

# New Jersey

## Wetland Resources

New Jersey's diverse wetlands are the result of the interaction of geologic events, human activities, and recent hydrologic conditions. The State's location on the East Coast has made it home to plants that include many threatened and endangered species (Tiner, 1985; Reyer and others, 1990). Of 338 rare plants identified in New Jersey by the U.S. Fish and Wildlife Service (FWS), 249 species grow in wetland or aquatic habitats. Major wetlands in the State include the Great Swamp (fig. 1) in the north and the wetlands of the New Jersey Pinelands and estuaries in the south (fig. 2A).

The wetlands of New Jersey are valuable for their fish and wildlife and their contribution to environmental quality, society, and the economy (Tiner, 1985). Wetlands provide spawning and nursery grounds for shellfish such as crabs, clams, oysters, and shrimp and for finfish species such as alewives, blueback herring, bass, white perch, American shad, menhaden, bluefish, sea trout, and mullet. Bird species that include peregrine falcons, snow and Canada geese, and pintail, canvasback, mallard, and black ducks use New Jersey's salt marshes for feeding, migration, and wintering grounds. Beaver and muskrat use wetlands for their homes, and other furbearers such as raccoons, mink, river otter, foxes, mice, and rabbits use wetlands for food and shelter (Tiner, 1985). Many reptile and amphibian species, including the endangered pine barrens tree frog, the blue-spotted salamander, and the endangered bog turtle, also live in the State's wetlands (Susan Lockwood, New Jersey Department of Environmental Protection and Energy, written commun., 1993).

The environmental quality of aquatic habitats is enhanced by wetlands. Wetland soils and vegetation filter or absorb nutrients and can remove heavy metals and other contaminants from waters moving through them (Tiner, 1985). Wetlands reduce turbidity and sediment loading, thereby slowing the rate of siltation of downstream harbors and navigable rivers and streams. The aquatic productivity of wetlands is very high. The net vegetative productivity of a salt marsh can exceed that of a tropical rain forest, and salt marshes support a diverse community of animals that inhabit estuarine waters.

Wetlands have socioeconomic as well as habitat and environmental-quality value (Tiner, 1985). They provide flood- and storm-damage protection, erosion control, and public water supply and allow for the production of economically important natural species such as blueberries, cranberries, wild rice, salt hay, and timber. Cranberry growing is a significant industry in New Jersey; more



**Figure 1.** The Great Swamp National Wildlife Refuge near Meyersville. (Photograph by Mark Hardy, U.S. Geological Survey).

than 3,000 acres of cranberry bog were under private management in 1992. Wetlands also provide many recreational and educational opportunities, including hunting and fishing, nature study, boating, painting and drawing, and photography.

### 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 New Jersey 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 New Jersey are described below.

System	Wetland description
Palustrine .....	Nontidal and tidal-freshwater 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 .....	Nontidal and tidal-freshwater wetlands within an intermittently to permanently flooded lake or reservoir larger than 20 acres and (or) deeper than 6.6 feet. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine .....	Nontidal and tidal-freshwater wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.
Estuarine .....	Tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 part per thousand (ppt) and is variable owing to evaporation and the mixing of seawater and freshwater.
Marine .....	Tidal wetlands that are exposed to waves and currents of the open ocean and to water having a salinity greater than 30 ppt.

An FWS study indicated that, as of the mid-1980's, wetlands covered about 916,000 acres (19 percent) of New Jersey (Tiner, 1985). Although wetlands are present throughout the State, most are in New Jersey's coastal plain. Six of the 10 counties in the Coastal Plain are more than 25 percent wetland; 3 of the remaining 4 are between 10 and 25 percent wetland.

Nearly 99 percent (by area) of New Jersey's wetlands are palustrine or estuarine (Tiner, 1985). Palustrine wetlands generally



are swamps and freshwater lowlands, whereas estuarine wetlands are marshes and associated saltwater wetlands. Two-thirds of the State's wetland acreage is palustrine, and nearly one-third is estuarine. The remaining 1 percent is divided among the other wetland systems. New Jersey's most common palustrine wetland types are swamps (forested wetland), shrub swamps (scrub-shrub wetland), and freshwater marsh and wet meadow (emergent wetland). Bogs (wetlands that have organic soils) are less common and are found mainly in the northwestern part of the State. Palustrine forested wetlands are more abundant and more widely distributed in New Jersey than any other wetland type. They also have the most diverse vegetation. Of the palustrine category, about three-fifths (by area) is deciduous-forested (hardwood swamps), and about one-fifth is evergreen-forested (cedar swamps and pitch-pine lowlands). Nearly

three-fourths of New Jersey's estuarine wetlands is salt and brackish marsh distributed over four major drainage areas: Hudson River–Raritan Bay, Barnegat Bay, New Jersey inland bays, and Delaware Bay (Field and others, 1991).

The location of New Jersey's wetlands is closely related to the State's ecoregion distribution (fig. 2B), as defined by Omernik (1987). The ecoregional structure of the State is, in large part, defined by its physiography (fig. 2C), which is, in turn, determined primarily by its geology and glacial history. The northern part of the State is mostly in the Northern Piedmont Ecoregion and is underlain by sedimentary, igneous, and metamorphic rocks that have been modified in places by glacial action. During the last ice age, glaciation affected the northern one-third of the State, and this was a major factor in the creation of wetlands there. After the glaciers melted, wetlands formed in depressions left by glacial action. Three of the State's physiographic units—the Piedmont, New England, and Valley and Ridge Provinces—largely correspond to the sedimentary and igneous geological units of the northern part of the State and generally coincide with the Northern Piedmont Ecoregion.

The State's southern one-half lies in the Middle Atlantic Coastal Plain ecoregion and is in the Coastal Plain physiographic province, which is underlain by layered sedimentary rocks. Water in the well-drained sandy soils and aquifers of the southern part of the State discharges to the barrier-island embayments of the Atlantic coast and to the Delaware Bay, forming estuarine wetlands along those coasts. Also, freshwater wetlands have formed where water discharges to streams or to depressions in the low-relief landscape.

Human and animal activities also have created wetlands. Beaver have played an important role, creating impoundments behind their dams. Dam building, farm-pond construction, and construc-



#### WETLANDS AND DEEPWATER HABITATS

##### Distribution of wetlands and deepwater habitats—

This map shows the approximate distribution of large wetlands in the State. Because of limitations of scale and source material, some wetlands are not shown

- Predominantly wetland
- Predominantly deepwater habitat



#### ECOREGIONS

- A. Northeastern Highlands
- B. Northeastern Coastal Zone
- C. Northern Appalachian Plateau and Uplands
- D. North Central Appalachians
- E. Middle Atlantic Coastal Plain
- F. Northern Piedmont



#### PHYSIOGRAPHIC DIVISIONS

- A. Valley and Ridge Province
- B. New England Province
- C. Piedmont Province
- D. Coastal Plain Province

**Figure 2.** Wetland distribution in New Jersey and ecological and physical features that control wetland distribution in the State. **A**, Distribution of wetlands and deepwater habitats. **B**, Ecoregions. **C**, Physiography. (Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Omernik, 1987. C, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center.)

tion of artificially engineered wetlands are three of the ways that humans can create wetlands. Wetlands also can be formed by river action (Tiner, 1985).

## HYDROLOGIC SETTING

New Jersey has two geohydrologic regimes—one south of the Fall Line in the Coastal Plain, and the other north of the Fall Line, associated with the State's remaining physiographic provinces. The aquifer system of the Coastal Plain in the southern one-half of the State is composed of alternating layers of unconsolidated clay, sand, and gravel. In contrast, north of the Fall Line, ground water flows through fractured rocks and glacial valley-fill deposits. Precipitation, which is the source of water to the State's hydrologic system, ranges from about 43 inches on the coast to about 47 inches in the northern part. About one-half of the precipitation that reaches the land surface is returned to the atmosphere by evaporation and plant transpiration.

*South of the Fall Line.*—About 95 percent of the State's estuarine wetlands and 75 percent of its marshes and swamplands are in the Coastal Plain. Coastal Plain wetlands constitute about 87 percent of the State's total wetland area (Tiner, 1985). The layered clay, sand, and gravel that make up New Jersey's Coastal Plain form a wedge that dips and thickens to the southeast. From a feather edge along the Fall Line and the Delaware River, the Coastal Plain sediments thicken to more than 1,000 feet at the Continental Shelf. Recharge to the region's shallow ground-water system occurs in interstream areas. Water entering the system flows toward areas of lower altitude, where it returns to the surface as base flow to streams, ponds, and lakes and as leakage to coastal water bodies. Aquifers that are overlain by relatively impermeable clay layers are recharged by precipitation entering outcrop areas near the Fall Line and by slow percolation downward through the confining clay.

Wetlands form where ground water discharges along rivers and streams and in low-lying coastal areas. Farther inland, wetlands form where clay or other impervious materials restrict vertical water movement and provide habitats for hydrophytic vegetation. The forested swamplands in the Coastal Plain are strongly associated with rivers and streams—many of them in the New Jersey Pinelands. Most estuarine wetlands in the Coastal Plain are located in the barrier-island complex that lies along the Atlantic coast south of Point Pleasant and on the coast of the Delaware Bay south of Salem.

*North of the Fall Line.*—Northern New Jersey is underlain by consolidated sedimentary and igneous rocks. In such geohydrologic systems, ground-water storage and flow occur in fractures in the rocks. In the northeastern part of the State, glacial valley-fill sediments also store and transport water. Most of the wetlands in the northern part of the State are palustrine and have formed around water in glacial lakes and depressions that formed at the end of the last ice age. These lakes are gradually filling in with organic matter and becoming emergent, scrub-shrub, or forested wetlands that have organic soils. Water for the wetlands is supplied by precipitation and by ground-water discharge from the surrounding glacial sediments and fractured crystalline rock. Where silt and clay locally confine the aquifers, freshwater wetlands such as the Great Swamp have formed (Vecchioli and others, 1962).

The location and composition of plant communities inhabiting New Jersey's wetlands—both north and south of the Fall Line—are affected by depth of water, water-level fluctuations, soil moisture, and salinity (Penfound, 1952), as well as by other soil properties, biological factors, and human activities.

## TRENDS

The State's wetlands have been drained and filled since settlement by Europeans began in the 1600's. Dahl (1990) estimated that

New Jersey lost 39 percent of its wetlands between about 1780 and 1980. Filling increased markedly following World War II. Tiner (1987) estimates median losses of tidal marshes on a county-by-county basis from 1952 to 1973 at about 30 percent but reports losses of up to 100 percent in two counties. During that period, 2 of New Jersey's 15 counties that contain tidal marsh lost 100 percent of that marsh; 5 other counties lost about 50 percent of their tidal-marsh area. Ferrigno and others (1973) estimated that the loss in tidal-marsh acreage in New Jersey from 1953 to 1973 exceeded 24 percent. Since the enactment of the Wetlands Act of 1970 and the Freshwater Wetlands Protection Act of 1987 by the State, permitted wetland losses have fallen sharply to between 50 and 100 acres per year (Ernest Hahn, New Jersey Department of Environmental Protection and Energy, oral commun., 1992).

Wetlands have been drained primarily for crop production and pasture. Wetlands have been filled for housing, transportation, industrialization, and landfills. Stream channelization, dredging for navigation, and reservoir, harbor, and marina construction also have adversely affected New Jersey's wetlands. In addition to quantitative changes caused by these activities, qualitative changes have resulted from point and nonpoint discharges to surface waters. The discharges are associated with agriculture, logging, industry, municipal sewage, and urban runoff, all of which add contaminants and silt to surface waters (Tiner, 1985). Although the trend has been toward a net loss of wetlands, some wetland area has been added through the construction of ponds and reservoirs and through planned wetland construction.

## CONSERVATION

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

*Federal wetland activities.*—Development activities in New Jersey 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 silvicultural 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

**Table 1.** Selected wetland-related activities of government agencies and private organizations in New Jersey, 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 Commerce						
National Oceanic and Atmospheric Administration .....	•	•	..	..	•	..
Department of Defense						
Army Corps of Engineers .....	•	•	•	..	•	•
Military reservations .....	•	..	..	..	..	..
Department of the Interior						
Fish and Wildlife Service .....	•	..	•	•	•	•
Geological Survey .....	..	..	..	..	•	..
National Biological Service .....	..	..	..	..	•	..
National Park Service .....	•	..	•	•	•	•
Environmental Protection Agency .....	•	..	..	..	•	•
<b>STATE</b>						
Department of Environmental Protection and Energy						
Bureau of Coastal Regulation .....	..	•	•	..	..	•
Bureau of Inland Regulation .....	..	•	•	..	..	•
The Natural Lands Trust .....	•	..	..	•	..	..
Pinelands Commission .....	•	•	..	•	•	•
Rutgers University Center for Coastal and Environmental Studies .....	..	..	..	..	•	..
<b>PRIVATE</b>						
Ducks Unlimited .....	•	..	•	..	•	•
The Nature Conservancy .....	•	..	•	•	•	..
The New Jersey Conservation Foundation .....	..	..	..	•	•	•
The Trust for Public Lands .....	..	..	..	•	..	..
Private cranberry growers .....	•	..	..	..	..	..

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) 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 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 wetlands in New Jersey have been specially designated for research, protection, education, or other purposes. The 13,080-acre Edwin B. Forsythe National Wildlife Refuge has been designated a wetland of international significance by the FWS under the Ramsar Convention. (The Ramsar Convention on Wetlands of International Importance, named for Ramsar, Iran, where the conven-

tion was held, is an intergovernmental treaty that forms the basis for international cooperation in conserving wetland habitats.) Also, Supawna Meadows on the Delaware Bay, Cape May, and the Great Swamp are National Wildlife Refuges. Many other New Jersey wetlands are in State Wildlife Management Areas. The New Jersey Pinelands extends across much of the eastern part of southern New Jersey. Most of the Pinelands, including its wetlands, is part of the Atlantic Coastal Plain Biosphere Reserve of the United Nations Man and the Biosphere program (Good and Good, 1984). In the Pinelands, the Mullica River estuary is part of the Experimental Ecological Reserve network. The Mullica River also is being considered as a site for a National Estuarine Research Reserve.

**State Wetland Activities.**—State laws governing wetlands are the Hackensack Meadowlands Reclamation and Development Act of 1969, the Wetlands Act of 1970, the Waterfront Development Act of 1914, the Coastal Area Facility Review Act of 1973, the Flood Hazard Area Control Act of 1979, the Pinelands Protection Act of 1979, and the Freshwater Wetlands Protection Act of 1987. State agencies that have a role in wetland conservation include the Delaware River Basin Commission, the New Jersey Department of Environmental Protection and Energy, and the Pinelands Commission. The Department of Environmental Protection and Energy administers the Wetlands Act of 1970, the Coastal Area Facility Review Act, the Waterfront Development Act of 1914, the Flood Hazard Control Act of 1979, and the Freshwater Wetlands Protection Act of 1987. The Pinelands Protection Act of 1979 is administered by the Pinelands Commission. A summary of these laws can be found in a publication by the Department of Environmental Protection and Energy (1992).

In addition to its wetland-management activities, New Jersey also is active in data collection and public education regarding wetlands. The State's Natural Heritage Program maintains a data base of rare plant, animal, and natural communities, and its Natural Areas program administers 42 areas that are set aside for public use and education. New Jersey also runs the Delaware Estuary Research Program and the Natural Lands Trust, a land-bank program. The Natural Lands Trust has protected between 6,000 and 7,000 acres of New Jersey wetlands, mostly salt marsh, and was active in obtaining designation of the Delaware Bay as a Ramsar site. The Rutgers University Center for Coastal and Environmental Studies performs research and data-collection activities.

**Private wetland activities.**—Several private organizations are active in New Jersey wetlands protection. The New Jersey Conservation Foundation has a wetland-acquisition program and was instrumental in obtaining passage of the New Jersey Freshwater Wetlands Protection Act. The Trust for Public Lands also administers a wetland-acquisition program. The Nature Conservancy and Ducks Unlimited acquire and manage wetlands, conduct research on the preservation of endangered species, and work to create and restore wetland areas. Cranberry growers also manage several thousand acres of wetlands.

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