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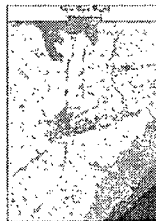
***SIGNIFICANT HABITATS
AND HABITAT COMPLEXES
OF THE
NEW YORK BIGHT WATERSHED***

U.S. FISH AND WILDLIFE SERVICE

**SOUTHERN NEW ENGLAND - NEW YORK BIGHT
COASTAL ECOSYSTEMS PROGRAM**

CHARLESTOWN, RHODE ISLAND

**COMPLETED NOVEMBER 1996
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SIGNIFICANT HABITATS AND HABITAT COMPLEXES OF THE NEW YORK BIGHT WATERSHED

New Jersey Pinelands COMPLEX #2

List of Species of Special Emphasis

Maps

I. SITE NAME: New Jersey Pinelands

II. SITE LOCATION: The core region of the New Jersey Pinelands, exclusive of its northern outliers, extends north-south 100 kilometers (177 miles) from Lakehurst to Cape May, New Jersey, between the Garden State Parkway on the east and the inland extent of pine barren communities on the west. The habitat complex consists of a mosaic of upland, aquatic, and wetland habitats occupying a contiguous area of well over 400,000 hectares (1+ million acres) on the outer section of the Atlantic Coastal Plain of southeastern New Jersey about 130 kilometers (80 miles) south of New York City.

TOWNS: 56 municipalities (see list)

COUNTIES: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth (outliers), Ocean

STATE: New Jersey

USGS 7.5 MIN QUADS: Sea Isle City, NJ (39074-26), Woodbine, NJ (39074-27), Heislerville, NJ (39074-28), Ocean City, NJ (39074-35), Marmora, NJ (39074-36), Tuckahoe, NJ (39074-37), Port Elizabeth, NJ (39074-38), Pleasantville, NJ (39074-45), Mays Landing, NJ (39074-46), Dorothy, NJ (39074-47), Five Points, NJ (39074-48), Tuckerton, NJ (39074-53), New Gretna, NJ (39074-54), Green Bank, NJ (39074-55), Egg Harbor City, NJ (39074-56), Newtonville, NJ (39074-57), Buena, NJ (39074-58), West Creek, NJ (39074-63), Oswego Lake, NJ (39074-64), Jenkins, NJ (39074-65), Atsion, NJ (39074-66), Hammonton, NJ (39074-67), Williamstown, NJ (39074-68), Forked River, NJ (39074-72), Brookville, NJ (39074-73), Woodmansie, NJ (39074-74), Chatsworth, NJ (39074-75), Indian Mills, NJ (39074-76), Medford Lakes, NJ (39074-77), Clementon, NJ (39074-78), Toms River, NJ (39074-82), Keswick Grove, NJ (39074-83), Whiting, NJ (39074-84), Browns Mills, NJ (39074-85), Pemberton, NJ (39074-86), Mount Holly, NJ (39074-87), Moorestown, NJ (39074-88), Newfield, NJ (39075-51), Pitman East, NJ (39075-61), Runnemede, NJ (39075-71), Lakehurst, NJ (40074-13), Cassville, NJ (40074-14), New Egypt, NJ (40074-

15), Columbus, NJ (40074-16), Asbury Park, NJ (40074-21), Farmingdale, NJ (40074-22), South Amboy, NJ (40074-43), New Brunswick, NJ (40074-44)

USGS 30 x 60 MIN QUADS: Cape May, NJ (38074-E1), Atlantic City, NJ (39074-A1), Hammonton, NJ (39074-E1), Wilmington, DE-NJ-PA-MD (39075-E1), Trenton, NJ-PA-NY (40074-A1)

III. BOUNDARY DESCRIPTION AND JUSTIFICATION: The New Jersey Pinelands habitat complex as defined here occupies more than one-quarter of the state of New Jersey's land area, and its major boundary approximates, in large part, the boundaries established for the Pinelands National Reserve and the state Pinelands Area. One important boundary distinction between those two areas is that the federal Reserve, totaling 445,000 hectares (1.1 million acres), includes land east of the Garden State Parkway and to the south bordering Delaware Bay that is omitted from the 379,204-hectare (937,000-acre) state Pinelands Area. The eastern boundary of this report's New Jersey Pinelands significant habitat complex follows closely the boundary established by the state, except in a few instances such as in the vicinity of Great Egg Harbor and sections in the northeastern area adjacent to state wildlife management areas. For the most part, the tidal estuarine waters and wetlands of the major Pinelands rivers and coastal streams are treated in this report under the backbarrier beach and lagoon complexes (see narratives for the Great Egg Harbor Estuary habitat complex and the Mullica River - Great Bay Estuary habitat complex). The northern portion of Cape May, included with the Cape May Peninsula habitat complex, contains similar upland and wetland communities to those found in the Pinelands. The many small developed areas and communities scattered throughout the Pinelands are so numerous that, for the sake of practicality, they are not excluded from the boundary designation even though they are not considered suitable habitat for the diversity of fish, wildlife, and plants occurring in the Pinelands. This boundary encloses the entire New Jersey Pinelands, a regionally and globally significant ecosystem supporting a unusual diversity of rare communities and species. Although the boundary includes the entire New Jersey Pinelands in both the New York Bight and Delaware Bay watersheds, the emphasis of this narrative is on the land and water areas within the New York Bight watershed.

IV. OWNERSHIP/PROTECTION/RECOGNITION: The Pinelands National Reserve, the country's first national reserve, was created by the National Parks and Recreation Act of 1978. At the state level, the Pinelands Protection Act of 1979 provided for implementation of the federal bill. A Pinelands Commission was established which created a comprehensive management plan (CMP) to balance protection and development interests; the plan was adopted in 1980 and approved in 1981. The comprehensive management plan established a 136,380-hectare (337,000-acre) core preservation district to be maintained in its natural state through strict regulation of development, and a protection area where there are various categories of land use (forest, agriculture, regional growth, rural development, pinelands, towns and villages, military and federal institutions) based on existing natural features and projected need.

Approximately one-third of the Pinelands is publicly owned. Of the nearly 400,000-hectare (1 million-acre) Pinelands, there are 30,000 hectares (75,000 acres) of federal properties, including portions of E.B. Forsythe and Cape May National Wildlife Refuges managed by the

U.S. Fish and Wildlife Service, and military installations such as Fort Dix, McGuire Air Force Base, and Lakehurst Naval Air Engineering Center, plus about 110,000 hectares (275,000 acres) of state-owned lands. State forests managed by the New Jersey Division of Parks and Forests include Bass River, Bass River North, Belleplain, Lebanon, Penn, and Wharton, and state parks include Belleplain, Double Trouble, and Wharton. Designated Natural Areas contained within the state forests include Batsto, Cedar Swamp, Oswego River, and West Pine Plains. State Wildlife Management Areas managed by the New Jersey Division of Fish, Game and Wildlife include Collier's Mill, Greenwood Forest, Makepiece, Manchester, Pasadena, Peaselee, Stafford Forge, Swan Bay, Whiting, and Winslow. The New Jersey Natural Lands Trust owns 14 parcels within the Pinelands. The Nature Conservancy owns Hirst Ponds Preserve.

The Pinelands National Reserve is part of the Atlantic Coastal Plain Biosphere Reserve designated by UNESCO under the Man and Biosphere program. The lower Mullica River and Great Bay have been designated a National Estuarine Research Reserve for research and education to be managed by the New Jersey Division of Fish, Game and Wildlife and Rutgers University. Thirty-nine miles of the Great Egg Harbor River and 89 miles of its tributaries were designated as National Wild and Scenic Rivers in recognition of their relatively pristine condition. A river conservation plan has been developed for the Great Egg Harbor River as part of this designation, and participating municipalities are developing local river management plans. The Maurice River and its tributaries, the Menantico River, Manumuskin Creek, and Muskee Creek, in the Delaware drainage were also designated as National Wild and Scenic Rivers. The Lower Atsion River, a tributary of the Mullica River, has been designated a Wild and Scenic River under the New Jersey Wild and Scenic Rivers Act. The Nature Conservancy has designated the Delaware Bayshores, including the Manumuskin River Watershed in the Pinelands, as a Bioreserve, one of their "Last Great Places." All waters in the Pinelands have been designated by the U.S. Environmental Protection Agency as Outstanding Natural Resource Waters that are to be protected from any change in water quality.

The U.S. Fish and Wildlife Service has identified several wetland areas in the New Jersey Pinelands as priority wetland sites under the federal Emergency Wetlands Resources Act of 1986; these include Hospitality Branch, Lake Pines, Oswego River Lowlands Macrosite, West Branch Wading River, and Manumuskin River Complex. Wetlands are regulated in New Jersey under several state laws, including the Freshwater Wetland Protection Act and Wetlands Act of 1970; these statutes are in addition to federal regulation under Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act of 1977, and various Executive Orders.

The New Jersey Natural Heritage Program recognizes numerous Priority Sites for Biodiversity (scorecard sites) within the New Jersey Pinelands. Pinelands sites in the New York Bight watershed are listed here along with their biodiversity ranks: Batsto Macrosite (B1 - outstanding biodiversity significance), East Plains (B1), Hirst Ponds (B1), Long Savanna (B1), Oswego River Lowlands Macrosite (B1), West Branch Wading River Macrosite (B1), West Plains (B1), Ancora Bogs (B2 - very high biodiversity significance), Atco Lake (B2), Atlantic Goose Ponds (B2), Atsion Burn (B2), Atsion Recreation Area Site (B2), Bear Swamp Hill Lowland (B2), Berlin Avenue Bogs (B2), Colliers Mills (B2), Cologne Road RR West (B2), Columbia Road Swales (B2), Drosera Street Site (B2), Frankfurt Avenue Bog (B2), Holly Street Pond (B2), Hunters Mill Site (B2), Little Plains (B2), Mackenzie Swales (B2), Manapqua Dry Burn (B2), Manapqua Lowlands (B2), Pond 74 (B2), Reading At Darmstadt (B2), Reega (B2), Sand Ridge Pond (B2), Pits And Pond (B2), Spring Hill Plains (B2), Whiting Clay Pits (B2), Winslow Pond (B2), Woodbine Bogs (B2), Woodbine Pond (B2), Archers Meadow (B3 - high biodiversity significance), Bill Henry Pond (B3), Blacks Branch (B3), Cape May Avenue Site (B3), Cape May Pond (B3), Cassville (B3), Chatsworth Goose Pond (B3), Five Acre Pond (B3), Hospitality Branch (B3), Laurel Street Pond (B3), Marsh Lake (B3), Odd Pond (B3), Peaslee Pond (B3), St. James

Pond (B3), Wading River Tidal Marsh (B3), Warren Grove (B3), Weymouth Avenue Pond (B3), Atlantic City Airport (B4 - moderate biodiversity significance), Bamber Macrosite (B4), Bass River Macrosite (B4), Chatsworth East Macrosite (B4), Chatsworth Woods Macrosite (B4), Clarks Landing Bog (B4), Crossley Railroad Corridor Macrosite (B4), Hammonton Field (B4), northeast of Weekstown (B4), Pomona Woods (B5 - general biodiversity significance), and Scullville (B5).

Additional scorecard sites occur within the Delaware Bay drainage of the Pinelands. These sites are listed here and shown on the maps but are not discussed in the narrative. They include Belleplain Pond South (B2), Fort Dix Line (B2), Manumuskin River Macrosite (B2), Pole Bridge Branch (B2), Whitesbog (B2), Pasadena Goose Pond (B3), Shinns Branch (B3), Belleplain Gravel Pit Site (B4), Johnson Place (B4), Mt. Misery (B4), Onga Hat Site (B5), and Pickle Factory Pond (B5). Scorecard sites that contain pine barrens communities and are outside the Pinelands boundary are listed here, but are not discussed further in the narrative. These include Shark River Station site (B2), Browntown (B4), Helmetta (B4), and Manasquan River (B5).

V. GENERAL AREA DESCRIPTION: The Pinelands is a large mosaic of contiguous forest and wetland habitats occurring on the gently rolling Outer Atlantic Coastal Plain of New Jersey between 15 to 46 meters (50 to 150 feet) above sea level. This ecosystem exists on the unconsolidated coastal plain sands, silts, and gravels that yield generally sandy, acidic (average pH of 4.0), well-drained soils. The Pinelands overlay the huge aquifer of the Cohansey and Kirkwood formations. This aquifer is close to the surface; in approximately 15 to 20% of the Pinelands, the water table is near or above the surface during some part of the year, and wetlands make up about one-third of the Pinelands total land area.

The Pinelands is distinctive for the widespread occurrence of dry pine, oak, and heath communities in a humid, temperate, deciduous forest climate. The presence of pine barrens in this climate results from the success of low-nutrient and fire-adapted species in invading and maintaining themselves competitively over the last several thousand years on the sandy, well-drained, nutrient-poor soils. Pinelands vegetation is also distinctive for its strong differentiation of plant communities in an area of low topographical relief. The uplands and lowlands have communities that are quite distinct from one another, controlled primarily by soil moisture differences. These upland and lowland communities are described below.

Uplands in the New Jersey Pinelands are predominantly vegetated by pine-oak forests and oak-pine forests. In the pine-oak forests, pitch pine (*Pinus rigida*) is dominant, with less than 25% cover of oak trees, including black oak (*Quercus velutina*), chestnut oak (*Q. prinus*), scarlet oak (*Q. coccinea*), and white oak (*Q. alba*). In oak-pine forests, larger tree-form oaks are more dominant than are pines, and shortleaf pine (*Pinus echinata*) often dominates over pitch pine. The dominant oak species is generally black oak to the north of the Mullica River and southern red oak (*Quercus falcata*) to the south of the Mullica River, with varying abundance of chestnut, scarlet, and white oak. The understory and shrub layers are generally dominated by heaths such as lowbush blueberry (*Vaccinium vacillans*), black huckleberry (*Gaylussacia baccata*), and mountain laurel (*Kalmia latifolia*), as well as sweet fern (*Comptonia peregrina*) and inkberry (*Ilex glabra*).

The dwarf pine plains community is a pitch pine forest dominated by dwarf (less than 3 meters [11 feet]) pines, along with blackjack and

scrub oak (*Quercus marilandica* and *Q. ilicifolia*). Almost all of the cones produced by these pine trees are of the closed cone (serotinous) type, characteristic of pine barrens areas experiencing frequent wildfires. There is a notable absence of oak species common in other parts of the Pinelands, such as black, scarlet, white, and chestnut oak, as well as shortleaf pine. The shrub and herb layers are generally dominated by sheep laurel (*Kalmia angustifolia*) and mountain laurel, sweet fern, and sand-myrtle (*Leiophyllum buxifolium*), and ground covers such as wintergreen (*Gaultheria procumbens*), bearberry (*Arctostaphylos uva-ursi*), trailing arbutus (*Epigaea repens*), and patches of broom crowberry (*Corema conradii*). Pyxie moss (*Pyxidanthra barbulata*) and false heather (*Hudsonia ericoides*) are often abundant in the dwarf pine plains. This community has evolved under severe environmental conditions, including frequent fires and nutrient-poor soils. Two large dwarf pine plains areas, the East Plains and the West Plains, and two smaller areas, Little Plains and Spring Hill Plains, occur in the Pinelands. These fire-maintained communities are primarily located in the eastern Pinelands, north and east of the Mullica and Wading Rivers and south of Cedar Creek. The extent of these communities is generally defined by the firesheds, i.e., those extensive upland areas between major waterbodies that are susceptible to uninterrupted burns.

Lowland areas in the Pinelands support a diversity of wetland communities, including Atlantic white cedar (*Chamaecypris thyoides*) swamps, hardwood swamps, pitch pine lowland forests, shrub swamps, marshes, and pine barren savannas. The wetland forests of the Pinelands are dominated by Atlantic white cedar, red maple (*Acer rubrum*), and black gum (*Nyssa sylvatica*), with pitch pine, gray birch (*Betula populifolia*), and sassafras (*Sassafras albidum*) as associates. In the Atlantic white cedar swamps, stands of white cedar are relatively dense. Tall pitch pines, red maple, black gum, and sweetbay (*Magnolia virginica*) sometimes form an understory, and the shrub layer contains highbush blueberry (*Vaccinium corymbosum*), dangleberry (*Gaylussacia frondosa*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), fetterbush (*Leucothoe racemosa*), and bayberry (*Myrica pensylvanica*). There is a sparse but diverse herbaceous vegetation layer, and thick hummocks and mats of *Sphagnum* mosses. Many streams in the Pinelands flow through narrow (generally not more than 300 meters [1,000 feet] wide) bands of Atlantic white cedar swamps from their headwaters all the way to the limit of tidal influence. Hardwood swamps in the Pinelands are dominated by red maple, with black gum and sweetbay as associates. Hardwood swamps are often contiguous with cedar swamps and may replace cedar swamps after extensive logging. Pitch pine lowland forests are dominated by dense stands of pitch pine, with lesser numbers of red maple and black gum, and a well-developed understory including black huckleberry, sheep laurel, and dangleberry, with leatherleaf (*Chamaedaphne calyculata*) in the wetter sites. These lowland forests occur as fringing swamps along streams in the pine barrens and in depressions and other poorly drained sites.

Herbaceous wetlands occur around depressions and along streams in the pine barrens. Near the ponds are fragrant waterlily (*Nymphaea odorata*), yellow waterlily (*Nuphar variegatum*), bladderworts (*Utricularia* spp.) and other submerged and floating-leaved vegetation. Peat mosses, sedges (*Carex* spp.), rushes (*Juncus* spp.), pipeworts (*Eriocaulon* spp.), chain ferns (*Woodwardia* spp.) and other emergent plants occur along the shorelines of ponds and streams. Pine barren savannas are grass and sedge-dominated wet meadow communities that occur in floodplains of pine barren streams; they are often separated from the streams by a levee and vegetated by lowland broomsedge (*Andropogon virginicus* var. *abbreviatus*), Torrey's dropseed (*Muhlenbergia torreyana*), bullsedge (*Carex bullata*), coast sedge (*Carex exilis*), and golden crest (*Lophiola americana*). This community type in the Pinelands has been reduced in extent from thousands of hectares to no more than 400 hectares (1,000 acres) at present. Most pine barren savannas have succeeded into shrub and forested swamps due to a lack of natural or human disturbance. Pine barren shrub swamps are dominated by leatherleaf, often associated with highbush blueberry or inkberry and growing on *Sphagnum* mats.

Coastal plain intermittent ponds (vernal ponds) with seasonally fluctuating water levels have seasonally saturated soils typically dominated by sedges (*Carex walteriana*, *Eleocharis microcarpa*, *Scleria reticularis*, and *Cladium mariscoides*) and panic and muhly grasses (*Panicum verrucosum*, *P. mattamuskeettense*, *P. capillare*, and *Muhlenbergia torreyana*), and usually contain several rare species. There are several locations in the Pinelands where soil has been artificially and mechanically excavated down to the water table, resulting in seasonally saturated soils similar to those of natural intermittent ponds and supporting some of the same plant and animal species, though generally at much lower diversities.

Surface waters in the Pinelands include streams, lakes, and bogs. Pine barrens streams flow in broad shallow valleys and mostly flow east and south into the New York Bight. The streams are slow-flowing, with sand and gravel substrates. Ground water discharge accounts for 89% of annual stream discharge. Close contact with the underlying aquifer keeps the streams relatively cool (about 25°C [77°F] in summer). The stream waters are generally of exceptional quality, rich in humic acids that give these streams their characteristic brown tea color, low in dissolved solids, and quite acidic, with an average pH of about 4.4. While these high-quality acid waters support indigenous fish and amphibian communities that are tolerant of the acidity of the waters, they are inhospitable to many non-indigenous plant and animal species. The acidic waters in the Pinelands support a unique algal flora. The insect fauna include abundant dragonflies and damselflies (Odonata) and whirligig beetles (Gyrinidae), a notable absence of mayflies (Ephemeroptera), and few caddisflies (Trichoptera) and other aquatic insect groups. Scattered throughout the river systems are human-made lakes and cranberry bogs. Elevated levels of pH, biochemical oxygen demand, magnesium, calcium, nitrates, and phosphates occur in wetlands disturbed by agricultural, residential, and urban land uses.

VI. ECOLOGICAL SIGNIFICANCE/UNIQUENESS OF SITE: The New Jersey Pinelands is the largest area of contiguous, undeveloped forest and wetland on the Atlantic Coastal Plain of the Mid-Atlantic region. The New Jersey Pinelands is the largest pine barrens complex in the world, and the mosaic of globally rare upland and wetland communities and species found here is of national significance. The Pinelands supports a number of endemic plant and animal species, several glacial relict species, and a few northern and numerous southern species that reach their geographical Coastal Plain limits in the Pinelands. Also, 24 plant taxa (type localities) were described from specimens originally discovered growing in the New Jersey Pinelands. The Pinelands overlay one of the largest aquifers in the country, and the wetlands and pristine headwaters arising within the Pinelands support a unique assemblage of indigenous species and are critical for the water quality and productivity of the New Jersey backbarrier lagoon estuaries.

There are 223 species of special emphasis in the New Jersey Pinelands, incorporating 84 species of plants and 75 species of birds, and including the following federally and state-listed species. (Living resources and their habitats are dynamic; therefore, the ecological significance and species information presented here may not be complete or up-to-date. State and federal environmental agencies [see Appendix III for office contacts] should be consulted for additional information.)

Federally listed endangered
chaffseed (*Schwalbea americana*)

Federally listed threatened

bald eagle (*Haliaeetus leucocephalus*)
Knieskern's beaked-rush (*Rhynchospora knieskernii*)
swamp pink (*Helonias bullata*)
sensitive joint-vetch (*Aeschynomene virginica*)

Federal candidate

bog turtle (*Clemmys muhlenbergii*)
bog asphodel (*Narthecium americanum*)

Federal species of concern⁽¹⁾

rare skipper (*Problema bulenta*)
Buchholz's dart (*Agrotis buchholzi*)
Daecke's pyralid moth (*Crambus daeckellus*)
Lemmer's pinion moth (*Lithophane lemmeri*)
Carter's noctuid moth (*Spartiniphaga carterae*)
northern pine snake (*Pituophis m. melanoleucus*)
cerulean warbler (*Dendroica cerulea*)
variable sedge (*Carex polymorpha*)
Long's bulrush (*Scirpus longii*)
New Jersey rush (*Juncus caesariensis*)
Hirst's panic grass (*Panicum hirstii*)
pine barren boneset (*Eupatorium resinosum*)
Boykin's lobelia (*Lobelia boykinii*)
Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*)
awned meadowbeauty (*Rhexia aristosa*)

¹Species of special concern listed here include former Category 2 candidates.

State-listed endangered

Cope's gray treefrog (*Hyla chrysoscelis*)
eastern tiger salamander (*Ambystoma t. tigrinum*)
timber rattlesnake (*Crotalus horridus*)
corn snake (*Elaphe guttata*)
pied-billed grebe (*Podilymbus podiceps*)
Cooper's hawk (*Accipiter cooperii*)
red-shouldered hawk (*Buteo lineatus*)

upland sandpiper (*Bartramia longicauda*)
least tern (*Sterna antillarum*)
vesper sparrow (*Pooecetes gramineus*)
southern arrowhead (*Sagittaria australis*)
quill-leaf arrowhead (*Sagittaria teres*)
Lancaster flatsedge (*Cyperus lancastricensis*)
coast flatsedge (*Cyperus polystachyos* var. *texensis*)
knotted spikerush (*Eleocharis equisetoides*)
rough cottongrass (*Eriophorum tenellum*)
thread-leaved beaked-rush (*Rhynchospora filifolia*)
grass-like beaked-rush (*Rhynchospora globularis*)
small-headed beaked-rush (*Rhynchospora microcephala*)
Virginia bunchflower (*Melanthium virginicum*)
false asphodel (*Tofieldia racemosa*)
pine barren bellwort (*Uvularia puberula*)
death-camus (*Zigadenus leimanthoides*)
yellow fringeless orchid (*Platanthera integra*)
lace-lip ladies'-trèsses (*Spiranthes laciniata*)
Pickering's reedgrass (*Calamagrostis pickeringii*)
wrinkled jointgrass (*Coelorachis rugosa*)
long-awned smokegrass (*Muhlenbergia capillaris*)
sand yellow-eyed grass (*Xyris caroliniana*)
fringed yellow-eyed grass (*Xyris fimbriata*)
swamp or low rough aster (*Aster radula*)
boltonia (*Boltonia asteroides* var. *glastifolia*)
pale Indian plantain (*Cacalia atriplicifolia*)
false boneset (*Kuhnia eupatorioides*)
Virginia false-gromwell (*Onosmodium virginianum*)
buttonbush dodder (*Cuscuta cephalanthi*)
broom crowberry (*Corema conradii*)
butterfly pea (*Clitoria mariana*)
sessile-leaved tick-trefoil (*Desmodium sessilifolium*)
slender water-milfoil (*Myriophyllum tenellum*)
two-flowered bladderwort (*Utricularia biflora*)
dwarf white bladderwort (*Utricularia olivacea*)
reversed bladderwort (*Utricularia resupinata*)
sandplain flax (*Linum intercursum*)

chickasaw plum (*Prunus angustifolia*)
pine barrens treefrog (*Hyla andersonii*)

State-listed threatened

eastern mud salamander (*Pseudotriton m. montanus*)
wood turtle (*Clemmys insculpta*)
American bittern (*Botaurus lentiginosus*)
barred owl (*Strix varia*)
red-headed woodpecker (*Melanerpes erythrocephalus*)
grasshopper sparrow (*Ammodramus savannarum*)
bobolink (*Dolichonyx oryzivorus*)
great blue heron (*Ardea herodias*)

Pine plains communities occur only in the New Jersey Pinelands, and are considered critically imperiled globally (G1) by The Nature Conservancy. Similar dwarf pitch pine communities occur in the Long Island Pine Barrens (dwarf pine plains) and on the Shawangunk Ridge in southeastern New York (dwarf pine ridges) but have different associated species. The dwarf pitch pine communities in the New Jersey Pinelands are by far the largest in the world. The two largest Pinelands sites are the **East Plains** to the south of the Oswego River, and the **West Plains** to the north of the Oswego River. Two smaller sites, the **Little Plains** and the **Spring Hill Plains**, also occur to the north of the river. The potential extent of these communities is defined by their firesheds and their riparian boundaries, which prevent the spread of wildfires beyond these areas. These sites support several globally rare moth species, including Buchholz's dart moth and Carter's noctuid moth, both of which are endemic to the New Jersey Pinelands and occur only in habitats that have frequent, intense fires. Other rare moth species include the noctuid moths *Apharetra purpurea*, *Chytonix sensilis*, and *Zanclognatha* sp. 1, pine barrens underwing (*Catocala herodias gerhardi*), jair underwing (*Catocala jair* ssp. 2), notodontid moth *Heterocampa varia*, spanworm moth (*Itame* sp. 1), Lemmer's pinion moth (*Lithophane lemmeri*), Doll's merolonche (*Merolonche dolli*), and coastal swamp metarranthis (*Metarranthis pilosaria*). Numerous other regionally rare Lepidoptera (butterflies and moths) also occur here and in other fire-maintained communities in the Pinelands. The regionally rare species broom crowberry, a northern plant species, occurs, sometimes abundantly, in these pine plains communities, reaching the southern limit of its range here. The northern pine snake also occurs in these dwarf pine plains communities, nesting in open sandy areas. The **Manapaqua dry burn site** in the northern Pinelands is a xeric, stunted, and open pitch pine-blackjack oak woodland that contains several rare insect species including pine barrens underwing, notodontid moth *Heterocampa varia*, spanworm moth, pine barrens zale (*Zale* sp. 1), and pink streak (*Faronta rubripennis*).

Pitch pine lowlands support a number of rare plant and insect species, especially where there have been recent fires. The **Atsion burn area** is an 809-hectare (2,000-acre) site that burned in 1984, leaving bare sand exposed in many areas. This site is the largest pitch pine lowland in the Pinelands. Rare plants include pine barren reedgrass (*Calamovilfa brevipilis*), Barratt's sedge (*Carex barrattii*), elliptical rushfoil (*Crotonopsis elliptica*), pine barren boneset, pine barren gentian (*Gentiana autumnalis*), and pine barren smokegrass (*Muhlenbergia torreyana*). Rare insects include the endemic Buchholz's dart moth and Carter's noctuid moth, as well as the noctuid moth *Apharetra purpurea*, notodontid moth *Heterocampa varia*, coastal swamp metarranthis, granitosa fern moth (*Calloplistria granitosa*), hand-maid moth

(*Datana ranaeiceps*), Buchholz's gray moth (*Hypomecis buchholzaria*), southern ptichodis (*Ptichodis bistrigata*), and *Loxagrotis* sp. 2. Other pitch pine lowlands areas include the **Astion Recreation Area**, **Bear Swamp Hill Lowland**, and **Manapaqua Lowlands**. The Manapaqua Lowlands supported the only known extant occurrence of the Daeke's pyralid moth in the world, plus several other globally rare moth species. Other pitch pine lowland sites with rare plant occurrences include Cassville and Colliers Mills.

Riverine lowlands contain wetland complexes, including pine barrens streams, Atlantic white cedar swamps, hardwood swamps, pine barrens savannas, and pitch pine lowland forests, along with adjacent pine-oak and oak-pine forests. The major high-quality occurrences of these sites are in tributaries flowing into the Mullica River, primarily the **Batsto River**, **West Branch of the Wading River**, **Oswego River**, and **Bass River**. Similar but smaller sites occur on the **Middle Branch of the Forked River** and **Blacks Branch of the Toms River** in the northeastern Pinelands, and on other pine barrens streams. Rare plants include Pickering's reedgrass, pine barren reedgrass, Barratt's sedge, pine barren boneset, pine barren gentian, New Jersey rush, sandplain flax, pine barren smokegrass, bog asphodel, yellow fringeless orchid, Knieskern's beaked-rush, pale beaked-rush (*Rhynchospora pallida*), curly grass fern (*Schizaea pusilla*), false asphodel (*Tofieldia racemosa*), reversed bladderwort, Canby's lobelia (*Lobelia canbyi*), sheathed panic grass (*Panicum scabriusculum*), Pickering's morning-glory, and sand yellow-eyed grass. Sites within these wetland complexes that are maintained in early successional stages support the majority of the remaining populations of the endemic Knieskern's beaked-rush occurring in natural habitat. Especially important habitats appear to be bog-iron deposits found adjacent to slow-moving streams. These wetlands are a stronghold for the globally imperiled federal candidate species bog asphodel at the northern end of its range and are an important area for the globally imperiled New Jersey rush. This is the northern end of the range for Pickering's morning-glory, and the southern end of the range for the regionally rare curly grass fern, which prefers *Sphagnum* hummocks under Atlantic white cedar trees. Rare insects include the barrens bluet (*Enallagma recurvatum*) and double-ringed pennant (*Celithemis verna*) damselflies, the precious underwing (*Catocala p. pretiosa*) and Carter's noctuid moths, and the Lakehurst satyr butterfly (*Neonympha areolatus septrionalis*). Riverine lowland areas support at least 17 species of amphibians and reptiles. Rare amphibians and reptiles that utilize the wetlands and adjacent uplands include the only known Coastal Plain occurrences of bog turtle, as well as pine barrens treefrog and pine snake, in the New York Bight study area. Spotted turtle (*Clemmys guttata*) are an abundant, but possibly declining, species in these habitats. **Long Savanna**, located along the Batsto River, is the largest and best example in New Jersey of a pine barrens savanna, a globally imperiled community. Atlantic white cedar and red maple swamps at the headwaters of streams, particularly in the Delaware drainage, support a large percentage of the remaining populations of swamp pink in the world. A few white cedar swamps in the New York Bight drainage also support this species. The southern bog lemming (*Synaptomys cooperi*) occurs where it is often the dominant small mammal in open bog areas characterized by *Sphagnum* moss, leatherleaf, huckleberry, and sedges. The southern red-backed vole (*Clethrionomys gapperi*) is the dominant small mammal in mature Atlantic white cedar swamps.

Northern Pinelands headwaters areas are contiguous wetland and upland habitat areas occurring in the northern part of the New Jersey Pinelands and supporting rare reptile species, including timber rattlesnake, corn snake, and northern pine snake, as well as pine barrens treefrog and several rare plant and insect species. Sites that are important for these species include **Bamber Macrosite**, **Crossley**, **Chatsworth Woods Macrosite**, **Chatsworth East Macrosite**, and the adjacent **Mount Misery** site in the Delaware River drainage. The northern pine snake prefers pine-oak and oak-pine forests but also occurs in pitch pine lowlands and cedar and hardwood swamps, usually breeding in nonforested areas, including disturbed sites. The corn snake is found in forested areas as well as in agricultural fields and old fields, and occurs frequently on active and inactive railroad beds. The timber rattlesnake occurs primarily in wooded habitat near water,

particularly oak-pine and pine-oak forests that border cedar and hardwood swamps.

Coastal plain intermittent or vernal ponds have seasonally saturated soils that limit growth of typical wetland and upland species, keeping sites at early successional stages. These communities contain many rare herbaceous species, especially grasses, sedges, and rushes. The vernal ponds are generally surrounded by pine-oak forests and pitch pine lowlands. Vernal ponds occur throughout the Pinelands, although they are more numerous in the southern Pinelands, contiguous with similar sites occurring on the Cape May Peninsula, in a concentration area near Egg Harbor City (the drainage divide between the Mullica and Great Egg Harbor Rivers) and in other headwater areas in the Pinelands. Species occurring at more than one vernal pond include pine barren smokegrass, floating heart (*Nymphoides cordata*), short-beaked bald-rush (*Rhynchospora nitens*), slender arrowhead, rose tickseed (*Coreopsis rosea*), slender water-milfoil (*Myriophyllum tenellum*), Wright's panic grass (*Panicum wrightianum*), and Boykin's lobelia. Species occurring at only one of the vernal ponds include wrinkled jointgrass, awned meadowbeauty, knotted spikerush, dwarf white bladderwort, pine barren boneset, Long's bulrush, drowned beaked-rush (*Rhynchospora inundata*), elliptical rushfoil, and the type locality and only known occurrence in the watershed of Hirst's panic grass. Fourteen vernal pond and borrow pit sites occur within the **Egg Harbor City** vernal ponds complex. Other examples of vernal pond sites in the Pinelands include **Woodbine Pond, Five Acre Pond, Odd Pond, Peaslee Pond, Bill Henry Pond, St. James Pond, Weymouth Avenue Pond, Marsh Lake, Sand Ridge Pond, Winslow Pond, and Chatsworth Goose Pond**. Several of these vernal ponds support the pine barrens treefrog. Rare insects include the chain fern borer moth (*Papaipema stenocelis*) and the chalky wave (*Scopula purata*).

Borrow pits with clay, sand, or gravel substrates that have been excavated down to the water table have seasonally saturated soils and function similarly to vernal ponds. These areas support several of the same species found in the vernal ponds, including pine barren smokegrass, rose tickseed, and pine barren boneset. Other species that occur in these borrow pits are pine barren reedgrass, Barratt's sedge, pale beaked-rush, Knieskern's beaked-rush, small-headed beaked-rush, pine barren gentian, and New Jersey rush. The Knieskern's beaked-rush is endemic to the New Jersey Pinelands where it occurs in early successional habitats maintained by natural forces and, in the case of the borrow pits, in human-created, early successional habitat; borrow pit sites account for almost half of the known populations. Several borrow pit sites occur near Egg Harbor City, as noted above. Examples of other borrow pit sites in the Pinelands include **Reega, Pond 74, Pits and Pond, and Whiting Clay Pits**.

Abandoned cranberry bogs scattered throughout the Pinelands have open bog areas that are succeeding into shrub swamps. These open sites support several populations of pine barren boneset, a globally imperiled plant reaching its northern limits in the New Jersey Pinelands. (It once occurred on Long Island but has been extirpated.) Examples of abandoned cranberry bogs in the Pinelands include **Hunters Mill, Woodbine Bogs, Hospitality Branch, and Ancora Bogs**.

The **Atlantic City Airport** within the New Jersey Pinelands has maintained grassy areas around the runways that are used for nesting by several rare grassland bird species, including grasshopper sparrow, upland sandpiper and, possibly, vesper sparrow. The U.S. Fish and Wildlife Service and the New Jersey Division of Fish, Game and Wildlife have worked with the Federal Aviation Administration to develop and implement a mowing plan to protect and enhance habitat for rare grassland-nesting birds and rare Lepidoptera and plant species.

The federally listed endangered American chaffseed grows in open sandy areas in the pine barrens. This species appears to have been

extirpated from the New York Bight drainage of the Pinelands, but still occurs at one site in the Delaware drainage in the northern Pinelands. The federally listed threatened sensitive joint vetch grows on mud banks of brackish rivers in the Pinelands, including the Wading River and Maurice River (see Mullica River - Great Bay Estuary habitat complex). Sensitive joint vetch is at the northern end of its range in the New Jersey Pinelands.

Southern New Jersey, including the Pinelands, has 26 species of amphibians and 34 species of reptiles, an unusually diverse herpetofauna. One of the reasons for this diversity is the large number of species at the limits of their ranges, especially southern Coastal Plain species such as corn snake. Characteristic Pinelands amphibians include pine barrens treefrog, southern leopard frog (*Rana utricularia*), and carpenter frog (*Rana virgatipes*). Many amphibian species are unable to establish viable populations in undisturbed areas of the central Pinelands, probably due to the low pH of the surface waters. Eastern tiger salamander occurs on the outskirts of the Pinelands where the surface waters have a higher pH. Wood turtle occurs at the fringes of the Pinelands, along the Inner Coastal Plain in the northwestern Pinelands. Thirty-four species of native mammals are known to reside in the New Jersey Pinelands, and four additional species of bats are found during migration.

There are about 70 species of birds breeding in the Pinelands inland of tidal areas. Abundant birds in the Pinelands include rufous-sided towhee (*Pipilo erythrophthalmus*) found throughout the Pinelands in areas of scrubby undergrowth, and gray catbird (*Dumetella carolinensis*) which prefers to nest in dense thickets near water. Oak-pine woodlands support insectivorous vireos and flycatchers such as red-eyed vireo (*Vireo olivaceus*) and warblers such as black-and-white warbler (*Mniotilta varia*) and ovenbird (*Seiurus aurocapillus*). Pine and prairie warblers (*Dendroica pinus* and *D. discolor*) nest in pine-oak forests, with pine warbler preferring tall pines and prairie warbler preferring the more open scrubby areas. Riverine lowland areas support feeding and nesting by a variety of waterbirds and waterfowl such as green heron (*Butorides virescens*) and wood duck (*Aix sponsa*). A small great blue heron heronry occurs in the **Pomona Woods** in the eastern Pinelands. Cedar swamps support insectivores such as eastern wood pewee (*Contopus virens*), wood thrush (*Hylocichla mustelina*), and yellow warbler (*Dendroica petechia*). Mature pine forests support the greatest diversity of breeding birds, with fewer species in mature oak forests and in pine plains communities. Barred owl breed in lowlands in the Pinelands, with a stronghold in Belleplain State Forest and the watershed of the Maurice and Manumuskin Rivers. Pairs of bald eagles nest in Belleplain State Forest and along the Mullica River, and several of the tidal rivers that drain the Pinelands also appear to be important wintering areas for the eagle. Red-headed woodpecker nests in open areas of pitch pine and oak pine forests in the Pinelands, including Lebanon State Forest in the northern Pinelands.


Pristine **headwater streams** in the Pinelands support a unique assemblage of flora and fauna. Some of the more pristine headwater streams in the Pinelands, based on lack of sewage input and percent of unaltered land cover in the watershed, include the McDonald's Branch in Lebanon State Forest, the East Branch of the Bass River, the Oswego River, the West Branch of the Wading River, the Batsto River, and the upper Mullica River. Fish in the Pinelands are, for the most part, acid-tolerant species and are an important part of the region's biodiversity. They may be classified by their distribution: restricted, widespread, peripheral, anadromous, introduced, and marine. Restricted species include banded sunfish (*Enneacanthus obesus*), yellow bullhead (*Ictalurus natalis*), pirate perch (*Aphredoderus sayanus*), blackbanded sunfish (*Enneacanthus chaetodon*), mud sunfish (*Acantharchus pomotis*), and swamp darter (*Etheostoma fusiforme*). Species that are widespread in the Pinelands streams are American eel (*Anguilla rostrata*), eastern mudminnow (*Umbra pygmaea*), redfin pickerel (*Esox americanus*), chain pickerel (*Esox niger*), creek chubsucker (*Erimyzon oblongus*), tadpole madtom (*Noturus gyrinus*), bluespotted sunfish (*Enneacanthus gloriosus*), and tessellated darter (*Etheostoma olmstedii*). Pinelands fish are generally found in areas of abundant vegetation.

The dominant open sandy bottom streams are home to some of the darters. The swamp darter prefers moderate currents, while the tessellated darter is found in the higher gradient streams. The stream margins and backwaters are the preferred habitat for eastern mudminnow and the Pinelands' most dominant fish, the creek chubsucker.

The profusely vegetated areas, especially the quiet backwaters, are home to the majority of New Jersey Pinelands fish species. American eel, chain and redbfin pickerel, and yellow bullhead are dominant in the vegetated areas. Others common to the Pinelands vegetated habitats include brown bullhead (*Ictalurus nebulosus*) and more secretive species such as tadpole madtom and pirate perch. The bluespotted sunfish is common throughout the state, whereas the occurrence of blackbanded and banded sunfish is restricted to the Pinelands habitats. The saline waters of the Mullica River and Great Egg Harbor estuaries buffer the acid waters draining the Pinelands, enabling common peripheral fish species intolerant of acid waters to occur (see narratives for the Mullica River - Great Bay Estuary habitat complex and the Great Egg Harbor Estuary habitat complex).

Human-made impoundments make up the bulk of Pinelands water bodies, and the majority of Pinelands stream fishes living in the quiet vegetated waters are well adapted to these artificial lakes, mill ponds, and cranberry bogs. Swamp darter, golden shiner, pumpkinseed, and yellow perch are common. A peripheral species, the redbreasted sunfish (*Lepomis auritus*), is present, and several non-native species are stocked for angling including bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*); these latter species are well established throughout New Jersey. Trout are also stocked as put-and-take fishery, although the native brook trout (*Salvelinus fontinalis*) may have occurred historically. Other fish that may have been stocked include the redear sunfish (*Lepomis microlophus*), flathead minnow (*Pimephales promelas*), black bullhead (*Ictalurus melas*), channel catfish (*Ictalurus punctatus*), goldfish (*Carassius auratus*), and carp (*Cyprinus carpio*). The goldfish and carp are good indicators of high nutrient areas, caused by excessive disturbance and/or pollution.

VII. THREATS AND SPECIAL PROBLEMS: Several community types in the pine barrens, particularly the pine plains, are maintained by frequent, severe wildfires; suppression of the wildfires could reduce or eliminate these unique community types. The development of lands near these communities will result in fire suppression to protect houses and property. Suppression of wildfires, so essential to the maintenance of the pine barrens ecosystem, could result in marked vegetation changes and loss of the characteristic pinelands biota, including many of its rare species.

 Increased development of the Pinelands region would degrade water quality, increase turbidity, alter hydrology, and increase discharges of pesticides or hazardous materials into the rivers or ponds, to the detriment of aquatic species. Eutrophication caused by runoff from fertilizers, septic tanks, roads, farmlands, and cranberry bogs is of considerable concern, as such over-enrichment of naturally acidic and nutrient-poor waters could lead to invasions and dominance by exotic, nutrient-loving, weedy plants and displacement of the native flora. Elimination or disturbance of adjacent wetland and forest habitat would adversely impact rare or uncommon wildlife and plant species. Human disturbance of wetlands includes illegal dumping of household and commercial waste, the use of all-terrain vehicles on trails and shorelines, disruption of vernal ponds and other wetlands, removal of plants, and expansion of cranberry and blueberry farming into wetlands and uplands. Significant

changes in the water quality or hydrologic regime of vernal ponds would result in the loss of rare species and degradation of the ecological character and value of wetland communities. Permanent drawdown of the water table would result in the invasion by woody species into pondshore zones, while prolonged flooding would inhibit the germination and growth of pondshore plants.

VIII. CONSERVATION RECOMMENDATIONS: This remarkable pine barrens complex is of high regional and national significance. It should be protected and managed to the greatest extent possible to ensure the perpetuation of its unique natural communities and rare species, many of which are simply not found, or are not as well-developed or in such concentrations, elsewhere in the region or the world. Active management, including ecologically driven prescribed burning, will be necessary to perpetuate many of the fire-maintained species and communities. Protection of water quality in the river and its tributaries and the maintenance of its resident fish populations should be given high priority by federal and state regulatory agencies. Any expansion of cranberry bogs and other permitted agricultural activities should avoid pristine wetlands and tributaries and rare upland and wetland communities and plants.

All activities in the Pinelands (including the protection area) could impact the ecological integrity of the Pinelands and should be carefully reviewed. Open space within federal and state facilities, such as military bases and airports, should be restored and managed to maintain natural pine barrens communities. If these facilities are determined to be obsolete, they should be transferred to federal or state conservation agencies and managed for rare pine barrens species. The Pinelands forests along the Atlantic coast marshes are important for migrating and breeding birds and as buffers for the wetlands, and should be preserved.

Since all of the populations of Knieskern's beaked-rush occur in the Pinelands and over half of the swamp pink populations occur in southern New Jersey, tasks and objectives of the Knieskern's beaked-rush and swamp pink recovery plans should be given a high priority by federal, state, and local agencies. The tasks and objectives in the recovery plans for the sensitive joint vetch, chaffseed, and bald eagle should also be given priority.

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Municipalities in the New Jersey Pinelands area

Atlantic County

Buena Borough
Buena Vista Township
Corbin City
Egg Harbor City
Egg Harbor Township
Estell Manor City
Folsom Borough
Galloway Township
Hamilton Township

Hammonton Town
Mullica Township
Port Republic City
Weymouth Township

Burlington County

Bass River Township
Evesham Township
Medford Lakes Borough
Medford Township
New Hanover Township
North Hanover Township
Pemberton Township
Shamong Township
Southampton Township
Springfield Township
Tabernacle Township
Washington Township
Woodland Township
Wrightstown Borough

Camden County

Berlin Borough
Berlin Township
Chesilhurst Borough
Waterford Township
Winslow Township

Cape May County

Dennis Township
Upper Township
Woodbine Borough

Cumberland County

Maurice River Township
Vineland City

Gloucester County

Franklin Township

Monroe Township

Ocean County

Barnegat Township

Beachwood Borough

Berkeley Township

Dover Township

Eagleswood Township

Jackson Township

Lacey Township

Lakehurst Borough

Little Egg Harbor Township

Manchester Township

Ocean Township

Plumsted Township

South Toms River Borough

Stafford Township

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