

# Missouri

## Wetland Resources

**M**issouri wetlands occupy 643,000 acres, about 1.4 percent of the State's area (Dahl, 1990). Before the arrival of European settlers, wetlands occupied about 4.84 million acres, about 10.8 percent of what is now Missouri, and were a significant component of the landscape (Epperson, 1992).

Before European settlement, wetlands primarily were associated with the major rivers and streams, especially in the State's "bootheel" (southeastern area), which borders the Mississippi River. This area once contained about 50 percent of the State's wetlands and was nicknamed "swampeast" Missouri. Although they were considered impediments to progress, wetlands provided large economic benefits to the railroad companies that purchased and harvested the vast bottom-land forests of cypress, tupelo gum, and oak for timber (Epperson, 1992). After the commercial timber had been removed, these cleared wetlands were drained and converted to agricultural use, and they remain in that land-use category today.

Wetlands maintain water quality, mitigate flood effects, provide critical habitat for many rare and endangered plants and animals, and are a source of recreational activities such as birding, fishing, hunting, and ecotourism in unique areas such as Slaughter Sink and Grasshopper Hollow (fig. 1). Wetlands in Missouri provide critical habitat for 15 animal and 4 plant species that are endangered or threatened (Rick Hansen, U.S. Fish and Wildlife Service, written commun., 1993). Also within Missouri, a large number of wetland species are of special concern. Some of the endangered or threatened plants and animals associated with wetlands in Missouri include the eastern prairie fringed orchid, gray bat, Indiana bat, Ozark big bat, bald eagle, least tern, Neosho madtom, Ozark cavefish, and the Higgins eye pearly mussel.

Missouri's location on the Mississippi Flyway makes the State a favored wintering area for waterfowl and raptors. As many as 200,000 ducks, mainly mallard, but also pintail, green-winged teal, widgeon, gadwall, and shoveler, reside in the 21,600-acre Mingo National Wildlife Refuge in southeastern Missouri. As many as 200,000 geese and 300,000 ducks winter in the 6,890-acre Squaw Creek National Wildlife Refuge in northwestern Missouri. This refuge supports one of the largest wintering concentrations of bald eagles in the United States and harbors as many as 200 bird species at any given time. About 100 bald eagles winter in the 10,670-acre Swan Lake National Wildlife Refuge in north-central Missouri (Riley, 1979). Missouri has five National Wildlife Refuges, one National Scenic Riverway, one National Forest system, seven State

wetland areas under the jurisdiction of the Missouri Department of Conservation in cooperation with the North American Waterfowl Plan, and four State parks that feature and preserve wetlands within their boundaries (Lower Mississippi Valley Joint Venture Management Board, 1990; Epperson, 1992).

### 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 Missouri is shown in figure 2A; 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 Missouri 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.

Palustrine forested wetlands (swamps and other forested wetlands), palustrine emergent wetlands (marshes and fens), and palustrine scrub-shrub wetlands (shrub swamps) constitute most of the wetland acreage in Missouri (Epperson, 1992). Most of the State's wetlands are associated with rivers and streams (fig. 2A). The bootheel region is especially rich in wetlands.

Fens are small (0.5–10 acres), palustrine forested or emergent wetlands unique to areas where ground water, underground streams, and karst topography (resulting from limestone and dolomite rock dissolution) characterize the local hydrology and geology. In contrast to most other wetlands in Missouri, fens are created by ground water, not surface water (Epperson, 1992). These wetlands are located primarily along stream terraces and at the base of slopes in the Ozark Highlands (fig. 2B). Vegetation in fens primarily consists of grasses, sedges, and reeds; however, some are forested. Fens provide habitat for several unique plant and animal species, includ-



**Figure 1.** Grasshopper Hollow, a fen in the Ozark Highlands of Missouri. (Photograph by Jane Epperson, Missouri Department of Natural Resources.)



ing a disproportionate number of Missouri's rare and endangered plants and invertebrates (Mohlenbrock, 1993). Notable examples of fens include Grasshopper Hollow (fig. 1) and Slaughter Sink.

## HYDROLOGIC SETTING

The existence of wetlands depends on specific topographic and geologic conditions that favor flooding or saturated soils and on the hydrologic processes that allow the water to persist (Winter and Woo, 1990). Wetland hydrology involves complex water-flow patterns that are affected by regional and local geology, topography, soil characteristics, and climate.

Wetlands in Missouri are a result of diverse surface- and ground-water conditions. Surface water collects in topographic lows, and ground water typically discharges there. Soil characteristics determine the rate at which water percolates downward to recharge the ground-water system or discharges from it. Fluctuations in lo-



**Figure 2.** Wetland distribution in Missouri and ecoregions of the State. **A**, Distribution of wetlands and deepwater habitats. **B**, Ecoregions. (Sources: **A**, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. **B**, Omernik, 1987.)

cal precipitation can combine with local geologic differences to create transient or seasonal changes in the interactions of ground water and surface water. Average annual precipitation ranges from 36 to 48 inches per year across Missouri (Waite and Skelton, 1986). The extent of wetland areas located in parts of the State with lower annual precipitation rates, especially those associated with shallow ground-water systems and surface-water runoff, such as fens, depends on the timing and amounts of rainfall. Other wetland areas, such as those along major rivers, are less dependent on local rainfall patterns for their continued existence.

The largest wetlands in Missouri are closely associated with and are directly and indirectly affected by the Mississippi and Missouri Rivers and their tributaries. The flood plains created by the Mississippi and Missouri Rivers have resulted in an area of relatively flat slope that has been flooded frequently. The wetlands of the Missouri bootheel were formed as a result of the New Madrid earthquake (actually a series of earthquakes), which occurred in 1811. Lasting for several months, this catastrophe changed the course of the Mississippi River and greatly changed the topography of the Mississippi Alluvial Plain (McCaig and Boyce, 1988). All of the land from Cape Girardeau south to Arkansas sank from 10 to 50 feet, converting rich bootheel forests into swamp (Johnson and DeLano, 1990). The subsequent flooding in the subsided forested areas following the earthquakes resulted in the formation of large tracts of backwater swamps characterized by water-tolerant trees such as cypress, tupelo gum, water oak, and swamp red maple.

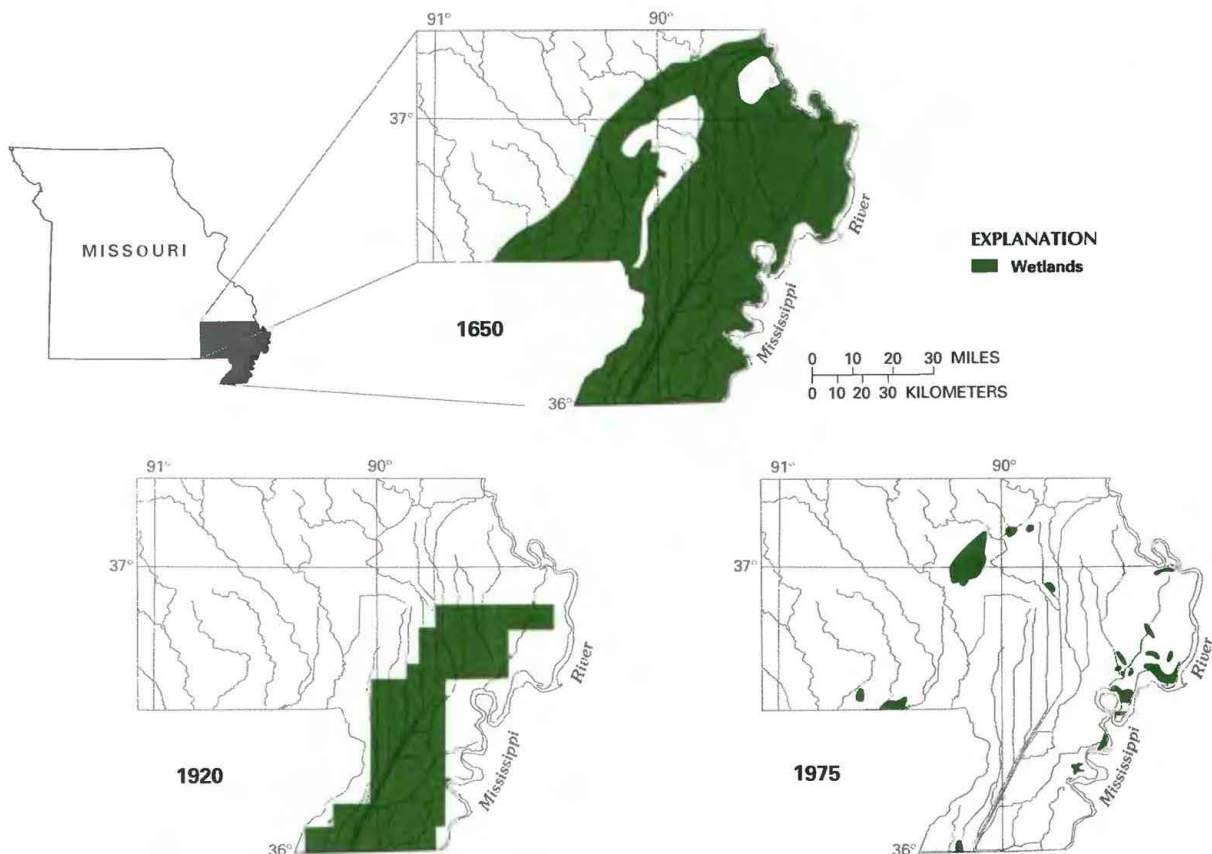
Backwater flooding in the major tributaries of the Mississippi and Missouri Rivers has resulted in the formation of similar wetlands along their flood plains. The existence and continued survival of these forested, scrub-shrub, and emergent wetlands depends on

whether these areas are able to undergo continued flooding and dewatering cycles. Disruption of this continual flooding/dewatering cycle results in (1) replacement of the existing trees by less water-tolerant trees and shrubs when periodic flooding is prevented (such as occurs when levees are built along a river and the flood plain is drained) or (2) lack of recruitment of new trees in areas that become permanently flooded (such as occurs when a river is dammed).

Water in fens is supplied by local shallow ground-water flow systems. These wetlands typically are associated with springs or seeps that discharge at the surface. In Missouri, fens occur in the Ozark Highlands ecoregion. The Ozark Highlands ecoregion is underlain by limestone and dolomite overlain by less easily erodible rock such as sandstone. If sinkholes (formed by the collapse of limestone and dolomite caves) become plugged, fens develop as the result of retention of ground-water discharge or stormwater runoff. Fens are sustained by water that has passed through highly mineralized soils (Mitsch and Gosselink, 1993).

## TRENDS

Wetland losses and the land-use changes that have altered wetland functions and biota began at the time of settlement by Europeans. As of the 1980's, Missouri had only 643,000 acres of wetlands of an estimated 4,844,000 acres of wetlands existing in the 1780's (Dahl, 1990), an 87-percent loss. Large-scale wetland losses began after 1850, when the U.S. Congress passed the Swamp Land Act. The act granted to Missouri 3,432,481 acres of Federal forested wetlands and overflow lands considered unfit for cultivation. The object of the act was to promote flood control in the Mississippi River Valley (Shaw and Fredine, 1971). The remaining 1,410,000



**Figure 3.** Palustrine forested-wetland loss in the Mississippi Alluvial Plain, southeastern Missouri, 1650–1975. (Source: Epperson, 1992.)



acres were transferred to the State during the next few years. Shortly thereafter, the land was transferred to the counties, which in turn sold large tracts at public auction (Epperson, 1992).

By 1912, about 3,500,000 acres of wetlands had been targeted for drainage statewide (Epperson, 1992). Stream channelization and damming also have significantly affected wetlands within Missouri. The primary cause of recent wetland loss, both nationally and statewide, has been conversion of wetlands to agricultural use. Other causes include urban development, flood control, and timber harvesting (Frayer and others, 1983).

The most severe wetland loss has occurred in the southeastern part of the State in the Mississippi Alluvial Plain (fig. 3), where only about 60,000 acres (2.5 percent) of an estimated original 2,400,000 acres of forested wetlands remain intact (Vaught and Bowmaster, 1983). Wetland loss in the southeastern part of the State ranged from 257,000 acres from 1870 to 1890 to 595,000 acres from 1900 to 1920. In the 1930's, fearing that this magnificent wetland forest would be lost, businessmen, residents, and local school children contributed their nickels and dimes to purchase some of the last remnants of the once vast wetland forest. In 1938, more than 1,000 acres were purchased and became the Big Oak Tree State Park (Johnson and DeLano, 1990).

## CONSERVATION

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

*Federal wetland activities.*—Development activities in Missouri 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; and the 1986 Emergency Wetlands Resources 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 encourages wetland protection through funding incentives. The 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.

The Rivers and Harbors Act of 1899 requires a permit for construction or excavation in, over, or under "navigable waters" of the United States. The Corps is the lead agency for administration of this Act. The Lake of the Ozarks and the Osage, Mississippi, and Missouri Rivers are the major navigable waters in Missouri. The Flood Control Act of 1928 authorizes the Corps to construct and maintain levees, floodways, channel modifications, and various control structures for the lower Mississippi River Valley downstream from Cairo, Ill.

The FWS has section 404 responsibilities under the Fish and Wildlife Coordination Act of 1934, National Environmental Policy Act of 1969, and the Endangered Species Act of 1973. The FWS provides advisory comments to the Corps, during section 404 permit-application review on the potential effects on fish, wildlife, and related environmental resources. The FWS is mapping the Nation's wetlands under its National Wetlands Inventory project. Missouri has five National Wildlife Refuges that are managed by the FWS primarily for migratory birds and federally listed threatened and endangered species.

The NPS manages the Ozark National Scenic Riverways, which includes 134 miles of the Current and Jack Fork Rivers. Natural wetland communities are common in the riparian corridors (the area adjacent to a stream or river that is at least occasionally flooded) of these rivers and their tributaries.

*State wetland activities.*—Under section 401 of the Clean Water Act, the Missouri Department of Natural Resources must certify that a proposed federally permitted or licensed activity will not violate State water-quality standards. If section 401 water-quality certification is denied, the Corps must deny the section 404 permit

**Table 1.** Selected wetland-related activities of government agencies and private organizations in Missouri, 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
<b>FEDERAL</b>						
Department of Agriculture						
Consolidated Farm Service Agency .....	...	●		...		...
Forest Service .....	●			●		●
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 .....		●			●	
<b>STATE</b>						
Department of Conservation .....	●	...	●	●	●	●
Department of Natural Resources .....	●	●	●	●	●	●
<b>PRIVATE</b>						
Ducks Unlimited .....	●			●		●
National Audubon Society .....	●			●		
The Nature Conservancy .....	●			●	●	●

application. The Department's Division of State Parks is responsible for preserving, restoring, and managing natural wetland ecosystems through the State park system. The Department of Natural Resources, Division of Geology and Land Survey's Water Resources Program, with extensive public participation, has developed short- and long-term wetland goals for the State, as well as specific recommendations for achievement of the goals. Recently, the Missouri Departments of Natural Resources and Conservation, the FWS, and the NRCS have been working toward a common wetland data base for use by these agencies.

The Missouri Department of Conservation is the State's primary fish and wildlife agency. The Department's Natural Heritage Database is an inventory of wetlands and other natural features owned or managed by the Department, as well as of other wetlands considered by the State to be valuable. The Department also has developed a wetland-management plan to guide its efforts in the restoration and management of wetlands until the year 2000. The key elements of the plan are to (1) protect, restore, and improve wetland habitat, (2) acquire new wetland areas, (3) identify population goals and management strategies for waterfowl, wildlife, furbearer, and fish species, (4) address human use of wetland resources, and (5) identify future research needs.

*Private wetland activities.*—The Nature Conservancy is developing an integrated approach for the conservation and restoration of the Mississippi Alluvial Plain. The organization owns six properties containing wetlands, including ponds, fens, flood-plain forest, and wet prairies. Ducks Unlimited participates in wetland-protection efforts through its involvement in the North American Waterfowl Management Plan. The National Audubon Society conducts a considerable variety of public-education and wetland-preservation programs and projects.

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