Ohio
Wetland Resources

Ohio's wetlands cover about 1.8 percent of the State (Dahl, 1990). Though greatly reduced in acreage since colonial times, these wetlands are an important economic and environmental resource. Wetlands can lessen the effects of floods by storing floodwater and releasing it gradually. Wetlands also help regulate water quality, and wetland vegetation can provide bank stabilization and reduce erosion. Wetlands provide habitat for migratory birds, waterfowl, and fish and are prominent attractions in a well-developed State system of nature areas, preserves, and parks (fig. 1). Ohio wetlands attract large numbers of hunters, fishermen, and naturalists. Historically, wetlands have provided timber and peat and have been converted into some of the most fertile farmland in the State.

TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in Ohio is shown in figure 2*A*; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in Ohio are described below.

System	Wetland description
Palustrine	Wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted, herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

There is no published comprehensive inventory of Ohio wetlands. Dahl (1990) provided the only recent estimate of total area—about 483,000 acres. Two inventories are presently (1993) in progress. The National Wetlands Inventory has been completed for northern and eastern Ohio. State and Federal agencies began the Ohio Wetland Inventory in 1991 and have located and classified wetlands in 50 of 88 Ohio counties. This inventory locates wetlands on LANDSAT satellite images and, in some cases, verifies wetland identification and classification by ground reconnaissance (Ohio Department of Natural Resources, 1992; Yi and others, 1994).

Palustrine wetlands such as swamps (forested wetlands), wet prairies (emergent wetlands), coastal and embayment marshes (emergent wetlands), peatlands (wetlands that have organic soils), and wetlands along stream margins and backwaters collectively are the most important Ohio wetlands. Lacustrine and riverine wetlands constitute only a small percentage of the State's wetland acreage. Many wetlands have formed on poorly drained soils that are of glacial origin. Remnants of once extensive forested wetlands and wet prairies are widely distributed across glaciated parts of northern, central, and western Ohio. Wetlands in these areas include the swamps, oak forests, and wet prairies that were part of a large wetland system known historically as the Great Black Swamp (Ohio Department of Natural Resources, 1988) and the wet prairies and wet mixed-oak forests of south-central Ohio (Forsyth, 1970).

Ohio peatlands comprise bogs and fens. Bogs receive moisture mostly from precipitation and typically contain large numbers of mosses that are tolerant of acidic conditions. Fens generally receive drainage from surrounding mineral soils and commonly support communities of grasses, sedges, or reeds (Mitsch and Gosselink, 1986). Bogs and fens are located in glaciated areas of northern and western Ohio (Andreas and Knoop, 1992). Bogs are concentrated in the Southern New York Section of the Appalachian Plateaus of northeastern Ohio, and fens are common in the Till Plains of the Central Lowland of western Ohio (fig. 2*B*) (Denny, 1979).

Large coastal marshes border the southwestern shore and Sandusky Bay of Lake Erie (fig. 2*A*). These marshes generally range from 1 to 2 miles in width and are interrupted by points of higher land and developed areas. Undisturbed shores of western Lake Erie have marshes fronted by low barrier beaches and interspaced with river mouths. These wetlands are protected by constructed earthen and rock dikes. Two sand spits separate Sandusky Bay from Lake Erie and protect extensive wetlands in the bay. East of Sandusky Bay, low, marshy backshores grade into low bluffs, and wetlands in this area are restricted to mouths of tributaries such as the Huron River and Old Woman Creek. A large wetland, Mentor Marsh, occupies the former valley and delta of the Grand River. Twelve bedrock islands in western Lake Erie have rocky shores, but small embayments on large islands contain wetlands (Herdendorf, 1992).

Figure 1. Cedar Run in Cedar Bog Nature Preserve. Cedar Run drains bog meadows and marl meadows of Cedar Bog, a relict alkaline fen. *(Photograph by Ralph E. Ramey, Columbus, Ohio).*

Numerous riverine and palustrine wetlands are located in the drainages of the Muskingum, Scioto, and Great Miami Rivers (fig. 2*A*). These wetlands extend from glaciated headwaters into unglaciated sections. To date, the hydrology and ecology of these wetlands have been little studied.

HYDROLOGIC SETTING

Wetlands form where ground water or surface water saturates poorly drained or impermeable soils. Wetlands typically develop in depressions or other low areas that are intermittently to permanently flooded by runoff, ground-water discharge, or precipitation. Water is removed primarily by runoff, evaporation, and transpiration. In areas that develop into wetlands, moisture is maintained at or near the surface by fine-grained, hydric soils. These water-saturated soils support the growth of specialized plants (hydrophytes) that are adapted to low oxygen concentrations and, in some cases, extreme acidity, alkalinity, or low nitrogen concentrations.

Many Ohio wetlands are located on fine-grained soils that were deposited by an extensive system of glacial lakes. These lakes were created as advancing glaciers blocked the flow of preglacial streams or when receding glaciers blocked the flow of meltwater. As the lakes drained, their beds became extensive deposits of fine-grained silts and clays known as till. These deposits cover extensive areas of northwestern Ohio (Spooner, 1982).

As ice of the most recent glaciation receded to the southern shore of Lake Erie, it blocked the northward drainage of meltwater and formed a large lake (Lake Maumee) in northwestern Ohio. As ice sheets continued to recede, Lake Maumee drained, and sand deposits from ancient dunes and flat deposits that formed the lakebed were left behind. Lake deposits contained large amounts of silt and clay and formed poorly drained soils that at one time supported extensive swamps (Forsyth, 1970).

Sand deposits left by Lake Maumee were inhabited by oak forests and wet prairies. Oak forests developed where precipitation drained through thick sand of ancient dunes and accumulated on underlying clay till. The surfaces of these sand deposits were relatively dry and supported only dry-tolerant, oak forests. Where sand deposits were thin, ground water saturated the sandy soil and created swamps or shallow lakes. These areas developed into wet prairies (Forsyth, 1970).

Lake deposits from early glaciation and glacial outwash from more recent glaciations have been deposited in valleys of the Kanawha Section of the Appalachian Plateaus of southeastern Ohio (fig. 2*B*). Following the retreat of the last glacier, wetlands have developed along streams that drain these deposits. These wetlands typically are located on saturated loam soils and include oak-maple associations on clays; elm, sycamore, and birch associations on alluvial bottoms; and American elm, ash, and maple associations in better drained and aerated soils (Spooner, 1982). Sedges, button-

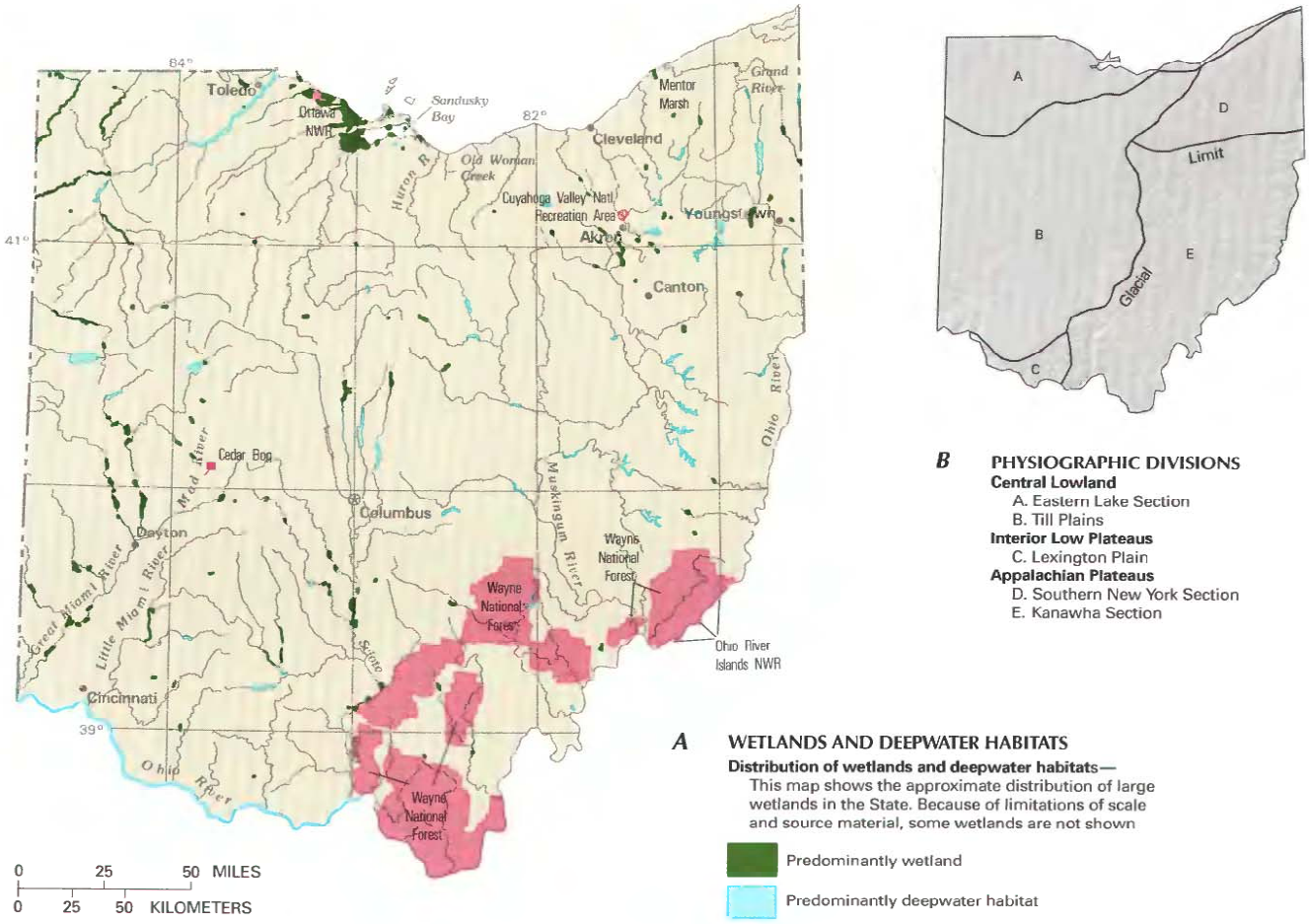

Figure 2. Wetland distribution in Ohio and physiography of the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Physiography. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center.)*

bush, willow, alder, and maple grow in the wettest areas. Swamp forests consist of swamp white oak, black willow on wetter sites, and American elm, sycamore, and maple stands in less wet areas. Recent beaver activity has killed trees and created wetter and more open wetlands (Spooner, 1982).

In the glaciated part of Ohio, peatlands are located on lakebed deposits (Dachnowski, 1912) and in areas where glacial deposits formed topographic features that favor the retention of water (Andreas, 1985). These features provided the poorly drained soils and hydrologic setting necessary for the formation and maintenance of peatlands (Andreas, 1985; Andreas and Knoop, 1992). A common glacially derived feature, kettle holes, formed as ice was trapped in glacial deposits and then melted. As these ice pieces slowly thawed, meltwater eroded the surrounding deposits into funnel-shaped depressions (Goldthwait, 1959). Large kettle holes developed into lakes that eventually were filled by peat from accumulated and consolidated plant debris (Denny, 1979). The resultant wetlands developed plant communities dominated by mosses and evergreens.

Hydrologic and biological differences separate peatlands into acidic (pH 3.5–4.5) bogs and circumneutral (pH 5.5–8.0) fens. In Ohio, fens develop where springs emerge from glacial deposits and produce a continuous flow of cool, mineral-rich water. Primarily sedges and grasses, not sphagnum, are adapted to this environment and in fens form most of the peat. Bogs develop as water-saturated organic materials decay slowly at low pH and temperature to form thick peat deposits (Denny, 1979).

The relation of glacial geology to wetland hydrology has been thoroughly studied in Cedar Bog, a typical Ohio fen located in the Mad River Valley (figs. 1 and 2*A*). Cedar Bog developed in the Mad River Valley Train (fig. 3), an outwash made up of highly permeable, calcium carbonate gravel (Quinn, 1974). In the Mad River Valley, ground water generally is 10 feet below the land surface. However, Cedar Bog has developed on hydric soils that were produced where ground water discharges on the eastern side of the valley. The water that sustains Cedar Bog is derived mainly from glacial outwashes to the north and east (Forsyth, 1974). These outwashes consist of coarse calcium carbonate gravel and rise about 100 feet above the fen. Ground water flows through the outwashes until it reaches the base of an escarpment along the eastern border of Cedar Bog. Here, cool, alkaline ground water discharges in springs, saturates soils, and flows across the fen. The continuously seeping ground water produces a perpetually cool, moist microenvironment that maintains a flora composed of many species normally found much farther north (Frederick, 1974). As surface water accumulates, it is drained by Cedar Run and the Mad River (Hillman and Kenoyer, 1989).

Changing water levels are important in the formation and maintenance of Lake Erie wetlands. Water levels in Lake Erie and in bordering coastal marshes are subject to long-term and short-term fluctuations. Long-term fluctuations are caused by changes in inflow that result from extended periods of wet or dry weather in the upper Great Lakes drainage. Wind action produces short-term changes in water level called seiches. These changes can cause water and chemical exchanges similar to those in salt marshes during tidal flow (Mitsch, 1992). Fluctuating water levels promote wetland formation by producing barrier bars, deltas, beaches, spits, lagoons, and natural levees. Water-level fluctuations also rejuvenate existing coastal wetland communities and preclude the conversion of vegetated marshes into dry fields (Herdendorf, 1992). Water levels at Cleveland have fluctuated almost 5 feet during the past 130 years.

TRENDS

From the 1780's to the 1980's, wetland area in Ohio declined by 90 percent, from about 5,000,000 acres to about 483,000 acres (Dahl, 1990). For the conterminous 48 States, the percentage of wetland loss in Ohio is second only to that of California. Drainage of wetlands for agriculture has been the primary cause of wetland loss, but recreational use, fluctuating water levels, urban development, mining, logging, and fire also have contributed (Andreas and Knoop, 1992).

The swamps of the Great Black Swamp in northwestern Ohio and the marshes bordering Lake Erie were once the State's two largest wetland systems. Before European settlement of the area, the Great Black Swamp occupied nearly 900,000 acres. Beginning in 1859, a series of drainage projects converted the swamp into some of the most productive farmland in Ohio. Today only 5 percent of the original swamp forest remains (Andreas and Knoop, 1992).

Coastal wetlands along the Ohio shore of Lake Erie have been destroyed as agriculture, real-estate development, and recreational areas have expanded (Heath, 1992). From 1850 to 1993, about 951,000 of 988,000 acres of coastal wetlands were destroyed along the southwestern coast of Lake Erie (Herdendorf, 1992). Only 10 percent of the original marsh along Lake Erie exists today (Andreas and Knoop, 1992). Since 1988, public agencies and private organizations involved in the Lower Great Lakes Joint Venture of the North American Waterfowl Management Plan have purchased and restored about 5,240 acres of Lake Erie wetlands (Ohio Department of Natural Resources, 1992).

Before 1780, about 183,000 acres (0.5 percent of Ohio's total area) were covered by peatlands (Dachnowski, 1912). In 1912, Dachnowski conducted a comprehensive, county-by-county survey of glaciated parts of Ohio and located 206 peatlands that had a com-

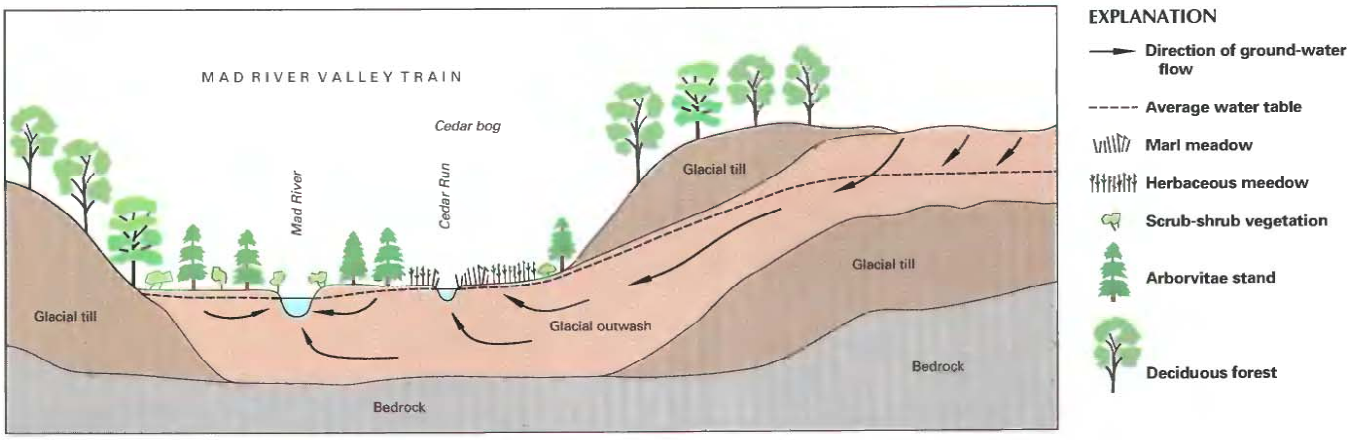

Figure 3. Generalized geohydrologic setting and vegetation of Cedar Bog. *(Sources: Forsyth, 1974; Frederick, 1974.)*

bined area of about 150,000 acres. Andreas and Knoop (1992) field-inventoried the flora of 125 peatlands and estimated that between 1900 and 1991, 76,500 of 79,500 acres of peatland were destroyed, and only 2 percent of these wetlands today contain plant communities associated with peatlands.

CONSERVATION

Many government agencies and private organizations participate in wetland conservation in Ohio. The most active agencies and organizations and some of their activities are listed in table 1.

Federal wetland activities.—Development activities in Ohio wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; the 1986 Emergency Wetlands Resources Act; and the 1972 Coastal Zone Management Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency, and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourage (through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wetlands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) (NRCS) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

The 1986 Emergency Wetlands Resources Act and the 1972 Coastal Zone Management Act and amendments encourage wetland protection through funding incentives. The Emergency Wetland Resources Act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service (NPS) provides guidance to States in developing the wetland component of their plans. Coastal and Great Lakes States that adopt coastal-zone management programs and plans approved by the National Oceanic and Atmospheric Administration are eligible for Federal funding and technical assistance through the Coastal Zone Management Act.

Several Federal agencies have managerial and regulatory responsibilities for specific Ohio wetlands. The FWS is presently (1993) surveying Ohio wetlands located in Ohio River embayments and on Ohio River islands. Wetlands on designated islands and in embayments could become part of the Ohio River Islands National Wildlife Refuge. The FWS also manages wetlands along the Lake Erie shore in the Ottawa National Wildlife Refuge, surveys flora and fauna of Ohio wetlands, and reviews all section 404 permit applications and section 401 water-quality certifications. The U.S. Forest Service (FS) manages wetlands in the Wayne National Forest in cooperation with the Ohio Department of Natural Resources. The FS has obtained three wetlands as part of eight recent land acquisitions. In addition, three wetlands recently have been constructed. No specific inventories of wetland plants and animals have been initiated by the FS, but recent inventories of amphibians, reptiles, and fish have included wetland areas. The NPS manages wetlands in the Cuyahoga Valley National Recreation Area between Cleveland and Akron. The NPS also protects all wetlands on fee-purchased lands, allows wetlands to develop naturally on all acquired lands, and purchases easements that protect wetlands on adjacent properties. The NRCS confirms wetland boundaries for the Ohio Wetland Inventory and notifies farmers when they are not in compliance with the Food Security Act of 1985.

State wetland activities.—Ohio designates all wetlands as State Resource Waters. As such, wetland water quality is protected from any degradation that may interfere with designated uses. The designation of Ohio wetlands as State Resource Waters protects them from the addition of toxic substances and addition or removal of any earthen material. Any dredging or filling of an Ohio wetland requires a section 404 permit issued by the Corps and a section 401 water-quality certification issued by the Ohio Environmental Protection Agency (Ohio Environmental Protection Agency, 1992). Typical activities that might affect wetlands and, consequently, require a section 404 permit and section 401 water-quality certification are construction of boat ramps, placement of rip-rap for erosion protection, placing fill, construction of dams or dikes, and stream channelization or diversion.

Table 1. Selected wetland-related activities of government agencies and private organizations in Ohio, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
FEDERAL						
Department of Agriculture						
Consolidated Farm Service Agency	...	•	...	...	...	...
Natural Resources Conservation Service	...	•	...	...	•	•
Department of Defense						
Army Corps of Engineers	...	•	•	...	•	•
Department of the Interior						
Fish and Wildlife Service	•	...	•	•	•	•
Geological Survey	...	...	...	...	•	...
National Biological Service	...	...	...	...	•	...
National Park Service	•	...	•	•	...	...
Environmental Protection Agency	...	•	...	...	•	•
STATE						
Department of Highways	...	•	...	...	...	...
Department of Natural Resources						
Division of Natural Areas and Preserves	•	...	•	•	•	...
Division of Parks	•	...	•	•	...	...
Division of Soil and Water	...	...	...	...	...	•
Division of Wildlife	•	...	•	•	•	•
Environmental Protection Agency	...	•	...	...	...	...
PRIVATE ORGANIZATIONS						
Ducks Unlimited	...	...	•	...	...	...
The Nature Conservancy	•	...	•	•	...	...

The Division of Wildlife has worked with conservation groups and government groups such as the FWS and NRCS to purchase, restore, and construct wetlands for waterfowl and other migratory birds. An important part of this effort has been the Lower Great Lakes Joint Venture of the North American Waterfowl Management Plan. This program purchases and manages wetlands in five focus areas. The Division also has initiated an Ohio income tax check-off option that provides monies for a nongame-wildlife management program and the Habitat Restoration Program, which protects wildlife habitat. The Division regulates and manages wetlands in 46 public wildlife areas throughout the State.

The Ohio Natural Areas Act of 1970 established a statewide system of natural areas and nature preserves that are managed either by the Division of Natural Areas and Preserves or by a cooperating managing agency. Twenty-five natural areas and preserves in the State contain 4,505 acres of wetlands. Wetlands constitute approximately one-fourth of all natural-area and preserve acreage in Ohio (Ohio Department of Natural Resources, 1988). The Division of Parks and Recreation manages wetlands in 59 State parks. Management responsibilities are coordinated with the Division of Wildlife, the Corps, and other governmental agencies.

The Division of Soil and Water Conservation has initiated the Ohio Land Capability Analysis Program. The program provides information on wetlands in the form of computer-generated maps and data relating to soil types, mineral resources, vegetation, and land use to local governments and private landowners.

The Department of Highways recently initiated programs that identify wetlands likely to be affected by road construction. These programs provide for the purchase or development of wetlands to mitigate wetland loss.

Wetland management in the future will be coordinated by a statewide task force consisting of about 30 individuals from State, county, and municipal governments; environmental and advocacy organizations; and business and industry affiliates. The Commission on Dispute Resolution and Conflict Management will chair the task force. The task force will attempt to reach consensus on the public values of wetlands, wetlands assessment, wetlands regulation, and wetlands creation and restoration.

Private wetland activities.—The Nature Conservancy has established the following preserves that contain wetlands: 7 sites (3,240 acres of wetlands) in the Eastern Lakes Section of the Central Lowland Province; 6 sites (1,000 acres of wetlands) in the Till Plains Section; 11 sites (2,510 acres of wetlands) in the Southern New York Section of the Appalachian Plateaus; and 2 sites (125 acres of wetlands) in the Kanawha Section. Thirteen of these sites are managed by a cooperating public or private agency. Ducks Unlimited has been influential in developing and preserving wetlands, particularly coastal marshes along Lake Erie. The organization's activities have included the purchase, restoration, and enhancement of wetlands. The Oak Harbor Conservation Club, Wildlife Legislative Fund of America, Ohio Plan Clubs, Lake Erie Wildflowers, Maumee Valley Audubon Club, Ohio Historical Society, Izaak Walton League, Sierra Club, League of Ohio Sportsmen, and other conservation groups contribute significantly to wetland conservation.

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