Parvin Natural Area
Management Plan

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New Jersey Department of Environmental Protection
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This management plan was prepared by Cynthia L. Coritz and Diane C. Lincoln of the Office of Natural Lands Management and adopted by Commissioner Robert C. Shinn, Jr. on December 4, 1995.

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Introduction

This management plan describes natural resources, uses and other features of the Parvin Natural Area and prescribes techniques, uses and practices that are consistent with or will aid in achieving the management objective of the natural area.

The Natural Areas System is established and administered pursuant to N.J.S.A. 13:1B-15.4 et seq. and N.J.S.A. 13:1B-15.12a et seq. A "Natural Area" is defined as "an area of land or water, owned in fee simple or as a conservation easement by the Department, which has retained its natural character, although not necessarily completely undisturbed, or having rare or vanishing species of plant or animal life, or having similar features of interest, which are worthy of preservation for present and future residents of the State" (N.J.A.C. 7:5A-1.3).

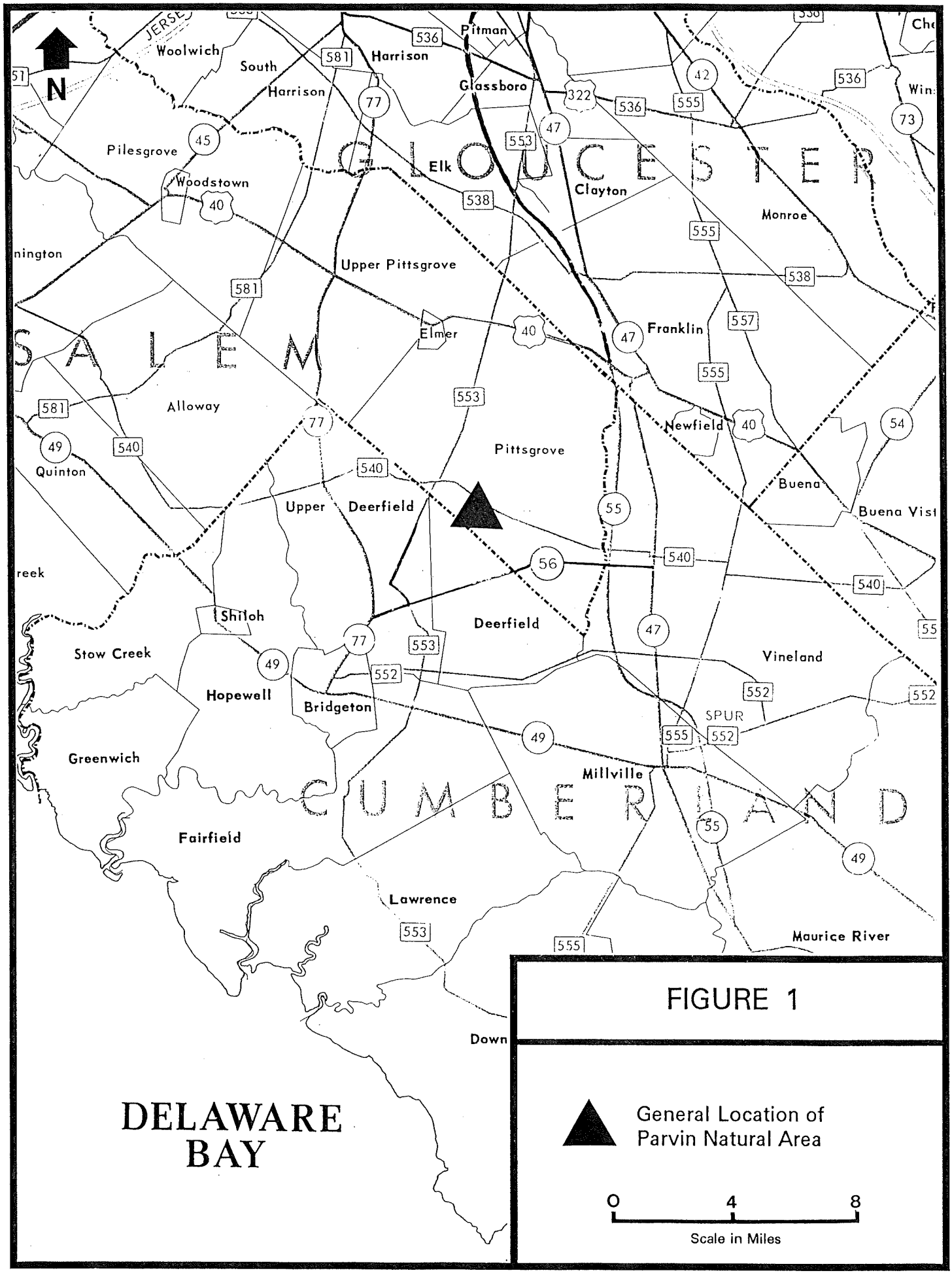
Parvin Natural Area is part of Parvin State Park, located in Pittsgrove Township, in the eastern portion of Salem County (Figure 1). The Park encompasses 1,135 acres including the 465-acre natural area (Figure 2). Surrounding the park are private residences, farmland and the village of Centerton. Nearby cities are Vineland, Millville and Bridgeton. Philadelphia is the nearest large city, approximately 35 miles to the north.

The Park is located west of the primary area of the New Jersey Pine Barrens. The oak-pine forest with scattered pitch pine (*Pinus rigida*) and shortleaf pine (*Pinus echinata*) found within the Park and the natural area is often found along the western edge of the Pine Barrens and has been characterized as Pine Barrens fringe forest (McCormick and Jones 1973). These forests are important for the protection of species that are at the edge of their range as well as those that prefer the fringe forest.

Parvin was added to the Natural Areas System in 1978 through promulgation of rules associated with the Natural Areas System Act of 1975. The management objective for this natural area under N.J.A.C. 7:5A-1.13(a)14ii is the "preservation of mixed oak and pine forest on the Pine Barrens fringe with a diversity of plant and animal species, and rare species habitat". N.J.A.C. 7:5A-1.8 also requires the preparation of this management plan.

The Division of Parks and Forestry, through Parvin State Park, serves as the administering agency, being responsible for implementing policy and, after consultation with other Divisions, organizations and individuals, making land management decisions affecting Parvin Natural Area. Parvin State Park, as part of its administrative responsibilities and priorities, shall implement the management policies necessary to achieve the management objective of this plan.

The Office of Natural Lands Management (ONLM) is responsible for overall administration of the Natural Areas System, promulgation and revision of rules governing System lands, and preparation of management plans. The ONLM also periodically monitors implementation of the management techniques outlined in management plans, and may propose amendments to plans as needed.


N
Woolwich
South Harrison
Harrison
Pitman
Glassboro
Pilesgrove
Woodstown
Elk
Clayton
Monroe
GLOUCESTER
Upper Pittsgrove
SALEM
Elmer
Franklin
Alloway
Newfield
Pittsgrove
Quinton
Upper Deerfield
Buena
Buena Vist
Shiloh
Deerfield
Stow Creek
Vineland
Hopewell
Bridgeton
SPUR
Greenwich
Millville
CUMBERLAND
Fairfield
Lawrence
Maurice River
DELAWARE BAY
FIGURE 1
General Location of Parvin Natural Area
0 4 8
Scale in Miles

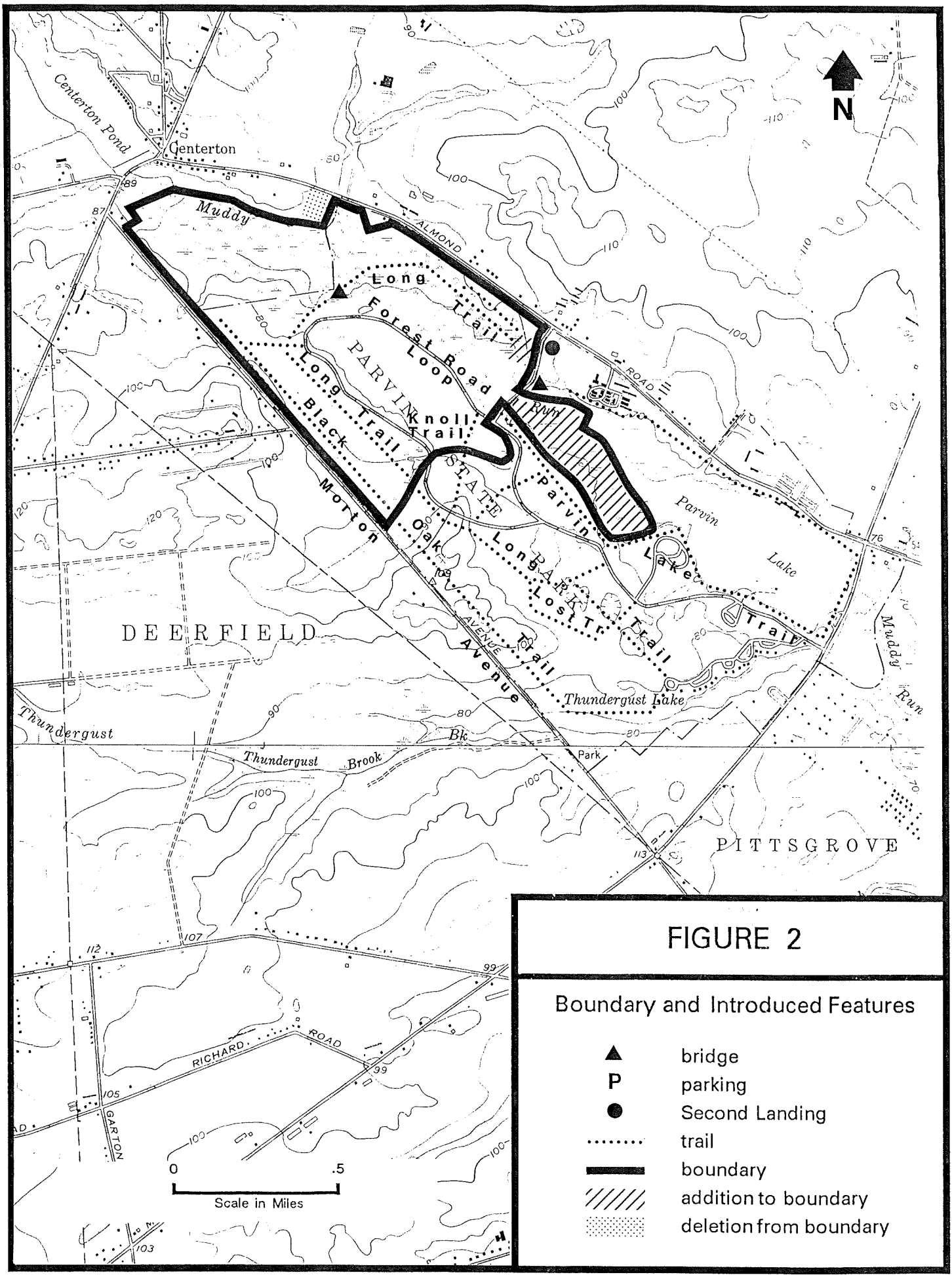


FIGURE 2

Boundary and Introduced Features

- ▲ bridge
- P parking
- ● Second Landing
- ..... trail
- ▬ boundary
- //// addition to boundary
- ▒ deletion from boundary

History

The history of Parvin State Park can be found in two New Jersey Department of Environmental Protection (NJDEP) documents: one written around 1945 (under the Department of Conservation and Economic Development), the other prepared by Park Superintendent Joe Reed around 1990. The following summary has been compiled using these documents except where noted.

The land that is now Parvin State Park may have been used by the Lenni Lenape, or Delaware Indians, that inhabited New Jersey at the time of European exploration of the region. During construction of a new dam at Parvin Lake, following the September 1940 flood, many arrowheads were found in the lake bed supporting the belief that the watershed had been used by Native Americans.

The NJDEP Office of Historic Preservation does not have any record of historic or prehistoric sites within the natural area. However, the mixed habitat of Manahawkin Muck soils and well-drained soils such as Evesboro have been associated with the occurrence of prehistoric sites in other areas. In particular, the well-drained area in the central portion of the area adjacent to Parvin Lake.

A parcel of 2,928 acres, including the area that is now Parvin State Park, was granted to John Estaugh by the proprietors of West Jersey on March 31, 1742. In May of 1796 Lemuel Parvin purchased a portion of this land so that he could impound Muddy Run and build a water powered saw mill. The resulting impoundment was called Parvin Lake and the mill that was built around 1800 was the Parvin Mill. A saw mill operated at this location from the time of its original establishment to about 1929. Much of the land between the mill and Centerton, known as the Stonehill tract, was cut for timber. Also, gravel in the area was mined for construction of houses and for roads.

Prior to State acquisition, this site had been used for recreational purposes such as picnicking, bathing, camping and fishing. There was a beach on Parvin Lake, a boat livery, and a concession stand. Cabins along the north side of the lake were rented to vacationers and at the northeast corner of the lake there was a Boy Scout camp. Located immediately south of the Parvin Lake dam was the Isaak Walton League building where a group of sportsmen met for organized social and sporting functions, especially fishing. The Isaak Walton League building no longer stands at the site.

In 1930 the State decided to purchase land for a park at Parvin Lake. The purchase included 918 acres of forested land and the 108-acre Parvin Lake. The Park was dedicated in 1931 and became the first State park in southern New Jersey. In 1932 the Civilian Conservation Corps (CCC) established a camp at Parvin State Park and began work to improve the Park for visitors. They expanded the beach, landscaped around it and constructed buildings adjacent to it, created a parking lot, cleared campsites, created trails, built pavilions and erected several bridges over Muddy Run. The CCC also created Thundergust Lake at the Park by clearing and digging out a swamp and damming a tributary to Muddy Run that had flowed into Parvin Lake. This CCC Company remained at Parvin until 1937.

In 1937 a second CCC Company, made up of World War I veterans, worked at the Park. They constructed cabins, completed Thundergust Lake, built a picnic area there and landscaped around the lake. They also built the bridge that is a scenic span to Flag Island. This CCC Company was at the Park in September of 1940 when a flood washed out the earthen Parvin Lake dam. This Company constructed a new dam that was completed in the summer of 1942.

The CCC camp at Parvin was closed in 1942 when the U.S. entered World War II. The CCC barracks were later used to house people who came to the region and worked in the local agricultural industry. In January 1944 a prisoner of war camp was established at Fort Dix. Some prisoners were transferred and held at the Parvin CCC camp barracks and worked at local plants and farms. After the war, the CCC camp was used as transition housing for displaced Japanese-Americans that had been at internment camps. Later, the camp was used for transition housing for other people, such as the Kalmyck people of the Volga basin who had left the U.S.S.R. during Stalin's regime. Very little of the CCC camp remains today, however, the work of the CCC throughout the Park is quite evident.

Description and Management Concerns

Boundary

The boundary of the natural area along Almond Road and the Second Landing access road does not satisfy requirements in the Natural Areas System Rules (N.J.A.C. 7:5A-1.12), which indicate that the natural area boundary must confirm with physical features identifiable in the field or the extent of State ownership. Additionally, the management objective, which includes the preservation of rare species, would be better served by a boundary that includes a population of the State endangered and federally threatened swamp pink (*Helonias bullata*).

The revised boundary, indicated in Figure 2, includes 51.8 acres of hardwood swamp, pitch pine lowland and pine-oak forest between Parvin Lake and Muddy Run and 1.7 acres of oak-pine forest along the Second Landing access road that contains a picnic area, small parking area and restroom facility. The revised boundary also excludes 8.1 acres of hardwood swamp and pine-oak forest along Almond Road (Figure 2). These revisions result in a net addition of 45.4 acres, an increase of approximately 11 percent. The resulting acreage of the natural area is approximately 465 acres.

The revised Parvin Natural Area boundary is as follows. Refer to Figure 2 for guidance. From Morton Avenue which borders the state park and natural area to the west, the boundary follows this road and residential property northwest to Muddy Run; east along Muddy Run; north along Rosey Run (a tributary to Muddy Run) to Almond Road; east along the State property line at Almond Road; south along the Second Landing Access Road; east along Muddy Run and Parvin Lake; west along Parvin Lake Trail; south along the Second Landing Access Road to its intersection with the Forest Road Loop; east a short distance along the road to where a small stream flows under the Forest Road Loop; south (upstream) along the small stream to its intersection with Morton Avenue; and northwest

along Morton Avenue to the residential property. Roads and watercourses that form the boundary are not included within the natural area.

Geology and Soils

Parvin State Park is located in the Atlantic Coastal Plain physiographic province. This physiographic province runs along the eastern shore of the United States from Cape Cod to the tip of Florida and westward across Alabama, Mississippi, Louisiana, and Texas to Mexico. In New Jersey, the Coastal Plain is a low lying area that was submerged during periods when sea level was higher than at present and subsequently exposed during glacial periods when sea level was lower than it is now. The formations found on the Coastal Plain are marine sediments and fluvial deposits. In New Jersey, the Coastal Plain is divided into subprovinces that include the Inner and Outer Coastal Plain differentiated by the age of the underlying deposits (Wolfe 1977). Parvin State Park is located in the Outer Coastal Plain.

The Coastal Plain has a geologic framework of gently southeastward dipping unconsolidated clay, marl, silt and sand of Late Cretaceous and Tertiary age (Wolfe 1977). In the area of Parvin State Park, the Tertiary Cohansey Formation overlies the older Kirkwood Formation (Tedrow 1986). Overlying deposits are of the Quaternary Bridgeton Formation (Wolfe 1977). The Bridgeton Formation consists of an unconsolidated mantel of highly weathered sand, clay and gravel. It also has occasional boulders present (Tedrow 1986). The Bridgeton Formation, which serves as parent material of the Aura soil found in this area of New Jersey, probably originated from the Beacon Hill, Cohansey and Kirkwood formations as well as some older formations (Tedrow 1986). The formation occurs as a cap of at least 30 feet over the older deposits (Tedrow 1986). The Coastal Plain was never glaciated, however, the Bridgeton Formation is believed to be of glaciofluvial origin from the Aftonian and Kansan stages (Tedrow 1986). A large boulder of Cambrian quartzite found near Second Landing (Figure 2) was also probably deposited there as a result of this glaciofluvial action (NJDEP ca 1990).

The broad soil classification covering Parvin State Park is the Aura-Sassafras-Downer Association. The following soil descriptions are based on the U.S. Department of Agriculture (1969) descriptions unless otherwise noted. The Aura soils have sandy or loamy soils in high positions with a firm subsoil; the Sassafras soils have loamy subsoils that can hold a moderate amount of water; and Downer soils have sandy loam subsoils that can hold a moderately low amount of water. The soils at the natural area range from these well drained soils to hydric Muck soils. Additional soils that occur at the natural area include Muck, Evesboro, Klej, Galestown, Fallsington, Keyport, Lenoir and Othello soils. Some of these soil types cover large portions of the natural area.

The Muck soil type covers two thirds of the natural area, forming a wide border along the Muddy Run stream corridor. It also occurs in the much smaller stream corridor of an unnamed tributary that flows northeast along the southeastern boundary of the natural area. The Muck soil is a wet, very poorly drained soil with a high organic matter content and acidic character. The thickness of this soil type typically ranges from 12 to 36 inches although it can range from 12 to 72 inches. The organic layer is underlain in most places by gravel, clay, or silt. In the winter the water table is at or near the surface and it rarely

drops much in the summer. Flooding of this soil type is frequent. The vegetation that is generally found on Muck soil includes red maple (*Acer rubrum*), sweetbay magnolia (*Magnolia virginiana*), Atlantic white cedar (*Chamaecyparis thyoides*) and pitch pine. These species are found throughout the natural area on this soil type.

The next most extensive soil cover at the natural area is Evesboro sand on zero to five percent slopes. This soil covers approximately 90 acres of the natural area in the vicinity of the Forest Road Loop. This area is surrounded by Muck soil except to the west where it is adjacent to an area of Sassafras sandy loam. Evesboro soil consists of deep, excessively drained, very sandy soils. The sand in most places extends to a depth of ten feet or more. The soil consists of siliceous, coarse-textured, loose sediments. Permeability of this soil is rapid and moisture-holding capacity and organic matter content are low. The Evesboro soil and small inclusions of other soil types in this mapping unit are droughty and have low natural fertility. The natural vegetation that dominates this soil type includes pitch pine, shortleaf pine, oak (*Quercus* spp.) and black huckleberry (*Gaylussacia baccata*). These species occur at the natural area on these soils.

The Sassafras sandy loam (0 to 2 percent slopes) is located in a band west of the Evesboro soil and parallel to Morton Avenue. It is a well drained soil with a heavy sandy loam subsoil over a substratum of stratified loamy sand and sandy loam. This soil is moderately permeable with a low to moderate organic matter content and a low to moderate natural fertility. The natural vegetation is mixed oak forest with scattered pines.

Galestown sand, a coarse textured, excessively drained soil of zero to five percent slopes is found in areas along the west edge of the natural area, north of the Sassafras soil and also adjacent to Morton Avenue. Permeability is rapid, organic matter content is low, and water holding capacity is moderately low. The water table is normally more than 60 inches below the surface. Natural fertility of Galestown soils is low.

Downer loamy sand, 0 to 5 percent slopes, is also found along Morton Avenue between areas of Galestown sand. The Downer loamy sand is droughty, with moderate to moderately rapid permeability. The organic matter content is low to moderate, and the natural fertility is low. The moisture holding capacity is low or moderately low.

Other soils found in the natural area but comprising much smaller coverage areas are Aura sandy loam (0 to 5 percent slopes), Aura gravelly sandy loam (0 to 5 percent slopes), Aura loam (0 to 2 percent slopes), Klej loamy sand (0 to 3 percent slopes) and Keyport loam (2 to 5 percent slopes). These soils are well drained to moderately well drained. Additional, minor soils that are found in the natural area are the poorly drained Lenoir-Keyport silt loam (0 to 2 percent slopes), Fallsington-Pocomoke-Berryland complex and Othello silt loam (0 to 3 percent slopes). Other soil types may also be present as inclusions in those mentioned.

Topography and Surface Hydrology

The topography of the Coastal Plain is generally of low relief with 80 to 90 percent of the land area at or below 100 feet in elevation (Tedrow 1986). Slopes across most of the Coastal Plain are less than five to ten feet per mile and are ten to fifteen feet per mile in

the inland portion of the plain (Wolfe 1977). Streams of the Coastal Plain flow in open valleys at only slightly lower elevations then the broad divides. The natural area is located in the Maurice River Watershed along the stream valley of the Muddy Run which flows generally north to south through the eastern portion of Salem County. The Muddy Run is dammed in five places forming Elmer Lake, Palatine Lake, Centerton Pond, Parvin Lake and Rainbow Lake before entering the Maurice River east of Deerfield and north of Union Lake. The Maurice River enters the Delaware Bay south of Port Norris approximately 24 miles after the point where the Muddy Run joins it.

The segment of the Muddy Run within the natural area is about 1.3 miles long. Muddy Run flows generally from the northwest portion of the natural area in a southeasterly direction, exits the natural area at the Second Landing bridge and eventually enters Parvin Lake. Muddy Run is classified according to NJDEP Freshwater Wetlands Maps as a riverine, perennial open water wetland. The substrate of the stream is muck and debris overlying sand. The stretch of the Muddy Run through the natural area is navigable by canoe except in the western reach where trees have fallen across the stream (Joe Reed pers. comm.). Flow measurements taken from 1976 to 1984, below the dam at Centerton Pond and just upstream from the natural area, reveal variable discharge rates year to year (U.S. Geologic Survey 1993). Flow rates ranged from 11 to 43 cubic feet per second for measurements taken one to three times a year from April through October. Flow velocities for these rates ranged from 0.2 to 1.1 feet per second. Measurements taken at the natural area at the Second Landing Road foot bridge from 1975 to 1981 reveal the pH of Muddy Run to be 5.9 to 6.6 (NJDEP 1993a). This is only slightly acidic compared to typical Pine Barrens streams that can be 100 to 1000 times more acidic (New Jersey Governor's Science Advisory Committee 1985, Boyd 1991).

North of the natural area, across Almond Road, is the drainage area of Rosey Run, a tributary to the Muddy Run. This tributary flows along the Centerton Country Club and joins the Muddy Run within the natural area. Other streams throughout the natural area are small tributaries that feed Muddy Run. These small streams, overgrown with shrubs and trees, flow slowly through the swamp. There are also mucky depressions with standing water in the hardwood swamp and small pools between hummocks in the cedar swamp. These small, shallow bodies of water vary from those lined with sphagnum mosses (*Sphagnum* spp.) to others filled with duckweed (*Lemna* spp.), sedges (*Carex* spp.) and emergents such as arrow arum (*Peltandra virginica*) and water plantain (*Alisma plantago-aquatica*). The tributary that cuts through the natural area from the southwest and enters the Muddy Run just east of the natural area is the small stream that forms part of the natural area boundary. Dense shrubs and a narrow band of hardwood forest surround this stream that makes its way through the oak-pine forest. These wetlands are considered palustrine forested wetlands and are characterized as broad leaved deciduous, needle-leaved evergreen, or a mix of these forest types. They are also indicated on the New Jersey Freshwater Wetlands Maps as areas that are temporary, seasonal, seasonally saturated and saturated wetlands.

The elevation ranges 20 feet throughout the natural area from just over 70 feet in elevation at Muddy Run to just above 90 feet along a short stretch of the natural area western boundary adjacent to Morton Avenue. The elevation of the area surrounding Parvin State Park is generally 100 to 130 feet above sea level. The slopes throughout the natural area are very low, being less than one percent throughout most of the area. Slopes

near Second Landing and between the Nature Trail and Almond Road are steeper, as much as 5 to 10 percent, as they grade from the swamp into the upland area.

Biotic Communities

The depiction of community types within the natural area in Figure 3 is based on aerial photo interpretation of vegetation (NJDEP 1987), and the descriptions of community types are based on Breden (1989), Robichaud and Buell (1973) and from site visits by the author on August 26 and September 22 and 30, 1993. Additional information regarding the occurrence of particular species within the different communities was also obtained from a list of plant species compiled by Louis Hand and published by the New Jersey Department of Conservation and Economic Development (1966).

The species assemblage at the natural area is an interesting combination of those typical of South Jersey, as well as some that are considered Pine Barrens species. Some of the species at the natural area are of southern affinity that range to Florida while others are northern species that range to Canada (Heusser 1979). The species listed in the following community descriptions include examples typical of that community as well as some of the species observed at the site. The lists are not meant to be comprehensive.

Pine Barren Hardwood Swamp

The Pine Barren Hardwood Swamp community is found in low lying portions of the Outer Coastal Plain and is often located along stream corridors or adjacent to Atlantic white cedar swamps (Breden 1989, Robichaud and Buell 1973). This community overlies much of the Muck soils along the Muddy Run stream corridor and along small tributaries. It covers nearly one half of the natural area and surrounds the Coastal Plain Atlantic White Cedar Swamp and Pitch Pine Lowland Forest communities. This community is dominated by red maple with sweetbay magnolia and black gum also found in abundance (Breden 1989). Other tree species found in this community are American holly (*Ilex opaca*) and scattered Atlantic white cedar.

Understory shrubs include sweet pepperbush (*Clethra alnifolia*), swamp sweetbells (*Leucothoe racemosa*), highbush blueberry (*Vaccinium corymbosum*), dangleberry (*Gaylussacia frondosa*), inkberry (*Ilex glabra*) and swamp azalea (*Rhododendron viscosum*) (Breden 1989). Sweet pepperbush is the dominant shrub. Other shrubs include scattered common winterberry (*Ilex verticillata*), euonymus (*Euonymus americana*), northern arrowwood (*Viburnum recognitum*), southern wild raisin (*Viburnum nudum*) and spice bush (*Lindera benzoin*). Shrubs listed by L. Hand as occurring near Second Landing include common alder (*Alnus serrulata*) and sweet-spires (*Itea virginica*) (New Jersey Department of Conservation and Economic Development 1966). Vines seen along trails were poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*) and common greenbrier (*Smilax rotundifolia*), among others.

Herbaceous species and sub-shrub species of this community that were seen along the Nature Trail and the Long Trail include dewberry (*Rubus* sp.), partridge-berry (*Mitchella*

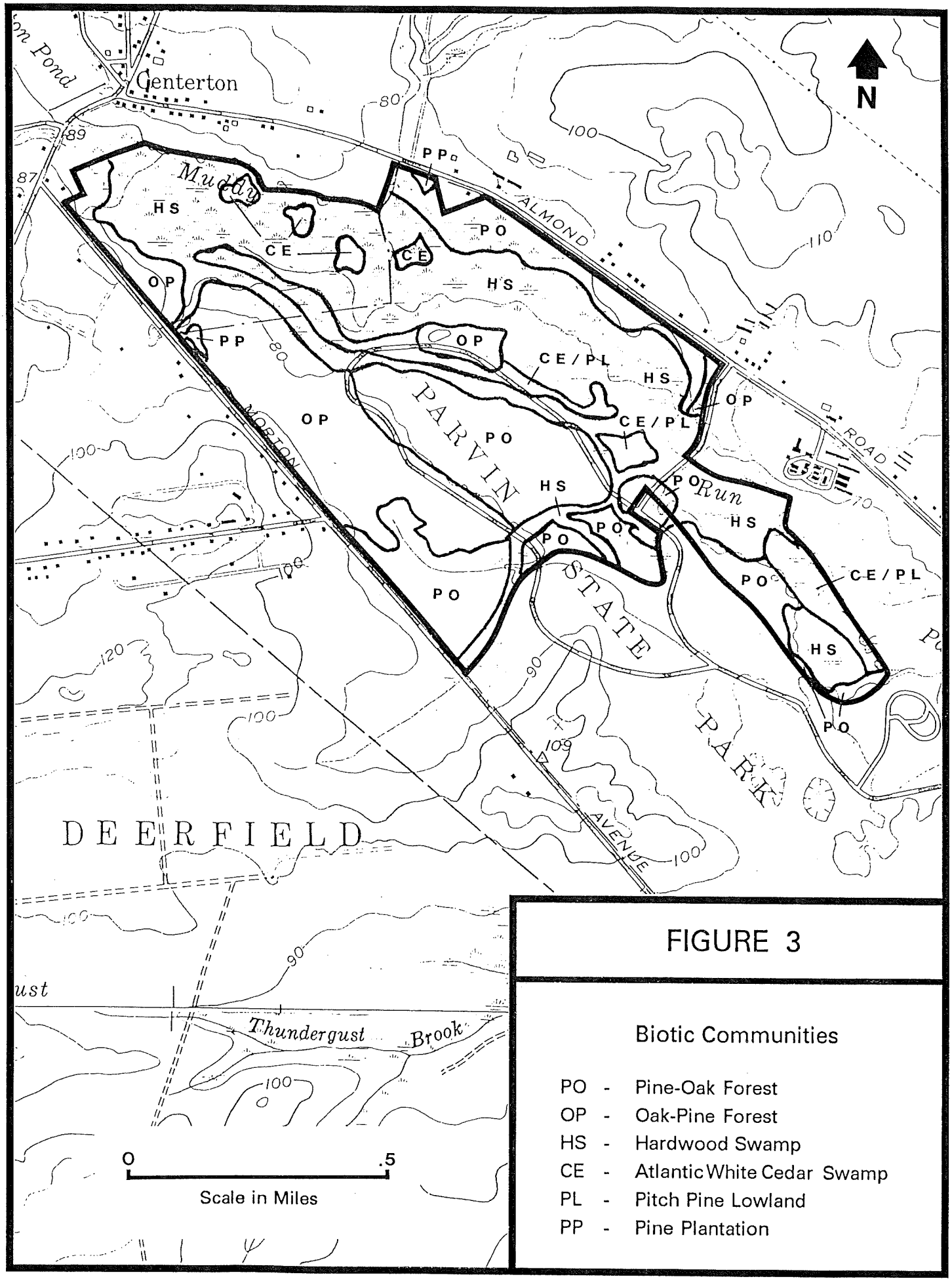


FIGURE 3

Biotic Communities

- PO - Pine-Oak Forest
- OP - Oak-Pine Forest
- HS - Hardwood Swamp
- CE - Atlantic White Cedar Swamp
- PL - Pitch Pine Lowland
- PP - Pine Plantation

repens), Indian cucumber-root (*Medeola virginiana*), teaberry (*Gaultheria procumbens*), cinnamon fern (*Osmunda cinnamomea*) and netted chain fern (*Woodwardia areolata*). In wetter, more open areas along the trail, vegetation was quite dense including smartweed (*Polygonum* sp.), jewelweed (*Impatiens capensis*), clearweed (*Pilea pumila*), halberd-leaved tearthumb (*Polygonum arifolium*), cardinal flower (*Lobelia cardinalis*), turtle head (*Chelone glabra*), false nettle (*Boehmerria cylindrica*) and sedges.

Near the arched bridge over the Muddy Run, along the Long Trail, this community grades quickly to a riparian shrub swamp community with buttonbush (*Cephalanthus occidentalis*) and black willow (*Salix nigra*). A small patch of purple loosestrife (*Lythrum salicaria*) is located here, just west of the bridge. South of the river the red maple, black gum, sweetbay magnolia community with scattered holly and dense sweet pepperbush continues.

Coastal Plain Atlantic White Cedar Swamp

Atlantic white cedar occupies over 50 percent of the canopy trees within this Coastal Plain community type (Breden 1989). It is found in small pockets of mature and dead standing cedar within the Muddy Run stream corridor within the natural area. Atlantic white cedar regeneration was not observed within the pocket of this community type along the Nature Trail. Atlantic white cedar seedlings were observed along an open edge of the trail in an area where cedar in the canopy composed approximately 30 percent of the cover. Pockets of this community further up Muddy Run, as indicated in the aerial vegetational survey, were not field checked. Species associated with the Atlantic white cedar in this community are red maple, sweetbay magnolia and black gum (Breden 1989).

Understory shrubs of this community include sweet pepperbush, swamp sweetbells, highbush blueberry, dangle berry, inkberry and swamp azalea (Breden 1989). Sweet pepperbush is the dominant shrub in the pocket of this community observed along the Nature Trail. Ferns of this community include sensitive fern (*Onoclea sensibilis*), marsh fern (*Thelypteris palustris*), bog fern (*T. simulata*), netted chain fern (*Woodwardia areolata*), Virginia chain fern (*W. virginica*), cinnamon fern and royal fern (*Osmunda regalis*). Typically, sphagnum moss covers the ground (Breden 1989). Other species of this community, listed by L. Hand, are sundews (*Drosera rotundifolia* and *D. intermedia*) and pitcher plant (*Sarracenia purpurea*) (New Jersey Department of Conservation and Economic Development 1966).

In total, this community covers only about 15 to 20 acres within the natural area. It extends outside the natural area on either side of the mouth of Muddy Run where it enters Parvin Lake.

Pitch Pine Lowland Forest

This community occupies narrow bands fringing swamps along stream courses or in poorly drained areas of low relief (Breden 1989). In the natural area, the Pitch Pine Lowland Forest occurs as a narrow band within the Pine Barren Hardwood Swamp (NJDEP 1987). Pitch pine is dominant with black gum and holly as associated species. A well

developed shrub layer is typical and includes sheep laurel (*Kalmia angustifolia*), dangle berry, leather leaf (*Chamaedaphne calyculata*) and dwarf huckleberry (*Gaylussacia dumosa*) (Breden 1989, Robichaud and Buell 1973). At the natural area, sweet pepperbush is also found in this community. Teaberry and partridge-berry were seen in the sub-shrub layer.

Dry Oak-Pine Forest

The Dry Oak-Pine Forest community is typical of Pine Barrens fringe areas (McCormick and Jones 1973). It is dominated by oaks such as black oak (*Quercus velutina*), chestnut oak (*Q. prinus*), southern red oak (*Q. falcata*), scarlet oak (*Q. coccinea*), post oak (*Q. stellata*) and white oak (*Q. alba*) (Breden 1989). These trees cover 40 percent or more of the ground and contribute 50 percent or more of the stems (Breden 1989). At the natural area, black oak, white oak and chestnut oak are found in abundance in this community (George Koeck pers. comm.). Blackjack oak (*Q. marilandica*), pin oak (*Q. palustris*), red oak (*Q. rubra*), Saul's oak (*Q. x saulii*) and willow oak (*Q. phellos*) also occur within the park (New Jersey Department of Conservation and Economic Development 1966). Pitch pine and shortleaf pine are present but are not dominant. In some areas, along the Black Oak Trail, sweet gum (*Liquidambar styraciflua*), flowering dogwood (*Cornus florida*), mockernut hickory (*Carya tomentosa*), holly and sassafras (*Sassafras albidum*) were observed. In the western portion of this area there is a small white pine (*Pinus strobus*) plantation and scattered red cedar (*Juniperus virginiana*). Occasional American chestnut (*Castanea dentata*) saplings were also observed.

Shrubs include lowbush blueberry (*Vaccinium pallidum*), black huckleberry (*Gaylussacia baccata*), dangleberry and scrub oak (*Quercus ilicifolia*) (Breden 1989). Mountain laurel is also found within this community in large, scattered groupings. Herbs include bracken fern (*Pteridium aquilinum*), which is quite abundant, and teaberry.

Threats to the Dry Oak-Pine and the Dry Pine-Oak Forest communities include outbreaks of the gypsy moth (*Lymantria dispar*) caterpillar. Gypsy moth defoliation has been severe in the natural area. Qualitative records of the extent of defoliation at Parvin State Park are summarized below:

years	oaks defoliated
1981 & 82	all
1983 & 84	some
1985 & 86	most
1987	some
1992	some

These records indicate this community experienced extensive assault by these caterpillars during the 1980s (George Koeck per. comm.). The repeated defoliation resulted in oak mortality throughout the natural area, ranging from a few scattered dead to pockets with as much as 80 percent dead (NJDEP 1991). Egg mass counts in 1993 were high along Almond Road leading to spraying of this portion of the Natural Area with B.t. (*Bacillus thuringensis* var. *israeliensis*) in the spring of 1994 (George Koeck pers. comm.).

Dry Pine-Oak Forest

This community type is typical of the sandy, excessively drained and low fertility areas of the Pine Barrens (Robichaud and Buell 1973). The Dry Pine-Oak Forest is dominated by pitch pine, which covers 30 percent or more of the ground and contributes 50 percent or more of the tree stems 2.5 cm or greater in diameter (Breden 1989). Other pines found in this community at the natural area are shortleaf pine and Virginia pine (*Pinus virginiana*). The oaks of this community, such as black, southern red, chestnut, scarlet, post, white and blackjack oak, cover no more than 25 percent of the ground and comprise no more than 25 percent of the stems (Breden 1989). This community is found in the natural area in a band of upland between Almond Road and the Pine Barrens Hardwood Swamp, in the upland area within the Forest Road Loop and in the southeastern corner of the natural area.

Shrubs typical of this community are heaths such as black huckleberry and lowbush blueberry and may also include scrub oak (Breden 1989). At the natural area, black huckleberry and bracken fern are abundant. Lowbush blueberry is plentiful and mountain laurel is seen occasionally.

Fire has historically affected this dry community by maintaining the dominance of fire resistant species such as pitch pine and shortleaf pine that can resprout after fire (Robichaud and Buell 1973). Since pine seedlings cannot establish themselves as well as oak seedlings when there is a substantial accumulation of litter on the forest floor, burning this litter also helps to favor pines. Pine-dominated forest vegetation is favored by a fire frequency of about twenty years (Robichaud and Buell 1973). Fires have been suppressed in the natural area (Jim Petrini and Joe Reed pers. comm.). Over the last 15 to 20 years there have been about six small fires in the natural area (Joe Reed pers. comm.). The New Jersey Forest Fire Service records indicate that in the last ten years, 1984 through December 1993, three fires occurred in the natural area. In May 1984 a quarter-acre burned inside the southwest portion of Forest Road Loop, and in April 1987 a half-acre burned in the middle of the loop. In April 1990, 15 acres burned southwest of the Forest Road Loop just northwest of the gravel pit near Morton Avenue. The two fires of less than an acre were determined to have been caused by human activity; the 15-acre fire is of suspicious origin (NJDEP 1993b). During the last ten years, prescribed burns have occasionally been recommended for areas of the Park to reduce fire hazard but have not taken place (Jim Petrini pers. comm.).

Gypsy moths may affect the oaks in this community, however, they are not known to feed on pitch pine or shortleaf pine when other, preferred, food sources are present (George Koeck pers. comm.). Reduction in oaks due to defoliation-caused mortality may be a factor in maintaining pine dominance in this area. Years of extensive defoliation are mentioned above in the Dry Oak-Pine Forest section.

Wildlife

The following description includes animal species that may occur at the natural area based on general life history information available for the species. Sources include the New Jersey Natural Heritage Database (NJDEP 1994), Conant (1979), Hastings (1979), Wolgast (1979) and others noted.

Mammals

White-tail deer were observed within the natural area and deer browse was evident along some of the trails. Parvin is in deer management zone 28 which has an average of 17 deer per square mile. Since there is no hunting at Parvin State Park, and the Park is partially surrounded by agricultural land, the deer density here may be higher than the average listed for zone 28 and may be increasing (Susan Predel pers. comm.).

Based on suitability of habitat, other mammals that may inhabit or utilize the mixed forests of the natural area include red fox (*Vulpes fulva*), grey fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), eastern cottontail (*Sylvilagus subflavus*), northern short-tailed shrew (*Blarina brevicauda*) and white-footed mouse (*Peromyscus leucopus*). Mammals that prefer upland forests that may be found at the natural area are woodland vole (*Microtus pinetorum*), eastern mole (*Scalopus aquaticus*), grey squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), southern flying squirrel (*Glaucomys volans*) and eastern chipmunk (*Tamias striatus*). Eastern pipestrelle (*Pipistrellus subflavus*), silver-haired bat (*Lasionycteris noctivagans*) and little brown myotis (*Myotis lucifugus*) may use the natural area, particularly for roosting sites under loose bark or in tree cavities. The meadow vole (*Microtus pennsylvanicus*) and star-nosed mole (*Condylura cristata*) may be found in the lowland forests. Raccoon (*Procyon lotor*), long-tail weasel (*Mustela frenata*), mink (*M. vison*) and river otter (*Lutra canadensis*) utilize riparian areas and may be found in the natural area along the Muddy Run stream corridor. Park Naturalist Paul Taylor has observed muskrats at Parvin.

Birds

Avian species observed in the pine and oak forests during fall field visits include downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), red bellied woodpecker (*Melanerpes carolinus*), chickadee (*Parus* sp.), black-throated blue warbler (*Dendroica caerulescens*), blue jay (*Cyanocitta cristata*) and red-breasted nuthatch (*Sitta canadensis*). Birds seen in the hardwood swamp were black-and-white warbler (*Mniotilta varia*), American redstart (*Setophaga ruticilla*), common flicker (*Colaptes auratus*), white-breasted nuthatch (*Sitta carolinensis*), chickadee and tufted titmouse (*Parus bicolor*). Northern cardinal (*Cardinalis cardinalis*), robin (*Turdus migratorius*) and gray catbird (*Dumetella carolinensis*) were seen in shrubs along Muddy Run and a great egret (Casmerodius albus) was seen wading near the arched bridge of the Long Trail. Turkey vultures (*Cathartes aura*) were seen overhead. Historically, the Zoological Research Society of Philadelphia conducted bird counts at Parvin State Park on a monthly basis for the period of November 1946 through October 1951 (Parker 1951). Park Naturalist Paul Taylor conducts migratory bird walks each spring. Mr. Taylor notes that numerous migratory species including warblers, vireos, thrushes, tanagers, and orioles either pass through the park or nest here. Several species observed or heard during a Spring 1995 field visit include prothonotary warbler (*Protonotaria citrea*), red-eyed vireo (*Vireo olivaceus*), wood thrush (*Hylocichla mustelina*) and scarlet tanager (*Piranga ludoviciana*). In March 1995 a check list of birds found at Parvin State Park was completed and made available to the public.

Reptiles and Amphibians

Reptiles and amphibians that may be found in either upland or lowland forests of the natural area include common garter snake (*Thamnophis sirtalis*), red-bellied snake (*Storeria occipitomaculata*), eastern hognose snake (*Heterodon platirhinos*), Fowler's toad (*Bufo woodhousii*), red-backed salamander (*Plethodon c. cinereus*), eastern tiger salamander (*Ambystoma t. tigrinum*) and marbled salamander (*A. opacum*). Northern black racer (*Coluber constrictor*), milk snake (*Lampropeltis triangulum*), rat snake (*Elaphe obsoleta*), northern fence lizard (*Sceloporus undulatus hyacinthinus*) and eastern box turtle (*Terrapin c. carolina*) may be found in the natural area and prefer upland areas for most activities. Eastern ribbon snake (*Thamnophis sauritus*), brown snake (*Storeria dekayi*), rough green snake (*Opheodrys aestivus*), five-lined skink (*Eumeces fasciatus*), ground skink (*Scincella lateralis*), northern red salamander (*Pseudotriton r. ruber*), gray treefrog (*Hyla versicolor*) and northern spring peeper (*Hyla crucifer*) may inhabit the lowland forest and riparian area of the natural area. The green frog (*Rana clamitans*), southern leopard frog (*Rana utricularia*), red-bellied turtle (*Chrysemys rubriventris*), snapping turtle (*Chelydra serpentina*), and the introduced spiney softshell turtle (*Trionyx spiniferus*) may be found in Muddy Run. Observed during a field visit in September 1993 were two large male red bellied turtles at Muddy Run, and a rough green snake in the narrow strip of hardwood swamp along the Knoll Trail. According to Park Naturalist Paul Taylor the northern watersnake (*Natrix sipedon*) is the most abundant species of snake in the park and the painted turtle (*Chrysemys picta*) and musk turtle (*Stenotherus odoratus*) are abundant.

Fish

Fish species that may inhabit Muddy Run include those that are widely established throughout the state such as American eel (*Anguilla rostrata*), tesselated darter (*Etheostome olmstedi*) and chain pickerel (*Esox niger*), and those that are well established in low acid waters of South Jersey such as yellow perch (*Perca flavescens*), pumpkinseed sunfish (*Lepomis gibbosus*), creek chub (*Semotilus atromaculatus*) and the introduced bluegill sunfish (*Lepomis macrochirus*). Another fish, the eastern mud minnow (*Umbra pygmaea*), inhabits coastal lowlands and may also be found here. Other fish that are common in Pine Barrens streams, though not restricted to acid waters, may also be found in Muddy Run. These include pirate perch (*Aphredoderus sayanus*), ironcolor shiner (*Notropis chalybaeus*), swamp darter (*Etheostoma fusiforme*) and mud sunfish (*Acantharchus pomotis*) (New Jersey Department of Conservation and Economic Development 1950, Hastings 1979, NJDEP 1994, Hugh M. Carberry pers. comm.).

Invertebrates

At present, no list or survey of invertebrates that occur in the natural area is known. According to Dale Schweitzer, Invertebrate Zoologist for The Nature Conservancy, common Lepidoptera species at Parvin Natural Area would be similar to non-tidal species found at Bear Swamp East Natural Area. Mr. Schweitzer collected at Parvin State Park in July 1967 and found no rare Lepidoptera. Specimens were forwarded to the Rutgers University Entomology Collection, but no list of these species is available.

Mr. Schweitzer indicated that quality habitat within the natural area for Lepidoptera species includes the cedar swamp, pitch pine lowlands and any dry disturbed area such as the Park Road Loop. However, due to aerial applications of B.t. for gypsy moth suppression at Parvin State Park, there are probably not more than 100 species of Lepidoptera, since about 200 species of Lepidoptera are at risk from B.t. applications with butterflies being highly susceptible and moths being less susceptible.

Rare Species

According to the New Jersey Natural Heritage Database, there are two recent records for the State threatened barred owl (*Strix varia*) and the State endangered swamp pink in Parvin Natural Area.

Barred Owl

The barred owl is a large woodland owl that ranges across most of the eastern United States (Peterson 1980). In New Jersey it is not a common species but is locally distributed (Soucy 1982). The barred owl has been a long-time breeding resident of lowland swamp forests of southern New Jersey but is less prevalent here than in North Jersey forests (Sutton and Sutton 1985). This owl prefers large tracts of forest with limited disturbance, showing a strong avoidance of human activity, major roadways and suburban housing developments (NJDEP 1984, Bosakowski *et al.* 1989). This raptor was last documented at Parvin Natural Area in March 1995 when one individual responded to a taped call from approximately 40 yards from the tape recorder.

Favored habitat of the barred owl is woodland that borders lakes, swamps, streams or marshes (Soucy 1982). The breeding habitat of the owl is low, wet, deep woods or wooded swamps (DeGraaf and Rudis 1987). In South Jersey the barred owl prefers inland, freshwater wetland hardwood swamps (Sutton and Sutton 1985). It frequently uses mixed or coniferous woods for nesting and roosting. Although it prefers nesting in large trees with cavities, it will utilize old bird nests or squirrel nests (DeGraaf and Rudis 1987). Soucy (1982) states that the barred owl almost always nests in hollow trees. Suitable nesting trees have a minimum diameter at breast height (dbh) of 20 inches that contain dead soft wood (DeGraaf and Shigo 1985).

Breeding typically occurs between March and April, however, nesting could continue into May (DeGraaf and Rudis 1987). After a 28-day incubation period the young hatch and may leave the nest at four to five weeks and fly at about six weeks (NJDEP 1994).

The threatened status of barred owl is due to its specialized habitat requirements (Soucy 1982). Destruction of suitable habitat is a likely cause of decline, as is the lack of proper nest sites even when habitat is otherwise adequate (Soucy 1982, NJDEP 1984). Soucy (1982) cites the removal of large dead standing trees, either for fire wood or to reduce public hazard, as part of the reason that nest sites are limited.

Barred owls will often stay in the same area throughout the year rather than migrate (Sutton and Sutton 1985) and tend to show high fidelity to a successful nest site (Soucy 1982). Since barred owls are known to have used and are likely continuing to use the

Parvin Natural Area, management efforts should be taken to maintain suitable habitat, particularly nest sites for these owls. Standing dead or injured trees of 20 inches dbh or more should be considered potential nest sites for the barred owl. If these trees have been removed due to hazardous proximity to trails, then consideration should be given to installing owl nest boxes in suitable nesting habitat (Soucy 1982).

Swamp Pink

The swamp pink was designated a Federally threatened species in 1988 due to population declines and serious threats to its habitat. Gleason (1952) describes habitat for this species as swamps or bogs ranging from southern New York and New Jersey to Virginia along the Coastal Plain and the Blue Ridge Mountains of Virginia and North Carolina. The Swamp Pink Recovery Plan (U.S. Fish and Wildlife Service 1991) states that the current distribution of the plant covers seven states from New Jersey to Georgia. The majority of the populations of this globally rare species are located in freshwater wetlands of New Jersey's coastal plain. However, the plant is locally abundant at only a few sites in southern New Jersey (Windisch 1993).

This plant flowers mid-April to late May and can be identified by its 3 to 10-cm long raceme of pink flowers and its basal rosette of elongate, evergreen leaves. It has been noted that relatively few plants within a population produce flowers at any one time (U.S. Fish and Wildlife Service 1991, Peterson 1992, Godt *et al.* 1995). This species reproduces primarily through clonal rhizomal growth with a limited degree of sexual reproduction. Plants are often clumped due to clonal growth and possibly due to limited seed dispersal (U.S. Fish and Wildlife Service 1991). Since this species is self-compatible and largely reproduces vegetatively, it may be that the bulk of genetic diversity is found between rather than within populations (Godt *et al.* 1995).

Swamp pink occurs in a variety of wetland habitats such as forested swamps adjacent to meandering streams, headwater wetlands, spring seepage areas, bogs, meadows, Atlantic white cedar swamps and Blue Ridge swamps (U.S. Fish and Wildlife Service 1991). Typical habitats of the swamp pink in southern New Jersey are swampy floodplain sites with heavy *Sphagnum* moss cover and dense stands of Atlantic white cedar (Windisch 1993). Habitat destruction and alteration, resulting from development, draining and filling of wetlands, and timbering and clearing activities, has reduced swamp pink habitat (U.S. Fish and Wildlife Service 1991).

The population at Parvin has been historically known since at least the 1950s (NJDEP 1994). This population, examined in May 1993 by C. Coritz and P. Taylor, was determined to consist of approximately one thousand rosettes. Ninety of these plants were in flower during the 1993 visit. Associated species at the site, noted during a September 1994 site visit, include red maple and black gum in the overstory, highbush blueberry and sweet pepperbush in the shrub layer, and several fern species and *Sphagnum* moss in the herbaceous layer. Mountain laurel, American holly and sweetbay magnolia are scattered throughout the area. Atlantic white cedar is present at this swamp but was not observed directly over the portion of the population examined during the 1994 site visit, the canopy of which was composed of up to 80 percent of red maple.

Due to the size and vigor of this population and the quality of the immediate habitat, as well as the protected nature of the habitat upstream, this population has been assigned a quality rank of "B" by the DEP's Natural Heritage Database. This rank indicates that only minor impacts are currently affecting the swamp pink habitat and that these impacts are not directly affecting the population at the site. The Swamp Pink Recovery Plan (U.S. Fish and Wildlife Service 1991) calls for the permanent habitat protection for populations that are ranked as "A" or "B" occurrences.

Threats to this species include habitat loss, fragmentation and degradation, collection, trampling, succession, changes in water quality and other physical and biological factors (U.S. Fish and Wildlife Service 1991). Although direct habitat damage is still a threat, impacts from off-site disturbances are now considered one of the major threats affecting this species (U.S Fish and Wildlife Service 1991). Examples of off-site threats to the swamp pink are changes in the water table, siltation and added nutrients from pollution runoff (Godt *et al.* 1995). Additional threats to the swamp pink are its life history characteristics including low percentage of plants flowering in a given year, low seedling recruitment, slow growth rate, limited seed dispersal, and low levels of genetic diversity within the species (Godt *et al.* 1995). Collection of swamp pink has occurred in the past and may still pose a threat to some populations (U.S. Fish and Wildlife Service 1991).

Specific threats at the site include the possibility of erosion and siltation near the camp sites that back up to the swamp pink habitat. Because there is access from the camping area to the swamp pink habitat people follow the short path through the shrubs into the swamp. Trampling may damage both adult plants and seedlings or may alter hydrologic conditions around swamp pink plants (U.S. Fish and Wildlife Service 1991). Additional threats to the population are changes in the water level and water quality. Swamp pink appears to reproduce slowly and may be unable to recolonize openings in suitable habitat, making it susceptible to perturbations in the water regime (U.S. Fish and Wildlife Service 1991). Water levels at this site could change due to removal of ground water or surface water for residential, agricultural or other purposes, failure of dams along Muddy Run upstream or downstream of the population, and changes in land use within the watershed. The poor condition of the Parvin Lake Dam poses a threat to the swamp pink population. Results of an inspection performed by the DEP's Dam Safety Section in 1993 indicate that although the dam has been placed in the Class II (significant) hazard category, the dam is considered to be safe with repairs necessary (NJDEPE 1993). Suggested immediate repairs include (1) removing trees and underbrush from the earthen embankment and filling and stabilizing the embankment properly, and (2) filling and stabilizing the eroded areas along the spillways, downstream wingwalls and all other areas as needed. The report also suggests some long term improvements and studies that should be implemented. Inspections of this dam are conducted approximately every two years. A result of water level changes may be changes in the vegetation composition and cover within swamp pink habitat. Herbivory may be an additional threat at this site. Deer browsing of flowers and new shoots of swamp pink has been observed at other locations (U.S. Fish and Wildlife Service 1991).

Important conservation measures are suggested in the Swamp Pink Recovery Plan (U.S. Fish and Wildlife Service 1991). A high priority is to permanently protect all "A" and "B" rated populations. Protection may include buffers in excess of 500 feet around habitat where site topography subjects a colony to habitat degradation (U.S. Fish and Wildlife

Service 1991). Monitoring biotic and abiotic factors that can influence the health of populations will provide baseline data regarding the status of the colony and feed back after management activities are implemented or if habitat conditions change.

Monitoring can include evaluating the population size (number of rosettes), and the area and density of the colony. The floral community composition and cover can be described and changes noted over time. Increases in the shrub layer or the invasion of aggressive, weedy species may pose a threat to populations of swamp pink (Gordon 1989). Evidence of herbivory or other destruction of individual plants should also be noted. If the population is small or occupies a small area, it is particularly important to protect the plants from deer or other agents that may be effecting individual plants (U.S. Fish and Wildlife Service 1991). Monitoring of populations has also included checking the percent of the population that flowers annually, measuring size of rosettes, and determining annual recruitment and mortality (Peterson 1992). Monitoring of the habitat can also include checking water levels and water quality.

Additional Rare Species

Several plant species of concern in New Jersey that are listed as occurring in the Park by L. Hand and could occur in the natural area are the fringe tree (*Chionanthus virginicus*), mistletoe (*Phoradendron leucarpum*), wild lupine (*Lupinus perennis*), pineland tick-trefoil (*Desmodium strictum*), poison oak (*Toxicodendron pubescens*), bearded skeketon grass (*Gymnocarpon ambiguus*) and Elliott's goldenrod (*Solidago elliottii*) (New Jersey Department of Conservation and Economic Development 1966, David Snyder pers. comm.). These plants are not documented in the Natural Heritage Database, but may possibly be extant. Parvin naturalist Paul Taylor (pers. comm.) indicates that he has observed mistletoe within the natural area.

In addition to the barred owl, another rare animal that may inhabit the Park is the State endangered eastern tiger salamander. Although the eastern tiger salamander is not documented in the Natural Heritage Database, Parvin naturalist Paul Taylor indicates that he has observed one tiger salamander at the edge of a small temporary pool in the natural area. This large salamander has irregular, olive or yellowish-brown spots over a dorsal ground color of black to deep brown; the belly is olive-yellow, marbled with darker pigment (Conant 1975). The tiger salamander breeds during early spring in temporary woodland ponds or water-filled abandoned gravel pits. Its habitat is oak-pine forest with sandy, gravelly soils (Zappalorti and Johnson 1982). Suitable habitat for the eastern tiger salamander exists within the Park and natural area and the animal has been sighted at nearby locations outside the Park.

According to Dale Schweitzer, Hessel's hairstreak (*Mitoura hesseli*) and Lemmer's pinion moth (*Lithophane lemmeri*), considered rare in New Jersey, may occur in the Atlantic white cedar swamp, however, if B.t. was applied to the cedar swamp, as a means of gypsy moth suppression, these species may have been impacted. Dale also believes that the precious underwing (*Catocala pretiosa*) and barrens daggermoth (*Acronicta albarufa*) could possibly be found in the natural area since they were collected at a light trap in the nearby town of Elmer by Rutgers University students.

Public Use

Parvin State Park is open for camping and cabin use from spring through fall and for day use activities year round. The Park provided recreation opportunities for approximately 131,000 people during the 1993 fiscal year (Joe Reed pers. comm.). The Park has a beach on Parvin Lake, picnic areas, campsites and cabins. These facilities are southeast and downstream of the natural area. Parvin State Park has an active Naturalist's program that includes guided walks, seminars, nature crafts, and speakers for visitors, campers, school groups, scouts, 4-H clubs, and church groups.

The natural area is currently used for nature interpretation and study, hiking, bicycle riding (on trails and Forest Road Loop), bird watching and botanizing. The trails throughout the natural area total approximately five miles and lead visitors through both upland and lowland communities. The Parvin State Park Appreciation Committee, an organization that helps promote Park activities, has produced a trail map for the Park and natural area. The Forest Road Loop, which is ADA approved, is often used for running, walking and bicycling. Other trail activities include fall hayrides on the Forest Road Loop, an annual walk for charity and a triathlon. Cross country skiing in the Park and natural area is undertaken occasionally during winters when snowfall permits. Activities not allowed in the natural area include horseback riding and hunting.

Popular activities on and adjacent to the Muddy Run include canoeing, picnicking, and fishing. The Muddy Run is navigable through the natural area and canoes can be rented at a concession at the Park. A canoe landing is maintained in the natural area at Second Landing (Figure 2).

Access to the natural area is provided at Second Landing where there is parking or via trails such as Parvin Lake Trail, Long Trail and Black Oak Trail. The paved Forest Road Loop is about two miles long and is used by pedestrians and visitors with wheelchairs, but is not open to vehicular traffic except Park personnel.

Research at Parvin appears to have been limited to the listing of some of the Park's flora and fauna and the collection of water quality data. Lists of birds have been prepared by the Zoological Research Society, Philadelphia (Parker 1951). Notable breeding birds at the Park, such as the prothonotary warbler (*Protonotaria citrea*), have been recorded by the New Jersey Audubon Society (1989-1990). Fish inhabiting Parvin Lake were listed in a survey by the Division of Fisheries and Wildlife in 1950 (New Jersey Department of Conservation and Economic Development 1950) as well as in a recent survey by the Division of Fish, Game and Wildlife (NJDEPE 1992). A list of flora was prepared in 1966 by Louis Hand (New Jersey Division of Conservation and Economic Development 1966) but the area should be reinventoried to look specifically for remaining rare plant populations (David Snyder pers. comm.). Also, the Division of Science and Research's Bureau of Water Quality Monitoring has gathered limited water quality data by sampling the Muddy Run at the area of Second Landing.

Management issues concerning public use of the natural area include trail maintenance and usage. Some trails such as Knoll Trail, inside Forest Road Loop, were overgrown with shrubs when examined in September of 1993. Also, the northern portion of the Long Trail has some fallen trees across the trail that made passage difficult. Plank bridges on the

Knoll Trail are in need of replacement as they are rotting and weak in some areas. Trail signs and blazing could be increased to make the trails easier to follow. Since these trails also pass through the swamp hardwood forest, where the soil is often saturated and narrow plank bridges span tributaries, these trails may not be appropriate for bicycle use. Bicycle use on trails within natural areas is prohibited according to New Jersey State Park Rules and Regulations at N.J.A.C. 7:2-2.25(l).

Introduced Features

Introduced features in the natural area include dirt trails, the paved Forest Road Loop and wooden bridges such as the two foot bridges with hand rails that span Muddy Run, and plank bridges that cross small tributaries and wet areas of the hardwood swamp. The Long Trail, between Second Landing and the arched bridge over Muddy Run, has 30 of these plank spans. There are also culverts under the Forest Road Loop at points where small streams pass under the road and several wooden benches along the roadside.

Trails within the natural area include Long Trail, the Nature Trail, Black Oak Trail, part of the Knoll Trail and part of the Forest Road Loop (Figure 2). The Long Trail forms a "U" around the Forest Road Loop from Second Landing, north of the loop, to the stream that is the natural area boundary west of the Forest Loop Road. It then continues outside of the natural area. The Nature Trail is a loop off of the Long Trail that starts north of Second Landing and runs about three-tenths of a mile before rejoining the Long Trail. Black Oak Trail, cleared as a fire break, runs mostly through Dry Oak-Pine Forest in a line parallel to Morton Avenue. Forest Road Loop runs through Dry Oak-Pine Forest, Dry Pine-Oak Forest and hardwood swamp. Approximately 1.4 miles of the two mile Forest Road Loop are within the natural area. The Knoll Trail traverses the Forest Road Loop and crosses the small stream that is the natural area boundary; only half of this trail is in the natural area. There are also short trails that connect these major trails to each other or give access to the Forest Road Loop.

At Second Landing an area has been filled with gravel along the edge of Muddy Run to make a canoe landing. This gravel is held in place by boards secured perpendicular to the stream surface. Other landings where gravel was used to make a firm substrate for small picnic areas further up Muddy Run within the natural area, are no longer maintained (New Jersey Department of Conservation and Economic Development ca 1945, Joe Reed pers. comm.).

The use of insecticide to control gypsy moths is also considered an introduced feature. The natural area was treated with the aerial applied larvacide B.t. in 1986 as a gypsy moth control method. This is the only record of control within the natural area (George Koeck pers. comm.). Apparently the natural area has not been treated with the chemical insecticide Sevin (George Koeck pers. comm.). These records are only for the natural area as the rest of the Park has been treated during other years.

Herbicides are not used in Parvin Lake (Joe Reed pers. comm.). If herbicide control was conducted in Parvin Lake it could potentially be harmful to the swamp pink population.

A hazard tree removal project was conducted adjacent to the Forest Road Loop in 1991. A total of 974 dead standing trees within 50 feet of either side of the Forest Road Loop, an area that encompassed 29 acres, were cut and the timber removed. Most of these trees were killed by gypsy moth infestation and posed a threat to public safety (NJDEP 1991). Slightly more than half of this swath along Forest Road Loop is within the natural area.

Natural Area signs are posted along natural area boundaries adjacent to Morton Avenue and Almond Road. Signs are not posted along interior trails.

Management Techniques

Natural Areas System Rules

Relevant sections of the rules and regulations concerning Natural Areas and the Natural Areas System (N.J.A.C. 7:5A-1.1 et seq.) appear in Appendix A. An important function of these rules is to provide general interim management guidelines for all natural areas for which management plans have not been prepared. Upon preparation of a management plan, interim management guidelines may continue or may be superseded by management techniques more appropriate to fulfill the management objective of the natural area. Should an issue arise that is not addressed in the management techniques of this plan, the interim management techniques at N.J.A.C. 7:5A-1.9 (Appendix A) will apply and should be consulted. The following analysis will outline management and uses contrary or supplemental to existing rules.

Management Objective And Classification

The management objective for Parvin Natural Area is "preservation of mixed oak and pine forest on the Pine Barrens fringe with a diversity of plant and animal species, and rare species habitat." The following management techniques are derived from issues discussed in previous sections of this plan and the interim management guidelines found in Appendix A. Techniques are based, in part, on consultation with appropriate agencies, individuals and the Natural Areas Council, and are designed to protect the features of the natural area and further its management objective. An explanation of the reason for each technique is also provided below each management technique.

Throughout this section, administering agency refers to the Division of Parks and Forestry, through Parvin State Park. It is recognized that the State Park Service is severely understaffed and, as a result, some management activities may need to be extended beyond the implementation dates indicated.

Boundary

1. The natural area boundary is hereby revised to include 51.8 acres between Parvin Lake

Trail and Muddy Run and 1.7 acres along the Second Landing access road, while removing 8.1 acres along Almond Road. The resulting acreage of Parvin Natural Area is 465 acres.

Revising the natural area boundary in accordance with the Natural Areas System Rules at N.J.A.C. 7:5A-1.12 will create a boundary that conforms with physical features identifiable in the field and will further the management objective of the natural area. A portion of the boundary will now follow two water courses instead of a treeline which could become indiscernible depending on the future use of the adjacent property. The boundary change also adds land that supports a large population of the federally threatened swamp pink. In accordance with N.J.A.C. 7:5A-1.12, revisions to the boundary of a natural area that result in a net change of not more than 25 percent of the total acreage of the natural area may be made, upon public notice, if the boundary change conforms with physical features identifiable in the field or the extent of State ownership and serves to protect the natural area or further its management objective. The net increase of 45.4 acres equates to a 11% net increase in size of the natural area.

2. The administering agency will post State Natural Area boundary signs along the natural area boundary, where practicable, at a maximum of ten per mile by May 1, 1996. These signs will be replaced as needed. The Office of Natural Lands Management (ONLM) will provide the administering agency with boundary signs and assist in posting as needed.

   The boundary of the natural area should be clearly posted for the public and to reduce the chance of inadvertent impacts to natural area features. The ONLM, which is responsible for overall administration of the Natural Areas System, designs and distributes paper boundary signs for posting of all State Natural Areas.

Biotic Communities

1. The Division of Parks and Forestry may perform gypsy moth control activities in the natural area if the following three criteria are met: counts of at least 400 egg masses/acre are recorded; the previous year defoliation occurred during or immediately preceded a severe drought; and a significant amount of tree mortality (not defoliation) will be expected if control activities are not performed. If these criteria are met, the Division will submit a gypsy moth control plan, including a spraying program environmental impact statement (EIS), with data that substantiates the above criteria, to the ONLM. The EIS will contain methods to avoid impacts on lepidoptera, rare and endangered species and other non-target species. If spraying is conducted, the following spraying guidelines must be followed: one application of *Bacillus thuringensis* (B.t.) is permitted per year; and spraying will be conducted from mid to late May. Should a more environmentally sound method of gypsy moth control become available in the future, this new gypsy moth control method will be allowed upon Natural Areas Council review and Commissioner approval.

   The Commissioner hereby approves of specified gypsy moth control activities at Parvin Natural Area. Performing gypsy moth control will further the management

objective by helping to maintain suitable habitat for State endangered and threatened species documented at Parvin Natural Area such as barred owl and swamp pink. High egg mass counts and defoliation during or preceding a drought are known to increase the susceptibility of the forest to mortality from gypsy moth defoliation (Schweitzer 1988). Drought places an additional stress on already defoliated trees which increases the chance of mortality from a second defoliation.

Rare Species

1. The ONLM will provide the administering agency with a map indicating known and possible locations of all species tracked by the Natural Heritage Database and, if possible, an illustration of any plant species by June 30, 1996. These materials will be updated by the ONLM should locations for any additional species be discovered.

   This management requirement is included so that the administering agency can more effectively manage the natural area for rare species and their habitats, and to ensure consideration of these species in future planning in the natural area.

2. The ONLM will survey/monitor for barred owl, swamp pink and eastern tiger salamander on a periodic basis and assess future management needs. Swamp pink monitoring should include number of plants, percent flowering, community composition and cover, observations of sedimentation or other impacts, and total area of the population. Should additional locations for these or any other endangered or threatened species be discovered in the natural area, they too will be monitored on a periodic basis.

   This management requirement is included to help ensure the preservation of these rare species, which are located in Parvin Natural Area.

3. Should a barred owl nest be found to exist in the natural area, the administering agency will reroute or close off any nearby trail during the nesting period (March - June) if it is determined that use of that trail poses a threat to the birds.

   Research has shown that human disturbance to barred owl during the nesting period can be detrimental to nesting success. This technique is included to reduce human disturbance to nesting barred owls thereby helping to ensure their preservation.

4. The administering agency will place logs in the area of campsites #28 and #29 and along the treeline downslope of the campsites as barriers to help prevent erosion originating at the campsites from causing siltation in the area of the swamp pink population. These horizontally placed logs would also help reduce access to the swamp pink population that is currently available via a path visible from Parvin Lake Trail and campsites #28 and #29.

   This technique is included to reduce the threat to the swamp pink population from siltation, trampling and collecting. Siltation may directly kill swamp pink plants or

provide a means for invasive species to become established within the swamp pink's habitat which can alter species composition. Trampling can damage or kill plants and alter hydrologic conditions around the plants. Collecting of this showy plant not only reduces the number of plants, but can alter the amount of seed dispersal and genetic diversity within the population.

5. By December 31, 1996, the ONLM will test water samples from standing water within the swamp pink habitat using water quality testing kits to gather baseline water quality information. Sampling should be conducted at least three times; May, July or August, and October to note any seasonal fluctuations. Water should be tested for pH, phosphorous and nitrogen compounds, and sedimentation. Water quality testing results will be compared to New Jersey Water Quality Standards. Testing results will be made available to the appropriate DEP offices.

   The swamp pink population can be impacted by changes in water quality. A single water quality monitoring event, if successful using testing kits, will provide baseline data. Should the swamp pink population change, these data could be compared to future monitoring results and could help indicate off-site threats such as added nutrients from pollution runoff, any herbicide/pesticide use at the nearby golf course or farms, land use changes occurring within the drainage of Muddy Run and on-site threats as well. This technique is included to indicate and possibly reduce the impact of off-site and on-site threats to the swamp pink population.

6. The administering agency may alter the water level of Parvin Lake only to restore water levels which have been altered due to a sudden natural phenomena or man-induced conditions off-site; routine repairs to existing water control structures may be undertaken but the structures may not be enlarged.

   This management requirement is necessary because disruption of the water regime in the natural area is a major threat to the population of the endangered swamp pink.

Public Use

1. Current uses of the natural area, which include nature interpretation and study, hiking, bird watching, botanizing, cross-country skiing, canoeing, fishing and use of the Forest Road Loop for bicycling, hayrides and walking/running events are allowed to continue. The administering agency will continue to monitor all uses to assess their effect on the natural features occurring in this area.

   The above uses are compatible with preservation of the species and natural communities that occur within the natural area and should continue to be allowed.

2. The following activities are prohibited in the natural area: horseback riding, camping, bicycle riding on trails, and campfires.

   Horseback riding, camping, campfires, and bicycle riding on trails is prohibited in

the natural area under N.J. State Park Service Rules and Regulations at N.J.A.C. 7:2-2.21, 7:2-6.1, 7:2-5.3 and 7:2-2.25(l), respectively.

3. The administering agency will obtain all applications to conduct research or collect specimens, forward a copy to the ONLM, and provide a response within a reasonable date of application submittal. The administering agency shall coordinate a response with the ONLM.

   This requirement is included to ensure thorough review of all research and collection proposals, as specified under N.J.A.C. 7:5A-1.10.

Introduced Features

1. The administering agency may construct a sanitary facility with adjacent parking on the western corner of Almond Road and the Second Landing access road, provided applicable permits are received.

   Sanitary facilities for visitors to this high-use area are needed when the Park Office is closed. Placement of the facility at this location will make use of existing utility lines along Almond Road. The Commissioner hereby approves the construction of a sanitary facility at the location indicated in order to provide the public with an alternate facility when the Park Office is closed.

2. The administering agency may remove standing dead trees within 50′ on either side of the Park Road Loop that pose a public health hazard to park visitors. A low percentage of felled trees will be left on site to maintain habitat diversity. Felled trees may be left in place as long as cutting is not conducted during high fire danger (March 15 - May 15 and/or September 15 - October 15) and the felled trees do not create an extraordinary fire hazard.

   Gypsy moth devastation during the 1980s has caused significant tree mortality in the upland portions of the natural area. As a result, periodic removal of dead standing trees may be required to protect park visitors using this area. Some felled trees should remain on site as a basic component of a typical forest life cycle.

3. The administering agency may resurface, but not enlarge, the existing Forest Road Loop.

   Maintenance of this road is needed for both emergency and recreational use.

4. The administering agency is responsible for maintenance of all trails. Maintenance includes marking trails, repairing boardwalks and bridges, pruning shrubs and trees necessary to clear the foot path, and erosion-control work. No widening of existing trails is permitted. The administering agency will repair the boardwalk and trim vegetation along Knoll Trail, and provide trail markers or signage by June 30, 1996.

   This management requirement is included to provide the public with safe access to the natural area.

5. The administering agency will forward any plans that include ground disturbance or any activity that may disturb historical features of the natural area to the New Jersey Historic Preservation Office for review. Should erosion or other factors result in the exposure of cultural remains within the natural area, the administering agency will contact the New Jersey Historic Preservation Office.

   This requirement is included to help ensure preservation of any historical or cultural features within the natural area.

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Appendix A

INTERIM MANAGEMENT PRACTICES FOR NATURAL AREAS

From Natural Areas System Rules
(N.J.A.C. 7:5A-1.1 et seq.)

7:5A-1.9 INTERIM MANAGEMENT PRACTICES

(a) Interim management practices shall be implemented by the administering agency, provided that:

1. The practice will have no direct or indirect adverse impact on natural features of concern;

2. The administering agency notifies the secretary of the Council, in writing, no later than 30 days after initiating the practice;

3. Approval of the Commissioner is not required by provision elsewhere in this subchapter; and

4. The practice is consistent with terms of any conservation easement held by the Department.

(b) Interim management practices listed at (e) or (f) below which require the approval of the Commissioner shall first be submitted to the Council for its review and recommendation.

(c) Upon finding that an interim management practice listed below at (e) or (f) would be detrimental to achieving a specific management objective, the Council shall recommend to the Commissioner the substitution of a more appropriate interim management practice. Should the Commissioner concur with the recommendation of the Council, the Commissioner may approve substitution by a more appropriate interim management practice.

(d) Where there are conflicts between general practices described below at (e) and practices specific to a natural area classification described below at (f), the latter shall apply.

(e) The following interim management practices apply generally to all natural areas upon designation to the System and until and unless superseded by the provisions of an adopted management plan:

1. Natural area boundaries shall be made clearly evident by posting signs at a maximum density of ten signs per mile; entrance points shall be posted to indicate to users that they are entering a natural area; boundary signs shall be of a standard size and format as approved by the Commissioner and provided by the Division;

2. Boundary fences that are needed to protect the natural area may be installed provided the fence shall not have a detrimental effect on movement of wildlife, air circulation, or other natural conditions;

3. Vehicular access lanes may be maintained within a natural area but may not be enlarged in any manner except upon approval of the Commissioner.

4. Existing firebreaks within a natural area may be maintained for safety purposes; temporary firebreaks made by mowing, raking, plowing or wetting, may be used in conjunction with prescribed burning for habitat management;

5. Existing structures may be maintained in a natural area; new structures and enlargement of existing structures may be undertaken upon approval by the Commissioner, provided the structures directly or indirectly contribute to the management objective; new structures, of a temporary nature, may be constructed for research purposes in accordance with N.J.A.C. 7:5A-1.10;

6. No measures, such as cutting of grass, brush, or other vegetation, thinning of trees, opening of scenic vistas, or planting, shall be taken to alter natural processes or features for the purpose of enhancing the beauty or neatness of a natural area;

7. Except as otherwise provided in this section, there shall be no introduction, removal or consumptive use of any material, product, or object to or from a natural area; prohibited activities include grazing by domestic animals, farming, gathering of plants or parts thereof, mining or quarrying, and dumping, burying, or spreading of garbage, trash, or other materials; structures or materials may be removed as follows:

   i. Old interior fences may be removed, giving consideration to leaving posts to mark boundaries between former land uses;

   ii. Rubbish or any other waste material may be removed; and

   iii. Structures having no historic, scientific or habitat value may be demolished and removed unless such structures are deemed essential for administrative purposes;

8. Water levels within a natural area shall not be altered except to restore water levels which have been altered due to a sudden natural phenomena or man-induced conditions off-site; routine repairs to existing water control structures may be undertaken but the structures may not be enlarged;

9. All wildfires shall be brought under control as quickly as possible; after a fire within a natural area, there shall be no cleanup or replanting except as approved by the Commissioner to achieve the management objective or for reasons of health and safety;

10. Prescribed burning, to eliminate safety hazards and to manage habitat, may be conducted upon review of a proposal for prescribed burning by the Council and

approval by the Commissioner; use of vehicles and equipment shall be specified in the proposal for prescribed burning;

11. Erosion control within a natural area shall not be undertaken except to restore existing grades which have been altered due to a sudden natural phenomena or man-induced conditions within or beyond the natural area;

12. Habitat manipulation may be undertaken if preservation of a particular habitat type or species of native flora or fauna is included in the management objective of the natural area and upon approval by the Commissioner of a specific habitat manipulation plan prepared by the Department.

13. Gypsy moth control activities may be implemented as an interim management practice after approval of a gypsy moth control plan by the Commissioner; the Commissioner shall review a gypsy moth control plan only after the State Forester has determined that egg mass counts and prior year defoliation indicates that tree mortality will be severe without intervention; to the extent practicable, biological controls, rather than chemical means, shall be used to control gypsy moths;

14. There shall be no physical manipulation of a natural area or application of chemicals known as adulticides for the purpose of controlling mosquitoes; the application of larvacides may be permitted in salt marshes only and only as follows:

    i. The application of *Bacillus thuringensis* var. *israeliensis* (B.t.i.) may be initiated by a mosquito control agency at any time; and

    ii. The application of other larvacides may be initiated upon approval by the Commissioner of a specific mosquito control plan submitted by a mosquito control agency; the plan shall identify the specific area where a larvacide application will be made, the types and amount of larvacide to be applied, the need for the application, and the reason why B.t.i. cannot be used for this application;

15. Research activities and the collection of specimens may only be conducted in accordance with N.J.A.C. 7:5A-1.10 and upon approval of the administering agency; and

16. Public use of natural areas shall be allowed only to the extent and in a manner that will not impair natural features; the administering agency may restrict access and use as necessary to protect the natural area; the following are permissible public uses of natural areas:

    i. Hunting, trapping, and fishing are permitted in accordance with N.J.A.C. 7:25-5 and 7:25-6; except for the stocking of fish and game, habitats may not be manipulated for the purpose of enhancing hunting, trapping, or fishing;

    ii. Occasional camping along trails, boating, and swimming may be permitted in specified locations of natural areas in accordance with N.J.A.C. 7:2-2, 7:2-5,

7:2-7, 7:2-8, and 7:25-2, and are further limited as follows:

(1) No permanent structures may be erected;

(2) No motorized methods of boating or camping are permitted;

(3) Trailside shelters of the type called lean-tos are permitted, but there may not be two such shelters within three miles of each other; and

iii. Existing trails may be maintained, but not enlarged in any manner, by the administering agency to allow public use and prevent erosion, trampling of vegetation beyond the trails, and other deterioration as follows:

(1) New trails or enlargement of existing trails for interpretive purposes may be initiated subsequent to review of a plan by the Council and approval of that plan by the Commissioner;

(2) Rare plants may not be removed for the purpose of maintaining existing or constructing new trails; and

(3) To the extent possible, natural materials shall be used on and along trails; and

iv. All pets shall be kept caged or leashed and under immediate control of the owner except that dogs used while legally hunting shall be exempt from the leashing requirement.

(f) The following interim management practices, unless superseded by an adopted management plan, apply to the appropriate specified natural area classifications:

1. Location markers identifying interpretation points of interest may be installed except within ecological reserves;

2. Trail blazes may be used within any natural area;

3. Existing vehicular access lanes may not be enlarged in any manner within an ecological reserve;

4. New vehicular access lanes may be constructed only within buffer areas and upon approval by the Commissioner;

5. The alteration of natural processes or features for the purpose of enhancing public use of the natural area may be conducted by the administering agency only within buffer areas; and

6. The following management practices shall not be permitted within ecological reserves:

i. New, existing, or temporary firebreaks;

ii. Construction of new trails;
iii. Alteration or restoration of water levels;
iv. Prescribed burning;
v. Erosion control measures;
vi. Gypsy moth control activities; and
vii. Manipulation of vegetation and wildlife habitats.

Appendix B

NATURAL AREAS SYSTEM
MANAGEMENT PLAN TASKS AND RESPONSIBILITIES

Natural Area:Parvin

Plan Adoption Date:

Name:

Date:

		Date Indicated in Plan	Proposed Accomp. Date	Date Accomp.
I.	**Parvin State Park Superintendent**			
1.	The natural area boundary is hereby revised to include 51.8 acres between Parvin Lake Trail and Muddy Run and 1.7 acres along the Second Landing access road while removing 8.1 acres along Almond Road. The resulting acreage of Parvin Natural Area is 465 acres.	N/A	N/A	N/A
2.	The administering agency will post State Natural Area boundary signs along the natural area boundary, where practicable, at a maximum of ten per mile by May 1, 1996. These signs will be replaced as needed. The Office of Natural Lands Management (ONLM) will provide the administering agency with boundary signs and assist in posting as needed.	5/1/96	_____	_____
3.	Should a barred owl nest be found to exist in the natural area, the administering agency will reroute or close off any nearby trail during the nesting period (March - June) if it is determined that use of that trail poses a threat to the birds.	N/A	N/A	N/A

4.	The administering agency will place logs in the area of campsites #28 and #29 and along the treeline downslope of the campsites as barriers to help prevent erosion originating at the campsites from causing siltation in the area of the swamp pink population. These horizontally placed logs would also help reduce access to the swamp pink population that is currently available via a path visible from Parvin Lake Trail and campsites #28 and #29.	As needed	As needed	As needed
5.	The administering agency may alter the water level of Parvin Lake only to restore water levels which have been altered due to a sudden natural phenomena or man-induced conditions off-site; routine repairs to existing water control structures may be undertaken but the structures may not be enlarged.	As needed	As needed	As needed
6.	Current uses of the natural area, which include nature interpretation and study, hiking, bird watching, botanizing, cross-country skiing, canoeing, fishing and use of the Forest Road Loop for bicycling, hayrides and walking/running events are allowed to continue. The administering agency will continue to monitor all uses to assess their effect on the natural features occurring in this area.	Ongoing	Ongoing	Ongoing
7.	The following activities are prohibited in the natural area: horseback riding, camping, bicycle riding on trails and campfires.	Ongoing	Ongoing	Ongoing
8.	The administering agency will obtain all applications to conduct research or collect specimens, forward a copy to the ONLM, and provide a response within a reasonable date of application submittal. The administering agency shall coordinate a response with the ONLM.	As needed	As needed	As needed
9.	The administering agency may construct a sanitary facility with adjacent parking on the western corner of Almond Road and the Second Landing access road, provided all applicable permits are received.	N/A	N/A	N/A

10.	The administering agency may remove standing dead trees within 50' on either side of the Park Road Loop that pose a public health hazard to park visitors. A low percentage of felled trees will be left on site to maintain habitat diversity. Felled trees may be left in place as long as cutting is not conducted during high fire danger (March 15 - May 15 and/or September 15 - October 15) and the felled trees do not create an extraordinary fire hazard.	As needed	As needed	As needed
11.	The administering agency may resurface, but not enlarge, the existing Forest Road Loop.	As needed	As needed	As needed
12.	The administering agency is responsible for maintenance of all trails. Maintenance includes marking trails, repairing boardwalks and bridges, pruning shrubs and trees necessary to clear the foot path and erosion-control work. No widening of existing trails is permitted. The administering agency will repair the boardwalk and trim vegetation along Knoll Trail, and provide trail markers or signage by June 30, 1996.	6/30/96	_____	_____
13.	The administering agency will forward any plans that include ground disturbance or any activity that may disturb historical features of the natural area to the New Jersey Historic Preservation Office for review. Should erosion or other factors result in the exposure of cultural remains within the natural area, the administering agency will contact the New Jersey Historic Preservation Office.	As needed	As needed	As needed

II. NJDEP Office of Natural Lands Management

1.	The ONLM will provide the administering agency with a map indicating known and possible locations of all species tracked by the Natural Heritage Database and, if possible, an illustration of any plant species by June 30, 1996. These materials will be updated by the ONLM should locations for any additional species be discovered.	6/30/96	_____	_____

2.	The ONLM will survey/monitor for barred owl, swamp pink and eastern tiger salamander on a periodic basis and assess future management needs. Swamp pink monitoring should include number of plants, percent flowering, community composition and cover, observations of sedimentation or other impacts, and total area of the population. Should additional locations for these or any other endangered or threatened species be discovered in the natural area, they too will be monitored on a periodic basis.	Ongoing	Ongoing	Ongoing
3.	By December 31, 1996, the ONLM will test water samples from standing water within the swamp pink habitat using water quality testing kits to gather baseline water quality information. Sampling should be conducted at least three times; May, July or August, and October to note any seasonal fluctuations. Water should be tested for pH, phosphorous and nitrogen compounds, and sedimentation. Water quality testing results will be compared to New Jersey Water Quality Standards. Testing results will be made available to the appropriate DEP offices.	12/31/96	_____	_____

III. NJ Division of Parks and Forestry

1.	The Division of Parks and Forestry may perform gypsy moth control activities in the natural area if the following three criteria are met: counts of at least 400 egg masses/acre are recorded; the previous year defoliation occurred during or immediately preceded a severe drought; and a significant amount of tree mortality (not defoliation) will be expected if control activities are not performed. If these criteria are met, the Division will submit a gypsy moth control plan, including a spraying program environmental impact statement (EIS), with data that substantiates the above criteria, to the ONLM. The EIS will contain methods to avoid impacts on lepidoptera, rare and endangered species and other non-target	As needed	As needed	As needed

species. If spraying is conducted, the following spraying guidelines must be followed: one application of *Bacillus thuringensis* (B.t.) is permitted per year; and spraying will be conducted from mid to late May. Should a more environmentally sound method of gypsy moth control become available in the future, this new gypsy moth control method will be allowed upon Natural Areas Council review and Commissioner approval.