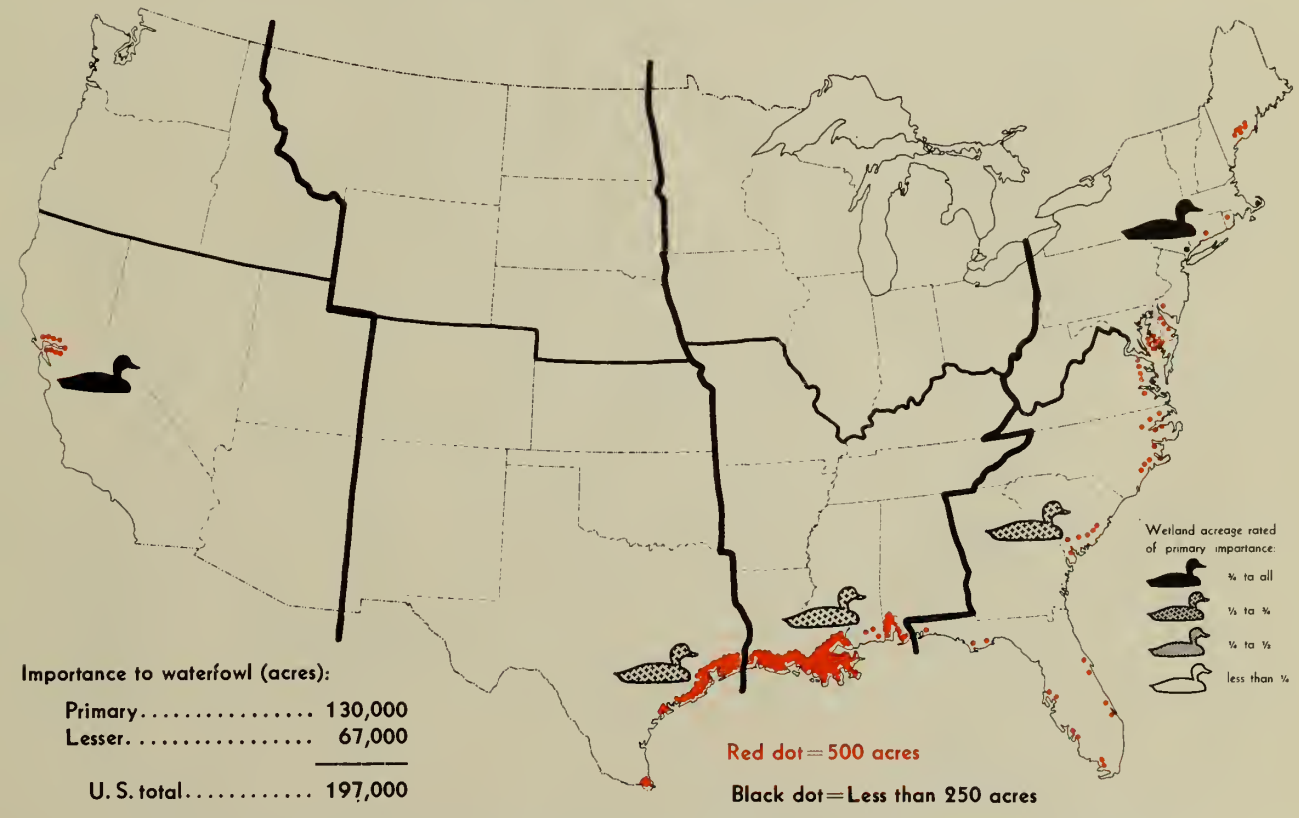
nportance to waterfowl (acres):

Primary	545,000
Lesser	1,086,000
U. S. total	1,631,000

Type 13—Coastal deep fresh marshes: Distribution, abundance, and importance to waterfowl.

PLATE 13

Coastal water in Horry County, S. C. Wintering waterfowl make heavy use of this area.



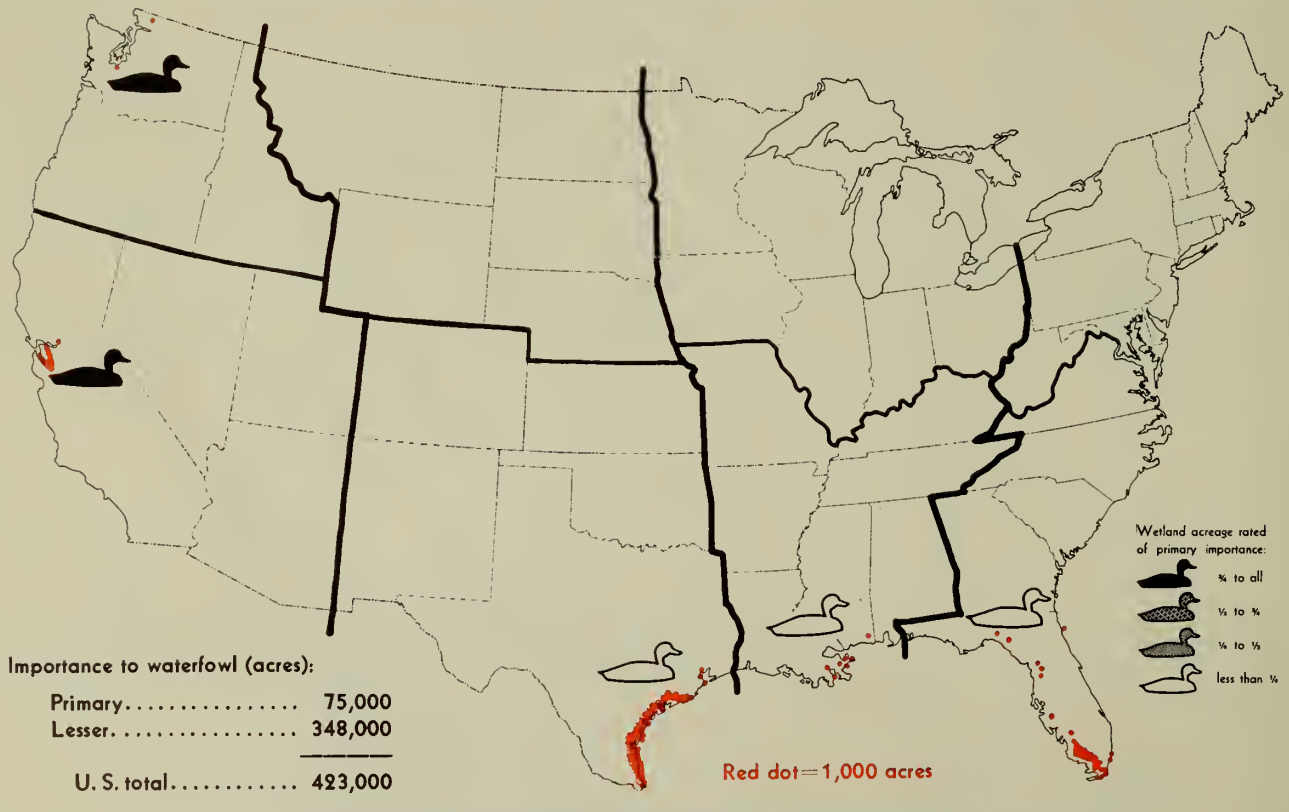
Importance to waterfowl (acres):

Primary	130,000
Lesser	67,000
U. S. total	197,000

Type 14—Coastal open fresh water: Distribution, abundance, and importance to waterfowl.

PLATE 14

Flats like this one in Refugio County, Tex., are sometimes used by resting waterfowl, but they provide little food.



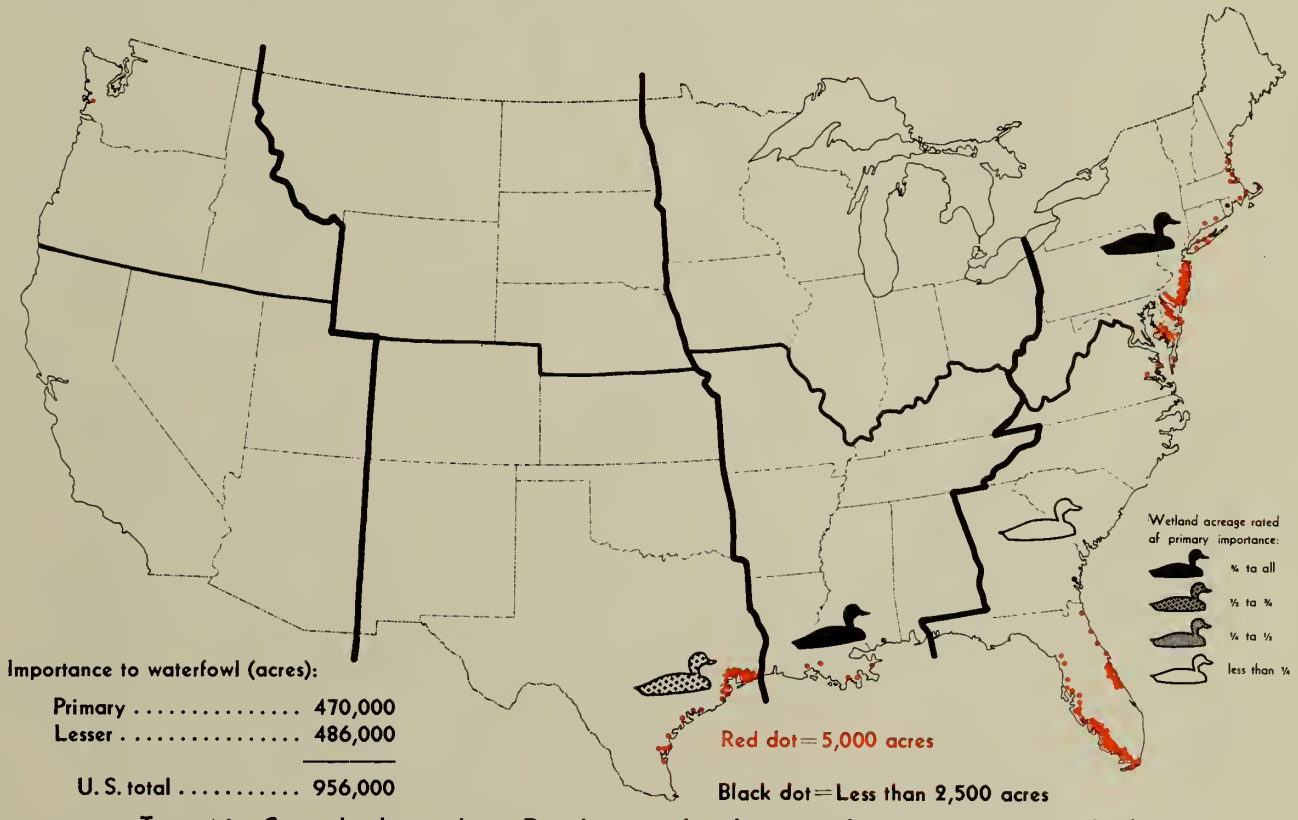
Importance to waterfowl (acres):

Primary	75,000
Lesser	348,000
U. S. total	423,000

Type 15—Coastal salt flats: Distribution, abundance, and importance to waterfowl.

PLATE 15

Meadow in embayment of coastal marsh in Virginia. Vegetation is mainly saltmeadow cordgrass, saltgrass, and blackrush. Open-water areas in this meadow help to increase waterfowl use.



Importance to waterfowl (acres):

Primary	470,000
Lesser	486,000
U. S. total	956,000

Type 16—Coastal salt meadows: Distribution, abundance, and importance to waterfowl.

PLATE 16

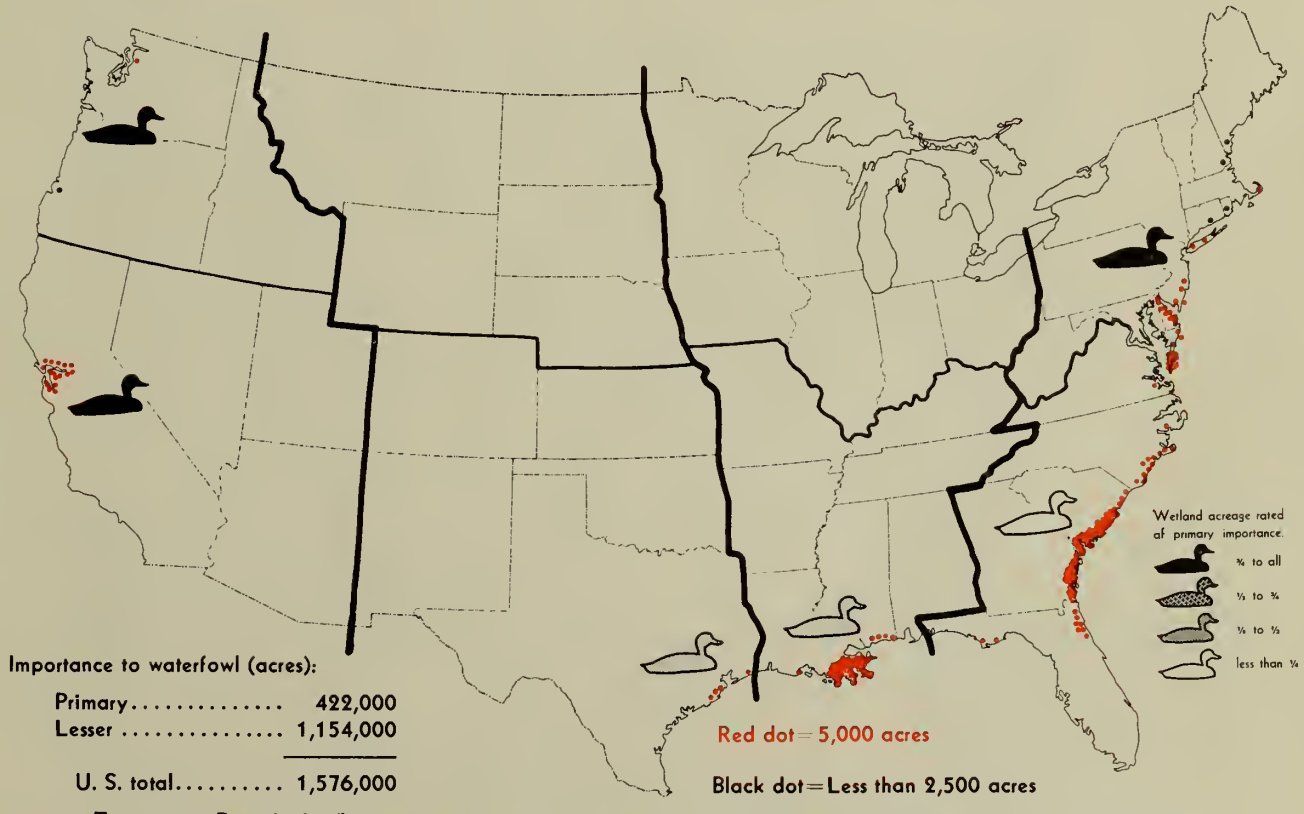
Marsh on Elliott Island, Dorchester County, Md. Dense needlerush, covering nearly 700,000 acres along the South Atlantic and Gulf coasts, produces no food for waterfowl. Recently, experimental needlerush control on Chassahowitzka National Wildlife Refuge in Florida has succeeded in replacing more than a hundred acres of this kind of marsh with vegetation attractive to waterfowl.

Importance to waterfowl (acres):

Primary	206,000
Lesser	492,000
U. S. total	698,000

Type 17—Irregularly flooded salt marshes: Distribution, abundance, and importance to waterfowl.

Marsh on Bulls Island, Cape Romain National Wildlife Refuge in South Carolina.



Importance to waterfowl (acres):

Primary	422,000
Lesser	1,154,000
U. S. total	1,576,000

Type 18—Regularly flooded salt marshes: Distribution, abundance, and importance to waterfowl.

PLATE 18

Sound in Laguna Madre region off the Texas coast. The Fish and Wildlife Service plane is taking winter inventory of waterfowl. Black specks in the water are ducks.

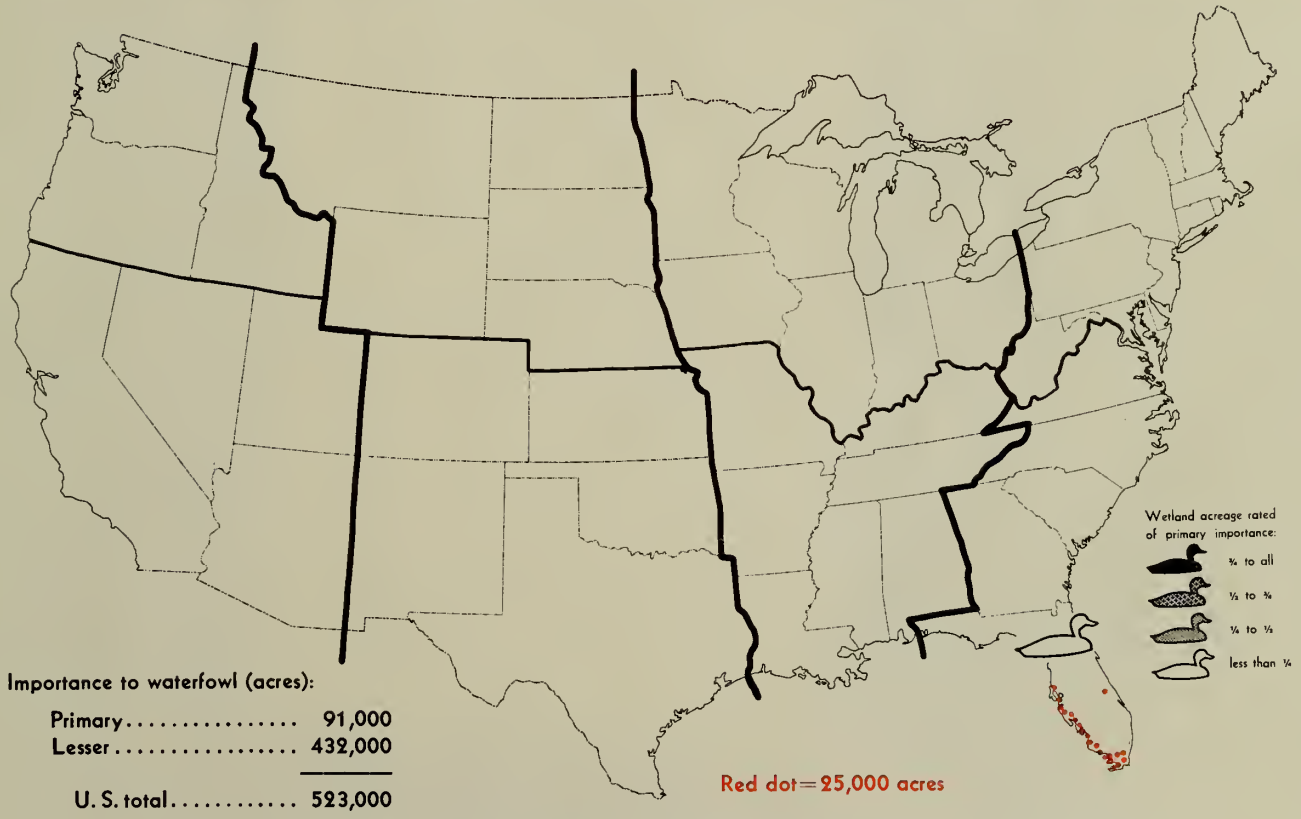
Importance to waterfowl (acres):

Primary	632,000
Lesser	482,000
U. S. total	1,114,000

Type 19—Sounds and bays: Distribution, abundance, and importance to waterfowl.

PLATE 19

Mangrove swamp on south shore of Big Pine Key in Florida. Waterfowl use of this type of habitat is dependent on closeness of other wetlands where food is more prevalent.



Importance to waterfowl (acres):

Primary	91,000
Lesser	432,000
U. S. total	523,000

Type 20—Mangrove swamps: Distribution, abundance, and importance to waterfowl.

PLATE 20

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Shading shows general areas within which are located all wetlands included in the inventory. At least 90 percent of the waterfowl use of wetlands occurs in these areas.

Importance (on an individual State basis) of wetlands to waterfowl:

Each red dot represents 10,000 acres of primary importance
U S total . 99 440 000 acres

Distribution of wetlands of the United States according to their relative values for waterfowl within each State, 1955

(From *Wetlands of the United States*, Circular 39, Fish and Wildlife Service, United States Department of the Interior)

382770 O - 1956 (In Pocket)