



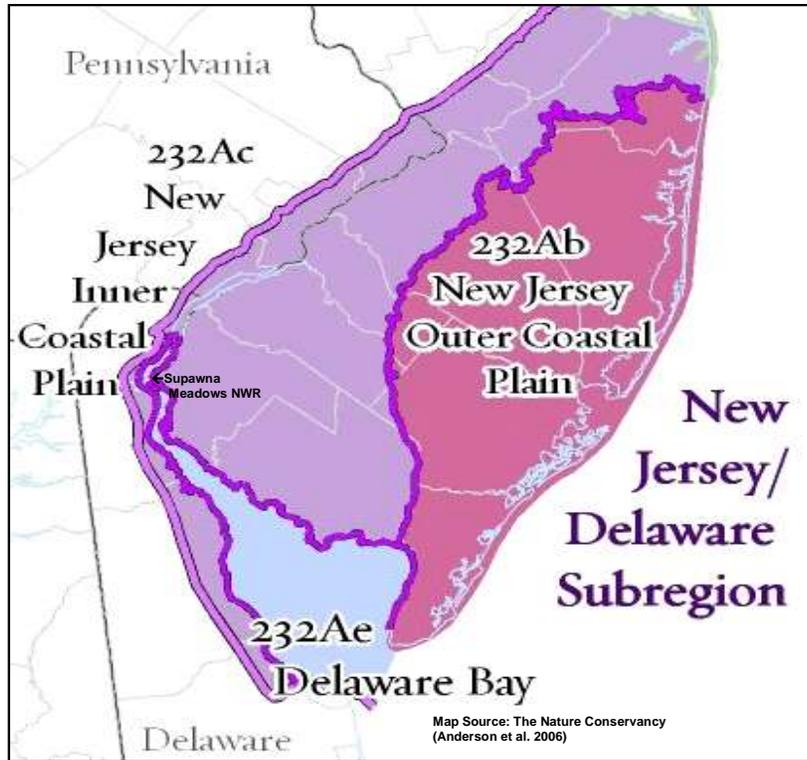
Steve Maslowski

Northern Bobwhite

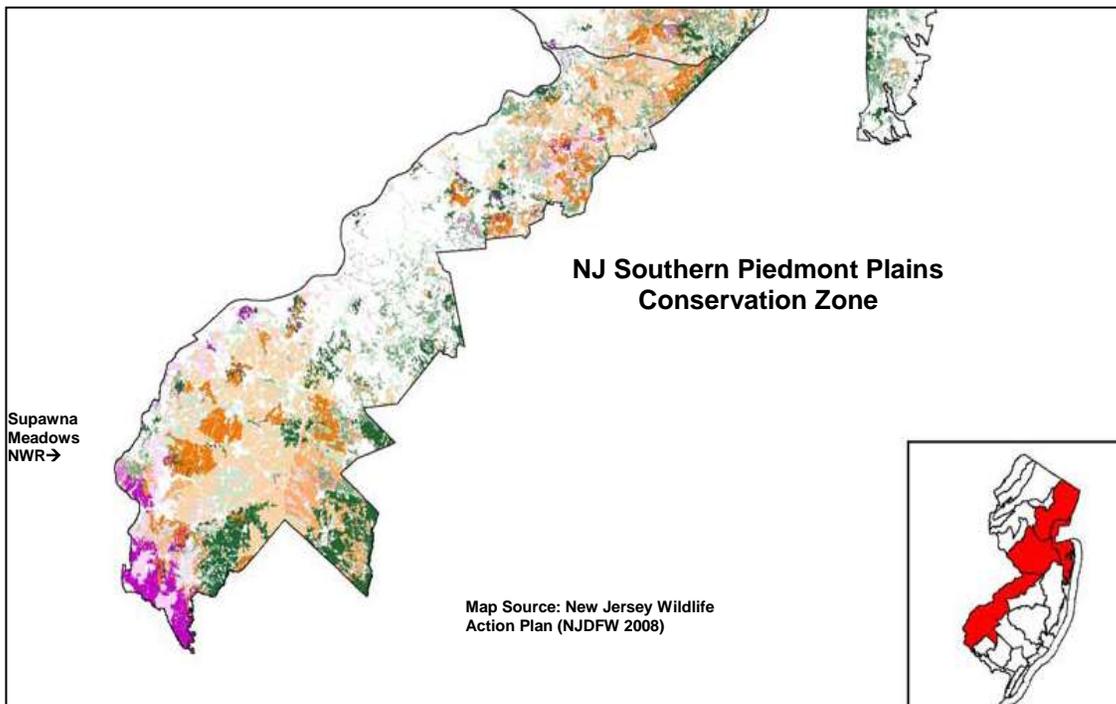
Existing Environment

- Introduction
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- Biological Resources
- Wildlife-dependent Public Use
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| | |
|----------------------|---|
| Introduction | This chapter describes in detail the physical, cultural, socioeconomic, biological, and administrative environments of the Supawna Meadows NWR and its resources directly related to our goals and key issues. It also provides the context for our management direction in chapter 4, “Management Direction and Implementation.” |
| Physical Environment | Elements of the physical environment considered include regional setting, air quality, water quality, soil types, and regional conservation lands. |
| Regional Setting | <p>According to The Nature Conservancy, Supawna Meadows NWR is located on the southwestern tidal shore of the Delaware River estuary in Salem County, New Jersey (Anderson et al. 2006). It is on the western edge of the New Jersey Inner Coastal Plain (232Ac) in the North Atlantic Coast Ecoregion (map 3.1). The New Jersey Wildlife Action Plan (NJDFW 2008a) shows the refuge located at the southwestern-most tip of New Jersey’s Southern Piedmont Plains conservation zone within the Piedmont Plains Landscape (map 3.2). The refuge is approximately 10 miles south of Wilmington, Delaware, and 35 miles south of Philadelphia, Pennsylvania. The refuge’s acquisition boundary encompasses approximately 4,527 acres. The refuge has acquired approximately 3,016 acres within the approved boundary.</p> <p>The refuge has a flat terrain typical of Delaware Estuary tidal areas. Elevations on the refuge range from zero to 10 feet above mean sea level (msl) (USFWS 2005a); however, in Pennsville, adjacent to the refuge, the elevation is 19 feet above msl.</p> <p>According to the National Oceanic and Atmospheric Administration (NOAA), the tidal amplitude on the Delaware River estuary in the vicinity of the refuge, as measured at a point near the refuge on the Salem River, averages about 5 feet (5.32 feet at Sinnickson’s Landing). The area’s climate can best be described as moderate, under a coastal influence (Delaware River/Bay). Days below zero degrees Fahrenheit (F) and above 100 degrees F are rare. The average frost-free period runs from late April to early October. Annual precipitation averages 41 inches per year and snowfall averages about 21 inches per year. Prevailing winds are from the northwest during the winter and from the southwest during the summer.</p> <p>Lands in the vicinity of the refuge have been in cultivation since the first permanent settlement was established in Salem County by John Fenwick in 1675, and farming is still the predominant land use surrounding the refuge. In the past, dikes were developed to block off the tides so wetlands could be farmed. These dikes required considerable maintenance. Storms and vandalism eventually breached all the dikes around the refuge; however, they remain to some degree between the Delaware River and the refuge. The last efforts by farmers to dike what are now refuge marshes ended in the late 1930s. Other traditional uses of the area include shad and sturgeon fishing, boat building and repair, muskrat trapping, and waterfowl hunting. All these activities, with the exception of sturgeon fishing, continue today.</p> |



Map 3.1. Ecoregion location of Supawna Meadows NWR in the New Jersey/Delaware Subregion.



Map 3.2. Ecoregion location of Supawna Meadows NWR in the New Jersey Southern Piedmont Plains zone.

The land surrounding the refuge is primarily residential, commercial, and agricultural. A Ganes Chemical Company facility, a shopping center with a Wal-Mart store, and an ACE facility are located on properties either immediately adjacent to the refuge or just outside the refuge acquisition boundary. Agriculture is declining, leaving some lands fallow while others are replaced by development. Recent recreational use of lands adjacent to or near the refuge has included waterfowl hunting, deer hunting, fishing, trapping, wildlife observation, photography, horseback riding, and all-terrain vehicle/off-road vehicle use. All of these lands are in private ownership; general public access to these lands is rare. Recreational uses of waterways adjacent to or near the refuge include canoeing and kayaking, use of motorized boats, and jet skiing. Waterways adjacent to the refuge are under jurisdiction of New Jersey State, which allows public access.

Fort Mott State Park and the Salem River Wildlife Management Area are adjacent to the refuge acquisition boundary. Several other wildlife management areas and private conservation lands are located within a 30-mile radius of the refuge. These lands provide some degree of protection for wetlands, uplands, and deciduous forests.

Air Quality

The U.S. Environmental Protection Agency (EPA) has issued the following air quality standards (table 3.1):

Table 3.1. Environmental Protection Agency (EPA) air quality standards

| Air pollutant | Air Quality Standard* |
|---|--|
| Carbon monoxide | 35 ppm (1-hour average), 9 ppm (8-hour average) |
| Nitrogen dioxide | 0.053 ppm (annual mean) |
| Ozone | 0.12 ppm (1-hour average), 0.075 ppm (8-hour average) |
| Sulfur dioxide | 0.14 ppm (24-hour average), 0.030 ppm (annual mean) |
| Airborne Particulates (< 2.5 micrometers in diameter) | 35 µg/m ³ (24-hour average), 15.0 µg/m ³ (annual mean) |

* ppm = parts per million

The New Jersey Department of Environmental Protection Bureau of Air Monitoring maintains a network of 44 air monitoring sites throughout the State for continuous monitoring of criteria air pollutants (NJDEP 2008). Air quality monitoring for Salem and Cumberland Counties is conducted at a monitoring site in Millville, New Jersey, approximately 30 miles southeast of Supawna Meadows NWR. In operation since 1983, the Millville site is currently monitoring nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂), and particulate matter (PM) less than 2.5 micrometers in diameter (PM_{2.5}). The Salem/Cumberland County area is in non-attainment for ozone for the 8-hour standard, but is in attainment for the other criteria pollutants (EPA 2010). See table 3.2 for 2004 to 2008 ozone measurements at Millville.

Table 3.2. Ozone measurements* closest to Supawna Meadows NWR from 2004 to 2008.

| Year | Ozone (in parts per million) | |
|------|------------------------------|----------------|
| | 2nd Max 1-hour | 4th Max 8-hour |
| 2004 | 0.092 | 0.083 |
| 2005 | 0.111 | 0.085 |
| 2006 | 0.103 | 0.083 |
| 2007 | 0.093 | 0.083 |
| 2008 | 0.089 | 0.079 |

* Measurements taken in Millville, Cumberland County, New Jersey. Source: Environmental Protection Agency. 2010. US AirData webpage. <http://www.epa.gov/air/data/index.html> Accessed 9 July 2010.

Water Quality

New Jersey water quality is monitored and managed within watershed management areas. Watershed Management Area 17 (WMA 17) includes the Cohansey, Maurice, and Salem rivers, and the Alloway, Dividing, Manantico, Manusmuskin, Miles, Mill, Stow, and Whooping creeks. This area includes portions of Atlantic, Cumberland, Gloucester, and Salem Counties; over 39 municipalities; and encompasses 885 square miles. Land use in this watershed is about 40 percent cropland with the rest being woodland, tidal/freshwater marsh, urban, and pasture. Nonpoint sources of water pollution range from agricultural activities, such as tree harvesting, crop production, and animal pastures, to urban runoff from construction, septic systems, and urban surfaces.

The Salem River drains an area of 114 square miles and flows 32 miles, from Upper Pittsgrove Township west to Deepwater, then south to the Delaware River. The area lies within Salem County, the major population center being the city of Salem. Much of the lower portions of the river are tidal.

The Delaware River is the longest undammed river east of the Mississippi, extending 330 miles from the confluence of its east and west branches at Hancock, New York, to the mouth of the Delaware Bay where it meets the Atlantic Ocean (DRBC 2008). The river is fed by 216 tributaries, the largest of which are the Schuylkill and Lehigh rivers in Pennsylvania. In all, the basin contains 13,539 square miles, draining parts of Pennsylvania (6,422 square miles; 50.3 percent of the basin's total land area); New Jersey (2,969 square miles; 23.3 percent); New York (2,362 square miles; 18.5 percent); and Delaware (1,004 square miles; 7.9 percent). Included in the total area number is the 782 square mile Delaware Bay, which lies roughly half in New Jersey and half in Delaware. Nearly 15 million people (approximately five percent of the nation's population) rely on the waters of the Delaware River Basin for a multitude of uses, but the watershed drains only four-tenths of one percent of the total continental U.S. land area. The Delaware River Basin Commission's (DRBC) recreational use standards for fecal coliform and enterococcus bacteria apply in the tidal Delaware River and Delaware Bay (DRBC 2009). August 2009 sampling at Pea Patch Island and Reedy Island showed levels of enterococcus that exceeded the standard of 35 colony forming units (cfu)/100 milliliters.

Currently, fish consumption advisories exist for waters in all states surrounding the Delaware Estuary and along the Delaware River (Delaware Estuary 2008). Contaminants found in estuarine fish that result in consumption advisories include polychlorinated biphenyls (PCBs), mercury, dioxins/furans, and chlorinated pesticides, including dichlorodiphenyltrichloroethane, better known as DDT. Given that fish accumulate many contaminants in their fatty tissues,

certain species with higher oil contents can pose more human consumption risks than others.

Soil Types

The U.S. Department of Agriculture's Natural Resource Conservation Services mapped the soils within Salem County, New Jersey in 1996. The major soil types found within the refuge include Transquaking mucky peat (65 percent of total acres), Mannington-Nanticoke complex (10 percent), Mattapex silt loam (9 percent), and Othello, Falsington, and Trussum soils (9 percent). The remaining soils on the refuge include Mattapex silt loam (2 percent); Othello and Falsington soils (2 percent); Sassafrass-Woodstown complex (2 percent), and Matapeake silt loam (1 percent). The major soil types are described below (USDA 1996, 2002):

Transquaking mucky peat, 0 to 1 percent slopes-This series consists of very deep, very poorly drained soils formed in thick organic deposits. They are very frequently flooded and occur on the brackish estuarine marshes along tidally influenced rivers and creeks.

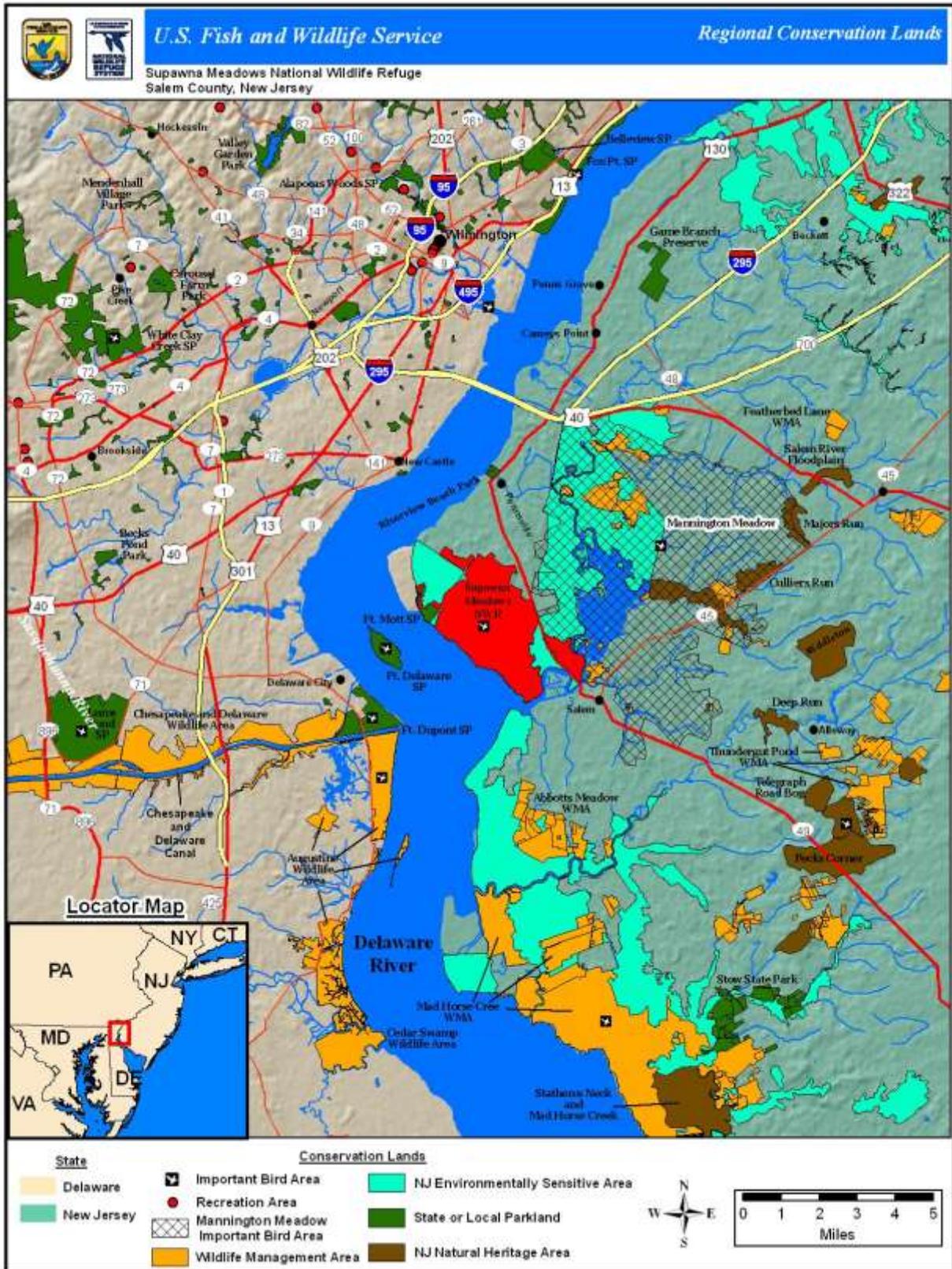
Mannington-Nanticoke complex, 0 to 1 percent slopes-This series consists of mucky silt loam, formed in silty estuarine deposits over organic, herbaceous material. These soils are non-acidic, fine silty, mixed soils that are very poorly drained, frequently flooded, and occur in tidal flats.

Mattapex silt loam, 2 to 5 percent slopes-These are very deep, moderately well drained soils formed from silty eolian deposits over coarser fluviomarine deposits. They have moderate to rapid permeability and are slightly acidic.

Othello, Falsington, and Trussum soils, 0 to 2 percent slopes-Both the Falsington and Othello series are very deep, poorly drained soils formed from silty eolian deposits over fluviomarine deposits. These occur on upland flats and depressions.

Regional Conservation Lands

There are several state, Federal, and locally managed conservation lands in the vicinity of Supawna Meadows NWR (map 3.3).



Map 3.3. Regional conservation lands around Supawna Meadows National Wildlife Refuge.

Socioeconomic Setting

Located in the southwestern corner of New Jersey, Salem County is bordered by Gloucester County to the north, Cumberland County to the east and south, and the Delaware River to the west. While only 15 minutes from Wilmington, Delaware and 35 minutes to Philadelphia, Pennsylvania, Salem County remains by far the least populated county in New Jersey. In spite of its close proximity to these urban and regional centers and major roadways (such as the New Jersey Turnpike, I-295, U.S. Routes 40 and 130, and New Jersey State Highways 45 and 49), only 13 percent of the county's land has been developed for residential, commercial, or industrial use. The remaining 90 percent of the county is farmland or tidal and freshwater wetlands, lakes, ponds, and forests (NJDEP 2002b).

Salem County

Salem County has, for the most part, maintained its traditional industries and land use patterns. The original settlements were made in the western end of the county where a network of rivers, streams, and creeks feed into the Delaware River. Lumber and grain mills were established among the major creeks as early industry was supported by timber and agriculture. Agriculture has played an important role in Salem County, both prior to European settlement, when it was inhabited by the Lenni Lenape Tribe, and through the 17th Century arrival of the Swedes, Finns, and Quakers (Salem County Visitors Center 2010).

Approximately 40 percent of the county contains productive farmland today, largely concentrated in the rural central and eastern sections. According to the Census of Agriculture, more than \$70.5 million of agricultural products were grown and raised on the 753 farms in Salem County in 2002 (USDA 2002). Salem ranks first in the State for wheat, barley, sweet corn, and potatoes, and second for milk production, soybeans, asparagus, and corn harvested for grain. Representing more than 10 percent of the State's agricultural market, Salem County is among the leaders for many other agricultural products as well (USDA 2002).

While agriculture is the mainstay of the eastern and central sections, western Salem County remains home to industry, the county's major employer. For more than a century, E.I. DuPont de Nemours and Company (DuPont) has formed the backbone of the chemical industry. At its peak in 1917, DuPont reportedly employed 25,000 people. By the 1960s, DuPont Chambers Works was the largest chemical factory in the world and DuPont employed 25 percent of Salem County households. Since then, the manufacturing industry in the United States has declined, as have the payrolls and outputs of DuPont and other companies in Salem County. Global competition and environmental regulations have led DuPont to relocate many of the site's business lines, cease operations of some altogether, and otherwise downsize its operation at the Chambers Works facility. The corresponding reduction in the industrial tax base, diminished employment opportunities, and significant loss of disposable income in the community has compromised the high quality of life associated with Salem County. By 2000, the county's per capita income was \$20,874, 23 percent lower than the State's per capita income of \$27,006 (US Census 2000).

Pennsville Township

Pennsville Township comprises 23.10 square miles located in the Philadelphia-Camden Metropolitan area. Pennsville has a population of 13,194, according to the 2000 Census. Estimated median household income in 2007 was \$57,310, which increased about 17 percent from \$47,494 in 2000. The town is predominately white, non-Hispanic (96.1 percent); Hispanic is the second largest demographic, at 1.6 percent (City Data 2009).

Contribution of the Refuge to the Local Economy

Refuges provide many benefits to local economies. Property values and associated property taxes often increase near open spaces, benefitting local communities (Gies 2009). In addition, land in public ownership requires little in the way of services from municipalities, yet provides valuable recreation opportunities for local residents. Based on a 2006 report completed by the Service, over 34 million people visited refuges for recreation that year (Carver and Caudill 2007). These visits generated almost \$1.7 billion in sales for regional economies, supporting 27,000 jobs and nearly \$543 million in employment income. Refuge recreation spending generated an additional \$185.3 million in tax revenue at the local, county, state, and Federal levels.

National wildlife refuges currently contribute to local economies through shared revenue payments. Under the provisions of the Refuge Revenue Sharing Act (the Act of June 15, 1935, 16 U.S.C. §715s), the Service pays an annual refuge revenue sharing payment to counties that contain lands the Service administers. The exact amount of the annual payment depends on Congressional appropriations, which in recent years have tended to be less than the amount to fully fund the authorized level of payments. Those payments will be continued in accordance with the law, commensurate with changes in the appraised market value of refuge lands, and new appropriation levels dictated by Congress. Recent Service revenue sharing payments for Supawna Meadows NWR are presented in table 3.3.

Table 3.3. Supawna Meadows NWR Revenue Sharing Payments

| Year Paid | Amount Paid* |
|-----------|--------------|
| 2000 | \$9,396.00 |
| 2001 | \$8,199.00 |
| 2002 | \$8,369.00 |
| 2003 | \$7,818.00 |
| 2004 | \$7,549.00 |
| 2005 | \$6,677.00 |
| 2006 | \$7,541.00 |
| 2007 | \$7,816.00 |
| 2008 | \$7,558.00 |
| 2009 | \$5,864.00 |

*Paid to Pennsville, Salem County

Refuge Administration

The refuge’s approved acquisition boundary encompasses approximately 4,527 acres along the Delaware and Salem Rivers in Pennsville Township, New Jersey. The refuge boundaries are defined by the Delaware River, Salem River, New Jersey Route 49, West Supawna Road, Fort Mott Road, and Lighthouse Road (see map 1.3 in chapter 1).

Supawna Meadows NWR Land Acquisition History

Table 3.4 lists the land acquisition history for the refuge. The dates from the 1800s represent when some of the original refuge lands were first transferred from private ownership to the Federal government. These properties were owned by different Federal agencies and were eventually transferred to the U.S. Fish and Wildlife Service.

Table 3.4. Land acquisition history for Supawna Meadows NWR

| Acquisition Year | Acres | Price* |
|------------------|-----------------|-----------------------|
| 1837 | 18.89 | 0 |
| 1837 | 19.01 | \$1,500.00 |
| 1876 | 1.86 | 0 |
| 1935 | 1.86 | 0 |
| 1941 | 5.0 | 0 |
| 1973 | 562.4 | 0 |
| 1973 | 91.0 | \$300,000.000 |
| 1974 | 41.8 | \$15,700.00 |
| 1979 | 1002.3 | 0 |
| 1979 | 11.9 | \$154,044.00 |
| 1987 | 367.5 | 0 |
| 1987 | 114.4 | \$84,000.00 |
| 1990 | 81.06 | 0 |
| 1990 | 254.47 | \$415,000.00 |
| 1992 | 288.4 | 0 |
| 1992 | 32.8 | \$327,400.000 |
| 2006 | 121.0 | 0 |
| 2009 | 254.3** | 0 |
| Total | 3,270.05 | \$1,297,644.00 |

*Zero price indicates land was donated

**All held in conservation easement

Operating Budget

With the complexing of Supawna Meadows NWR to Cape May NWR in 2004 and the implementation of the Northeast Region's Strategic Workforce Plan in 2006, no specific operating budget has been allocated for Supawna Meadows NWR. All operation and maintenance funding for Supawna Meadows NWR is supported by Cape May NWR's allocated annual budget.

Supawna Meadows NWR Staffing

The staff at Supawna Meadows NWR once consisted of a wildlife biologist, a maintenance worker (with collateral law enforcement duties), and an administrative support assistant. When the Northeast Region's Strategic Workforce Plan was implemented in 2006, the refuge was deemed an unstaffed satellite of Cape May NWR. The plan eliminated the wildlife biologist and administrative support assistant, and the maintenance worker position was relocated to Cape May NWR. Supawna Meadows NWR currently has no onsite staff. Cape May NWR currently has six full-time staff. Annually, about 20 percent of each full-time employee's time from Cape May NWR is spent providing management, maintenance, or law enforcement support to Supawna Meadows NWR (for more detailed information on staffing refer to appendix E).

Facilities and Maintenance

The refuge headquarters office is located along Lighthouse Road adjacent to the FPRRL. The building design was modeled after the FPRRL keeper's house to compliment this historic structure. It serves as office space for staff as well as a reception area for visitors; however, the building is currently unoccupied because there is no staff assigned to Supawna Meadows NWR. Also located at this site are a four-bay garage for storing equipment and three other outbuildings, including a small building that used to store oil for FPRRL. Buildings at the previous headquarters site, located approximately 0.5 miles from the refuge headquarters off Lighthouse Road, include a barn, garage, house, and office. The

refuge has two housing quarters. One is located off Route 49 and is currently used to house temporary employees. The other, located off Lighthouse Road, is vacant.

Refuge Operational Plans (“Step-down” Plans)

The Service Manual, Part 602, chapter 4 (Refuge Planning Policy), identifies more than 25 step-down management plans that generally are required on refuges. Those plans provide the details necessary to “step-down” general goals and objectives to specific strategies and implementation schedules. Some require annual revisions; others are revised every 5 to 10 years. Some require additional NEPA analysis, public involvement, and compatibility determinations before they can be implemented.

The following step-down plans are completed and up-to-date:

- Hunt Plan (reviewed annually)
- Fishing Plan (reviewed annually)
- Safety Plan
- Continuity of Operations Plan
- Fire Management Plan

The following step-down plans need to be completed for the refuge:

- Habitat Management Plan (HMP) (the highest priority plan to complete)
- Water Management Plan (to be incorporated into HMP)
- Law Enforcement Plan
- Integrated Pest Management Plan (to be incorporated into HMP)
- Facilities Plan
- Sign Plan
- Visitor Services Plan

Partnerships

The reduced staff time at Supawna Meadows NWR has limited our ability to fully participate in partnerships with agencies and organizations with which we have common conservation goals. We currently maintain partnerships with New Jersey Forest Fire Service, NJDFW, Friends of Supawna Meadows NWR, and New Jersey Audubon Society.

Volunteer Program

Approximately seven people regularly volunteer on the refuge. The primary duties consist of maintenance activities such as mowing around facilities and mowing and maintaining trails. The activities of the volunteers are critical to the operation of the refuge due to the lack of assigned full-time staff. Volunteers also engage in outreach activities sponsored by the Friends of Supawna Meadows NWR.

Friends Program

The Friends of Supawna Meadows NWR was created in 2003 by local residents and volunteers. The mission of the group is “To enhance this national treasure by fostering community awareness, conducting outreach and environmental education, and supporting habitat and wildlife conservation on the refuge.” The group currently consists of about 50 members; however, the number of members is increasing and the group is actively working to raise the profile of the refuge.

The group’s primary annual activity is the Youth Fishing Event, usually held in early June. Up to 100 youths attend the fishing derby. Participants are provided the gear and bait needed to fish. They also receive a free lunch and a prize.

Other activities organized by the Friends group include nature walks, trail maintenance days, and off-site outreach at local festivals such as Septemberfest and the Winter Raptor Festival. The Friends Group is also active in educating local and Federal officials about refuge needs and events.

| | |
|----------------------|---|
| Research | An impoundment study was conducted on the Tract 11 impoundment from 2005 through 2008 in cooperation with 22 other refuges in the Northeast and Midwest. The objectives of the study were to determine the response of waterbirds, plants, and invertebrates while providing habitat for migratory waterbirds; to use impoundment bathymetric data to meet spring shorebird, fall shorebird or fall waterfowl habitat requirements; and to study vegetation response to spring and summer drawdowns. Water levels in the impoundment were lowered for shorebird use and raised for waterfowl use during various times of year. |
| Special Use Permits | In general, special use permits are issued for associated wildlife related research projects or studies to cooperating partners such as NJDFW, New Jersey Audubon Society, and others. Proposed research projects and other compatible uses are issued special use permits when they are determined to be beneficial to the refuge mission. |
| Biological Resources | This section describes the physical characteristics and plant species composition of the principal refuge habitats as well as the invasive plant species that occur. It also identifies the wildlife species of conservation concern that use those habitats. Table 3.5 summarizes the acreage of each habitat type within the refuge. Approximately 87 percent of the refuge is in wetlands and impoundments, the other 13 percent is upland. |
| Tidal Marsh | <p>The largest single habitat type on Supawna Meadows NWR is slightly brackish (0 to 8 parts per thousand) tidal marsh, which comprises 2,423 acres, about 75 percent of the refuge's acreage. This habitat type includes marsh habitat (1,931 acres) and the open water tidal rivers and creeks (492 acres). The tidal marsh soils consist of organic silts and fine to very coarse dredge river material. They occur on flats along the Delaware River to a depth of 20 feet. These features are regularly flushed during high tides. Tidal pools and ponds are generally found in the interior portions of regularly flowing tidal marshes, but these water bodies themselves may not be flooded on every tidal cycle.</p> <p>The tidal marsh west of Route 49 was diked and drained for farming in the 18th century. Portions of the dike blew out in the 1930s, and the marsh reflooded. Originally, there was more sheet flow from the Delaware Bay to Mannington Meadow (to the east of Route 49). However, flow is now restricted to a few locations and Mannington Meadow is fresher than the marshes on the west side of Route 49.</p> <p>The portion of the refuge east of Route 49 lies within Mannington Meadow and contains a diversity of vegetation. Dominant species include smooth cordgrass (<i>Spartina alterniflora</i>), pickerelweed (<i>Pontederia cordata</i>), water hemp (<i>Amaranthus cannabinus</i>), wild rice (<i>Zizania aquatica</i>), rice cutgrass (<i>Leersia oryzoides</i>), and common reed or phragmites. The Baldrige Creek area contains a diversity of vegetation similar to that found in the Mannington Meadow area, but there is a greater amount of phragmites in this area. Several rare plants occur in tidal marshes on the refuge (for example, seashore mallow (<i>Kosteletzkya virginica</i>) and long-awned sprangletop (<i>Leptochloa fascicularis</i> var. <i>maritima</i>)).</p> <p>The Mill Creek and Mud Creek areas of the tidal marsh are extensively dominated by phragmites, which is the most prevalent invasive plant found on the refuge. Altogether, about 859 acres of the tidal marsh remain in native marsh vegetation; 762 acres are phragmites-dominated.</p> <p>Breeding birds that inhabit the tidal marsh include the clapper rail (<i>Rallus longirostris</i>), king rail (<i>Rallus elegans</i>), least bittern (<i>Ixobrychus exilis</i>), coastal plain swamp sparrow (<i>Melospiza georgiana nigrescens</i>), seaside sparrow</p> |

Table 3.5. Habitats and refuge acres for Supawna Meadows NWR

| Habitat Type | Current Acreage |
|--|------------------|
| Developed | 27.26 |
| Developed | 0.42 |
| Levee | 5.21 |
| Road | 7.29 |
| Rural | 14.34 |
| Forested Uplands | 240.14 |
| Mesic Mixed Oak Forest | 22.73 |
| Northeastern Modified Successional Forest | 139.16 |
| Norway Spruce Plantation | 1.10 |
| Successional Sweetgum Forest | 77.15 |
| Forested Wetlands | 181.97 |
| Red Maple - Sweetgum Swamp | 172.03 |
| Red Maple / Lizard's-tail Swamp | 9.94 |
| Grassland | 122.02 |
| Cropland | 36.25 |
| Hay | 5.22 |
| Northeastern Old Field | 77.78 |
| Pasture | 2.78 |
| Herbaceous Wetland | 41.61 |
| Freshwater Phragmites Marsh | 38.79 |
| Smartweed Pond | 0.35 |
| Successional Wet Meadow | 2.48 |
| Impoundments with Water Control Structures | 85.61 |
| Impoundments without Water Control Structures | 3.98 |
| Creeping Lovegrass Coastal Plain Pond | 1.30 |
| Other Impoundments | 2.68 |
| Scrub/Shrub Uplands | 37.87 |
| Northeastern Modified Successional Shrubland | 37.87 |
| Scrub/Shrub Wetlands | 56.00 |
| Northeastern Modified Successional Shrubland | 56.00 |
| Scrub/Shrub Wetlands (Tidal) | 27.66 |
| Maritime Shrubland (northern bayberry type) | 3.90 |
| Northeastern Modified Successional Shrubland | 23.76 |
| Tidal Marsh | 1,934.05 |
| Atlantic Giant Cordgrass Marsh | 5.41 |
| Brackish Meadow | 2.31 |
| Brackish Tidal Low Marsh | 64.63 |
| Cattail Brackish Marsh | 370.41 |
| Mesohaline Seepage Marsh | 2.53 |
| Oligohaline Marsh | 47.27 |
| Tidal Phragmites Marsh | 1,438.23 |
| Woolgrass Marsh | 0.26 |
| Open Waters | 491.70 |
| Grand Total | 3,249.89* |

*Includes 231 acres held under conservation easement by the refuge. The owners have reserved certain rights on an additional 20 acres of this easement so these acres are not included.

(*Ammodramus maritimus*), and sedge wren (*Cistothorus platensis*). The tidal marsh is an important foraging area for the nine Pea Patch Island colonial-nesting wading birds, which include five priority species: little blue heron (*Egretta caerulea*), glossy ibis (*Plegadis falcinellus*), snowy egret (*Egretta thula*), black-crowned night-heron (*Nycticorax nycticorax*), and least bittern.

The tidal marsh supports raptors including the bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*). The marsh also provides migrating and wintering habitat for two populations of the Canada goose (*Branta canadensis*), Atlantic Population Canada geese and North Atlantic Canada geese; and for the tundra swan (*Cygnus columbianus*). It also supports migrating shorebirds such as the semipalmated sandpiper (*Calidris pusilla*), dunlin (*Calidris alpina*), and greater yellowlegs (*Tringa melanoleuca*).

The tidal marsh supports a diversity of other wildlife species including the marsh rice rat (*Oryzomys palustris*), a New Jersey nongame species of conservation concern (NCC), and the northern diamondback terrapin (*Malaclemys terrapin terrapin*). It also supports NCC insects of conservation concern such as the frosted elfin butterfly (*Callophrys irus*) and a noctuid moth (*Macrochilo sp. 1 nr. absorptalis*).

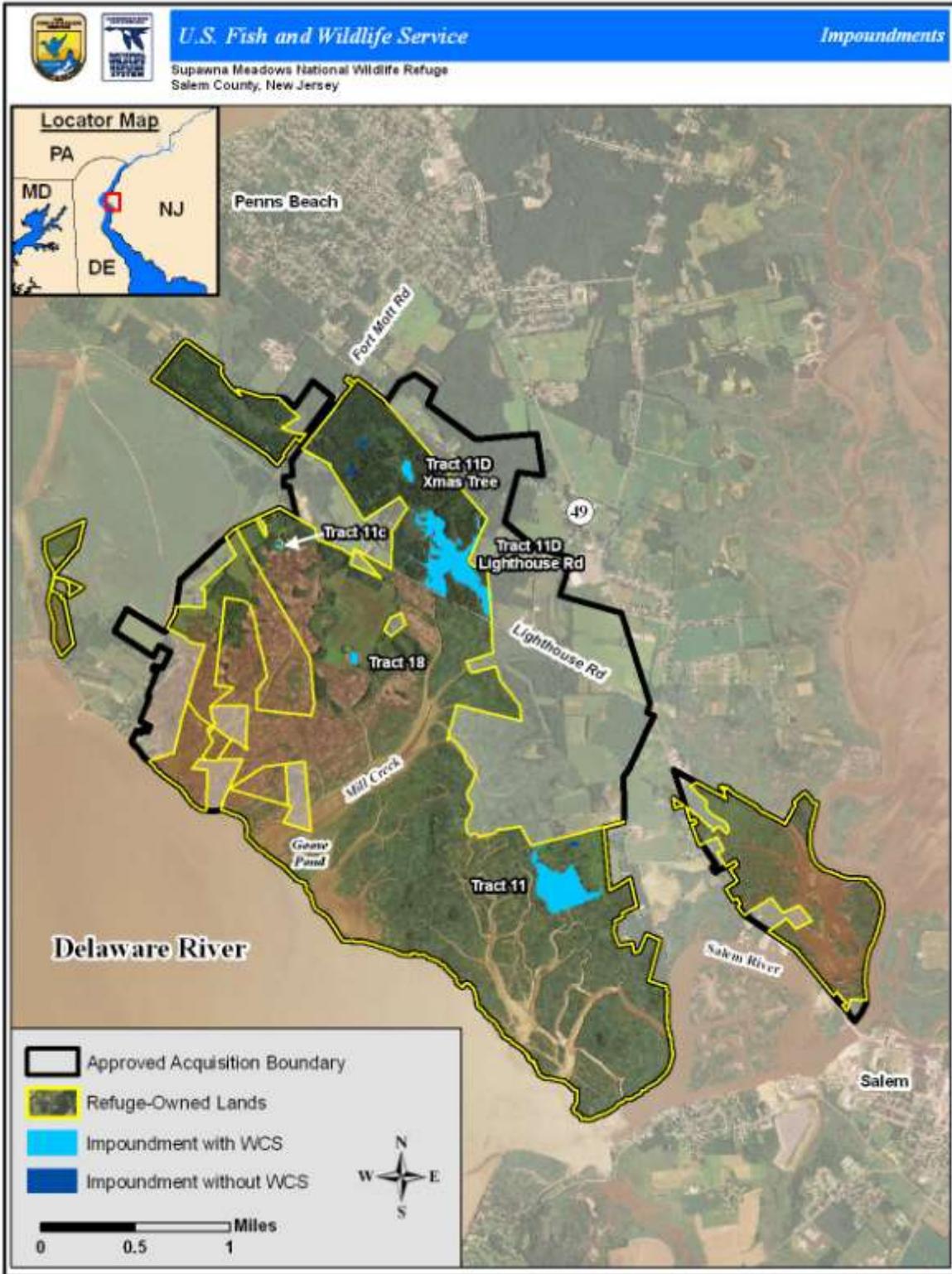
Managed Impoundments and Ponds

The refuge has five impoundments with water control structures, totaling approximately 84 acres (table 3.6, map 3.4). A natural increase in water levels can occur from rainfall and from natural springs. In these impoundments, boards are placed or removed to control the water level; either releasing impounded waters or allowing tidal water to flow into the impoundment. Currently, the water level is managed in three of the five impoundments.

Table 3.6. Managed impoundments of Supawna Meadows NWR

| Name | Location | Size (acres) | Habitat: |
|--------------------------------|---|--------------|---|
| Tract 11 | Off West Supawna Road | 30 | cattail marsh; surrounded by tidal marsh and farm fields |
| Tract 11C | Behind new office/quarters | 0.3 | open water; surrounded by tidal marsh, forested and scrub/shrub wetlands, old field |
| Tract 11D Lighthouse Rd (LHR) | On Lighthouse Rd | 48.5 | open water; surrounded by tidal marsh, forest |
| Tract 18 | At old office/barn | 1.5 | open water; surrounded by grassland and tidal marsh |
| Tract 11D Xmas Tree Lane (XTL) | Off X-mas Tree Lane/ off Forest Habitat Trail | 3.3 | open water; surrounded by forest |

The Tract 11 impoundment is a 30-acre freshwater emergent wetland adjacent to the tidal marsh. A water control structure at the head of a tidal creek is used to manipulate water levels within the impoundment. Prescribed fire has been used to control vegetation in the impoundment. Mowing and flooding can also be used to reduce overcrowding vegetation. Water levels are managed to provide habitat for trust resources, primarily shorebirds, wading birds, and waterfowl. Plants that occur in this impoundment include Walter’s cockspur grass (*Echinochloa walteri*), spreading panic grass (*Panicum dichotomiflorum*), cattail (*Typha sp.*), bulrush (*Scirpus sp.*), and sedges (*Cyperus sp.*). Several rare plants occur in and around this impoundment including hooded arrowhead (*Sagittaria calycina var.*



Map 3.4. Impoundments at Supawna Meadows National Wildlife Refuge.

calycina) and giant foxtail (*Setaria magna*). Invasive species such as phragmites, purple loosestrife (*Lythrum salicaria*), Canada thistle, and mile-a-minute weed are displacing native species in the impoundments and along the dikes.

Breeding birds that use the impoundments include the little blue heron, marsh wren (*Cistothorus palustris*), American black duck (*Anas rubripes*), wood duck (*Aix sponsa*), and clapper rail.

Also supported are spring-migrating shorebirds including the semipalmated sandpiper, greater yellowlegs, and dunlin. In response to impoundment management for spring-migrating shorebirds during 2000 to 2001, almost 3,000 shorebirds were observed in the Tract 11 impoundment during late May at the peak of the spring migration. In 2004, weekly shorebird surveys were conducted from March through July at high tide. Greater yellowlegs, lesser yellowlegs (*Tringa flavipes*), semipalmated sandpipers, least sandpipers (*Calidris minutilla*), dunlin, common snipe (*Gallinago gallinago*), solitary sandpipers (*Tringa solitaria*), spotted sandpipers (*Actitis macularia*), and semipalmated plovers (*Charadrius semipalmatus*) were observed. The greatest number of shorebirds was detected on May 11 when 840 shorebirds, mostly semipalmated and least sandpiper, were observed.



USFWS

Tract 11 Impoundment

The Pea Patch Island wading birds use the impoundments for foraging. Weekly wading bird surveys were conducted from March through September 2002 at high tide. Great blue herons, (*Ardea herodias*), great egrets (*Ardea alba*), snowy egrets, little blue herons, cattle egrets (*Bubulcus ibis*), and glossy ibis were observed. The greatest number of wading birds was observed in the Tract 11 impoundment on May 14 when 63 individuals of 6 species were counted.

Weekly waterfowl surveys were conducted January through March and September through December 2002. American black ducks, Canada geese, gadwall (*Anas strepera*), green-winged teal (*Anas carolinensis*), mallards (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and wood ducks were observed. The greatest number of ducks and geese was observed in the Tract 11 impoundment on November 25 when 326 Canada geese, 15 green-winged teal, 190 mallards, and 329 Northern pintail were counted.

Common snapping turtles (*Chelydra serpentina*), red-eared sliders (*Trachemys scripta elegans*), redbelly turtles (*Pseudemys rubriventris*), eastern painted turtles (*Chrysemys picta picta*), northern water snakes (*Nerodia sipedon*),

southern leopard frogs (*Rana sphenoccephala*), and northern spring peepers (*Pseudacris crucifer crucifer*) also are present in this impoundment. A number of amphibian and reptile species use all of the impoundments, including the **Fowler's toad** (*Bufo woodhousii fowleri*), which is listed as a non-game species of conservation concern by the New Jersey Division of Wildlife.

There are a number of small, unmanaged impoundments that lack water control structures. These consist of old clay pit ponds and other depressions in the forested areas. The ponds are man-made, most have high berms surrounding them, and some have drainage outlets. These impoundments are generally open water and unvegetated. However, the edges contain some plant species, such as **Walter's cockspar grass, spreading panic grass, cattail, bulrush, and sedges**. Wood duck and eastern screech owls (*Megascops asio*) benefit from nest boxes placed near these unmanaged impoundments.

Forested Wetlands

Forested wetlands comprise about 182 acres of refuge land. These wetlands are closed canopy swamps dominated by deciduous trees. The forest is interspersed with permanent and vernal ponds. Mature trees mostly have a 14 to 20 inch diameter breast height (dbh); dominant species include red maple (*Acer rubrum*), willow oak (*Quercus phellos*), sweetgum (*Liquidambar styraciflua*), and sour gum (*Nyssa sylvatica*). Dominant understory plants include southern arrowwood (*Viburnum dentatum*) and sweet pepperbush (*Clethra alnifolia*). Common groundcover plants include New York fern (*Thelypteris noveboracensis*) and false nettle (*Boehmeria cylindrica*). Several rare plant species occur in this habitat (for example, cutleaf water milfoil (*Myriophyllum pinnatum*) and stalked water horehound (*Lycopus rubellus*)). In many areas, the ground cover is dominated by the invasive plant Japanese stiltgrass (USFWS 2005a).

Upland Forests

Forested uplands, which include small forest openings not counted as scrub/shrub habitat, comprise about 240 acres of refuge land. At least 75 percent of the canopy coverage is from deciduous trees. The average height is at least 20 feet. Plant species include sweetgum, sour gum, black cherry (*Prunus serotina*), black oak (*Quercus velutina*), southern red oak (*Quercus falcata*), persimmon (*Diospyros virginiana*), American holly (*Ilex opaca*), and red maple. Dominant understory plants include southern arrowwood, highbush blueberry (*Vaccinium corymbosum*), and common greenbrier (*Smilax rotundifolia*).

Grassland

Approximately 86 acres of grassland habitat occur on the refuge, excluding cropland. A contiguous 78-acre grassland unit and several grassland patches of less than 6 acres occur on the refuge. The large grassland, located off Lighthouse Road, includes a diversity of grasses and forbs. It is maintained through mechanical methods, such as mowing, and by prescribed burning. Historically, the grassland was farmed; prior to farming, the conditions were maintained by fire that was periodically caused by lightning or man-made events. Some important plant species include cool season grasses, such as orchard grass (*Dactylis glomerata*), warm season grasses, such as switch grass (*Panicum virgatum*), and forbs, such as goldenrods (*Euthamia* sp. and *Solidago* sp.), and eupatoriums (*Eupatorium* sp.) (USFWS 2005a). Invasive plants of the grassland include Canada thistle, Chinese lespedeza (*Lespedeza cuneata*), and autumn olive. The grassland habitat does not support a large number of breeding birds but does provide migration and wintering habitat for songbirds, such as the bobolink, vesper sparrow, eastern meadowlark, and savannah sparrow, and for raptors, such as the northern harrier and short-eared owl.

Scrub/Shrub Habitat

There are approximately 122 acres of scrub/shrub and early successional habitats spread across the refuge, comprised of 84 acres of wetlands and 38 acres of uplands. These areas are dominated by a mixture of native plants (e.g.,

blackberry, goldenrod, grapevine, and bayberry (*Myrica pensylvanica*) and invasive plants (e.g., multiflora rose, autumn olive, Japanese honeysuckle, mile-a-minute weed, and phragmites) (USFWS 2005a).

Forest openings are mostly dominated by invasive plants (e.g., autumn olive, multiflora rose, Japanese honeysuckle, Japanese stiltgrass, and mile-a-minute vine). Other common plants in the forest openings include sweetgum, black cherry, blackberry (*Rubus* sp.), and grape vines (*Vitis* spp.). There are large patches within the mature forest where invasives do not occur. These patches host a number of S1³ and S2⁴ plants, including round-fruited hedge-hyssop (*Gratiola virginiana*), southern twayblade (*Listera australis*), stalked water horehound, cutleaf water milfoil, loblolly pine (*Pinus taeda*), and fragrant ladies' tresses (*Spiranthes cernua* var. *odorata*) (USFWS 2005a).

Invasive Plants

Invasive plants are found in all refuge habitats as discussed under each of the habitat types, but most importantly in the refuge's tidal marsh. The relative predominance of these species is shown in table 3.7, listing the most recent estimates of acreage across the refuge for each species.

Table 3.7. Important invasive plants* of Supawna Meadows NWR.

| Common Name | Scientific Name | Total Acreage | Acres of Dense (Monotypic) Coverage |
|--------------------------|-------------------------------|---------------|-------------------------------------|
| Phragmites/Common reed** | <i>Phragmites australis</i> | 531 | 511 |
| Japanese stiltgrass | <i>Microstegium vimineum</i> | 78 | 57 |
| Japanese honeysuckle | <i>Lonicera japonica</i> | 120 | 16 |
| Mile-a-minute vine | <i>Polygonum perfoliatum</i> | 63 | 6 |
| Autumn olive | <i>Elaeagnus umbellata</i> | 72 | 2 |
| Reed canary-grass | <i>Phalaris arundinacea</i> | 2 | 2 |
| Asiatic bittersweet | <i>Celastrus orbiculatus</i> | 16 | < 1 |
| Multiflora rose | <i>Rosa multiflora</i> | 93 | < 1 |
| Canada thistle | <i>Cirsium arvense</i> | 44 | < 1 |
| Chinese lespedeza | <i>Lespedeza cuneata</i> | 2 | < 1 |
| Wild Garlic | <i>Allium vineale</i> | 5 | < 1 |
| Johnsongrass | <i>Sorghum halepense</i> | 1 | < 1 |
| Bristled knotweed | <i>Polygonum caespitosum</i> | 11 | < 1 |
| Black locust | <i>Robinia pseudoacacia</i> * | 9 | 0 |
| Purple loosestrife | <i>Lythrum salicaria</i> | 1 | 0 |

*occupying a minimum of 1 acre as of 2002

**phragmites was not entirely mapped; the actual acreage is much higher.

Climate Change and Effects of Relative Sea Level Rise

Global climate change has already had an observable impact in the Northeastern United States, including an increase in the water temperatures, more days over 90 degrees Fahrenheit, less precipitation as snow fall, and sea level rise (Frumhoff et al. 2007). According to the Intergovernmental Panel on Climate Change (IPCC), sea level has risen worldwide approximately 4.8 to 8.8 inches (12 to 22 cm) during the last century (IPCC 2007). While there is some variation in projected sea level rise (e.g., Rahmstorf 2007, Pfeffer et al. 2008), the IPCC

³ S1: At very high risk due to extreme rarity (often 5 or fewer populations or occurrences in the State), very steep declines, or other factors.

⁴ S2: At high risk due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

projects sea levels will rise an additional 7.1 to 23.2 inches, about 0.07 to 0.23 inches per year, between 1999 and 2099 (IPCC 2007). The historic trend for sea level rise for the refuge is 0.136 inches per year, about twice the global average for the last 100 years.

Tidal marshes are highly susceptible to effects of climate change, especially sea level rise. In an effort to address potential effects of sea level rise on refuges, the Service contracted the application of Sea Level Affecting Marshes Model (SLAMM) for many refuges in the Northeast, including Supawna Meadows NWR (see appendix G for SLAMM report). The SLAMM analysis looks at effects of projected sea level rise on the refuge's approved acquisition boundary under five scenarios: 1.28 ft, 2.26 ft, 3.28 ft, 4.92 ft, and 6.56 ft by 2100. Results from SLAMM indicate that by 2025 there will be noticeable changes in refuge habitats under all scenarios. For example, saltwater intrusion will increase salinity and the amount of saltmarsh within the refuge boundary between 140 and 200 percent (adding between 219 and 300 acres). Other tidal marsh habitats will likely decrease between 14 and 18 percent (losing about 300 to 400 acres). Over this same time span, tidal creeks within the refuge will likely increase between 22 and 31 percent (between 150 and 220 acres). Because much of the refuge's habitat is tidally influenced, sea level rise will likely change the species composition and associated habitat management for much of the refuge. We have not modeled potential effects of increased air temperatures and changes in seasons; however, these are likely to be much smaller compared to sea level rise given the tidal influence over much of the refuge's habitats.

Federally listed
Threatened or Endangered
Species and Other
Species and Habitats of
Special Management
Concern

The following federally listed threatened or endangered species may enter the Delaware Bay and may occasionally travel up the river as far as the refuge:

- Atlantic hawksbill
- Atlantic loggerhead
- Atlantic ridley
- Atlantic leatherback
- Shortnose sturgeon

All of these species are under the jurisdiction of NOAA. No sea turtle nesting habitat is present on the refuge. The shortnose sturgeon is present in the Delaware River; however, this species prefers larger rivers (Dadswell et al. 1984) and is not expected to occur within the refuge boundary. Whales occasionally enter the Delaware Bay, and one individual is known to have strayed as far north as Philadelphia, Pennsylvania.

Sensitive joint-vetch, a federally listed threatened species, has been reported at two locations near the refuge. It was found on the muddy tidal banks of the Delaware River on August 8, 1881 and to the north of the refuge in 1934. No plants were found during a brief survey conducted on September 30, 1992 (Snyder 2010 personal communication).

We will continue to consult with the Service's Ecological Services division and NOAA, as appropriate, regarding refuge activities that may affect federally listed threatened and endangered species. In addition, to ensure compliance with the ESA, this document has been subject to intragovernmental review under Section 7 of the ESA.

New Jersey maintains a State list of threatened or endangered species. Of these species, the osprey successfully nests on the refuge. Great blue heron feed on the refuge throughout the year. Bald eagles have nested on the refuge since 1998. Another pair of bald eagles has been maintaining a nest in the adjacent Salem River Wildlife Management Area. Peregrine falcons (*Falco peregrinus*) nest on

the Delaware Memorial Bridge, approximately seven miles north of the refuge. Peregrines may occasionally use the refuge for feeding and are occasionally observed during migration. Coast flatsedge (*Cyperus pseudovegetus*), a State-listed endangered species, was collected along the Delaware River on October 29, 1934. Floating pennywort (*Hydrocotyle ranunculoides*), another State-listed endangered species, was observed on the north side of Lighthouse Road, west/northwest of Harrisonville, in 1967 and again in 1985.

Appendix A lists the animals potentially found on the refuge that are federally listed threatened or endangered or are State-listed threatened, endangered, or a species of special concern.

Birds

Supawna Meadows NWR is located in the Atlantic Flyway where birds migrating from interior Canada and the coastal provinces merge to form the main stem of the flyway. The refuge not only serves as an important migration area, but also provides wintering habitat for large numbers of waterfowl. Midwinter waterfowl inventory flights for the Salem River watershed averaged more than 2,000 dabbling ducks and more than 11,500 Canada geese during the 2009 midwinter count (USFWS 2009d). Over 300 species of birds can be observed in Salem County during the year. Supawna Meadows NWR provides habitat for regionally and nationally significant species such as rails, neotropical migrants, and raptors (USFWS 2005a).

In describing the Supawna Meadows NWR Important Bird Area (IBA), the New Jersey Audubon Society noted the following:

The Supawna Meadows IBA provides breeding habitat for the State endangered bald eagle. Over 20 State threatened king rails also breed at this site. Significant numbers of breeding mixed upland forest, shrub/scrub, and forested wetland-dependent species occur at Supawna Meadows. The refuge marshes provide valuable foraging habitat for more than 6,000 pairs of colonial wading birds nesting less *than a mile away on Delaware's Pea Patch Island*. One of the largest heron rookeries on the east coast north of Florida supports nine species: great blue heron, great egret, little blue heron, tricolored heron, snowy egret, cattle egret, black and yellow-crowned night-heron and glossy ibis. The refuge provides important resting and feeding habitat for spring and fall migrants including waterfowl species and passerines. Mallards and northern pintails also winter at the refuge.

New Jersey Audubon Society 2009

Waterfowl

Thousands of waterfowl, including American black duck, American widgeon (*Anas americana*), Canada goose, blue-winged teal (*Anas discors*), green-winged teal, gadwall, mallard, northern pintail, snow goose (*Chen caerulescens*), and tundra swan use the refuge tidal marsh during winter and migration (USFWS 2005a).

Coastal salt marsh habitats of the mid-upper Atlantic coast, including the Delaware Bay marshes and Supawna Meadows NWR, have been identified by the Black Duck Joint Venture as the most important habitat for wintering black duck. Coastal wetlands, including the Delaware Bay marshes, are of international importance to wintering waterfowl, annually wintering 34 percent of the entire Atlantic Flyway black duck population (Black Duck Joint Venture 2008).

| | |
|-------------------------------|--|
| Raptors | <p>Notable raptor species observed on the refuge include bald eagle, northern harrier (<i>Circus cyaneus</i>), sharp-shinned hawk (<i>Accipiter striatus</i>), Cooper's hawk (<i>A. cooperii</i>), red-shouldered hawk (<i>Buteo lineatus</i>), red-tailed hawk (<i>Buteo jamaicensis</i>), American kestrel (<i>Falco sparverius</i>), and peregrine falcon. A number of State-listed endangered northern harriers and State-listed threatened osprey nest in the refuge tidal marsh (USFWS 2005a). A pair of bald eagles has nested on the refuge since 1998.</p> |
| Forest Birds | <p>The forest supports breeding wood thrush (<i>Hylocichla mustelina</i>), eastern wood-pewee (<i>Contopus virens</i>), northern flicker (<i>Colaptes auratus</i>), and Baltimore oriole (<i>Icterus galbula</i>); and migrating black-and-white warbler (<i>Mniotilta varia</i>), hooded warbler (<i>Wilsonia citrina</i>), and Kentucky warbler (<i>Oporornis formosus</i>), as well as Cooper's hawk.</p> |
| Grassland Birds | <p>As mentioned previously, the refuge's grassland habitat does not support a large number of breeding grassland birds, but it does support migrating and wintering songbirds, including the bobolink (<i>Dolichonyx oryzivorus</i>), vesper sparrow (<i>Poocetes gramineus</i>), eastern meadowlark (<i>Sturnella magna</i>), and savannah sparrow (<i>Passerculus sandwichensis</i>), as well as raptor species such as northern harrier and short-eared owl (<i>Asio flammeus</i>).</p> |
| Marsh, Wading, and Shorebirds | <p>Supawna Meadows NWR provides foraging habitat for more than 6,000 pairs of 9 species of wading birds that nest on Pea Patch Island, one of the largest rookeries on the East Coast. Specifically, black-crowned night-heron, yellow-crowned night herons (<i>Nyctanassa violacea</i>) (State-listed threatened), great egret, and little blue heron (State species of special concern) forage in the tidal marsh throughout the breeding season. The refuge receives significant use by shorebirds during both spring and fall migrations, mostly least sandpiper and semipalmated sandpiper. King rail and least bittern (State species of special concern) breed in the refuge tidal marsh.</p> <p>Pea Patch Island and the surrounding area, including the refuge, have been designated a Special Management Area (SMA) by the States of New Jersey and Delaware in accordance with the Coastal Zone Management Act.</p> <p>The refuge receives significant use by shorebirds during both spring and fall migrations. Both the New Jersey and Delaware shores of the Delaware Bay are designated as International Shorebird Preserves, based on the importance of the estuary to migrating shorebirds.</p> |
| Mammals | <p>A large number of New Jersey non-game species of conservation concern mammals are on the refuge, including eastern small-footed myotis (<i>Myotis leibii</i>), eastern red bat (<i>Lasiurus borealis</i>), hoary bat (<i>Lasiurus cinereus</i>), silver-haired bat (<i>Lasionycteris noctivagans</i>), and southern bog lemming (<i>Synaptomys cooperi</i>).</p> <p>Common mammalian species include the meadow vole (<i>Microtus pennsylvanicus</i>), white-footed mouse (<i>Peromyscus leucopus</i>), short-tailed shrew (<i>Blarina brevicauda</i>), cottontail rabbit (<i>Sylvilagus floridana</i>), groundhog (<i>Marmota monax</i>), muskrat (<i>Ondatra zibethicus</i>), opossum (<i>Didelphis virginiana</i>), skunk (<i>Mephitis mephitis</i>), red fox (<i>Vulpes vulpes</i>), raccoon (<i>Procyon lotor</i>), mink (<i>Neovison vison</i>), long-tailed weasel (<i>Mustela frenata</i>), and river otter (<i>Lontra canadensis</i>).</p> <p>White-tailed deer are numerous on the refuge. The NJDFW estimates the deer density around Salem County, Hunting Management Zone 63, to be 40.4 deer per square mile based on the harvest data for 2003 through 2005 hunting seasons.</p> |

The overall deer condition and productivity in this zone is considered excellent by the NJDFW. However, the high population of deer on the refuge, which has led to habitat overbrowsing, was the catalyst in initiating a special permit refuge deer hunting season in 1988. At least 50 deer are expected to be harvested annually from the refuge. Prior to 2008, deer hunting was conducted based on a permit system. Limited hunting seasons were open on the refuge for bow, shotgun, and muzzleloader. The number of hunters was limited to 35, 25, and 25 individuals, respectively, and hunters were selected through a random lottery system. Hunters were required to pay a fee for their refuge permit and attend a hunter orientation session. Beginning with the 2008 hunting season, the refuge is closed to all firearm seasons. The refuge is currently open for all of the State bow hunting seasons. There is no longer a lottery, permit, fee, or hunter orientation.

A large maternity colony of more than 1,500 bats, primarily the little brown bat, roosts in a barn on the refuge. The federally listed endangered Indiana bat is known to form small colonies within large little brown bat colonies. Indiana bats have been documented within the Highlands region of New Jersey, but little survey work has taken place within the southern portion of the State. It is not yet known if the species is present within the Coastal Plain. The nearest potential natural habitat for these bats is in a forest on the refuge about 1 mile from the barn (USFWS 2005a).

Reptiles and Amphibians

A number of amphibians and reptiles are found on the refuge, including the eastern painted turtle, common snapping turtle, eastern garter snake (*Thamnophis sirtalis*), black rat snake (*Elaphe obsoleta*), southern leopard frog, green frog (*Rana clamitans melanota*), and American bullfrog (*Rana catesbeiana*). Reptile and amphibian species of conservation concern include northern diamondback terrapin, eastern box turtle (*Terrapene carolina carolina*), spotted turtle (*Clemmys guttata*), and Fowler's toad (USFWS 2005a).

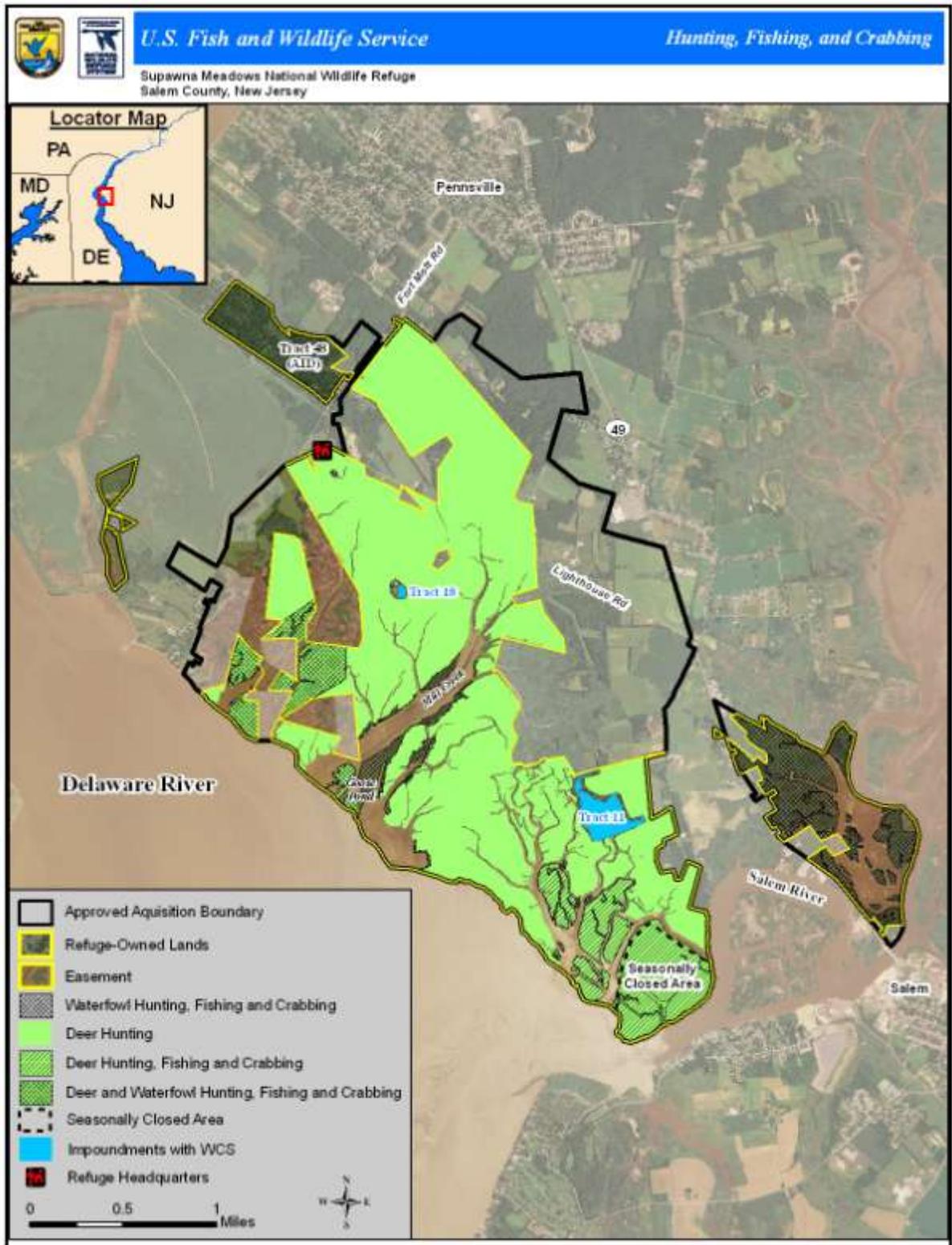
Fish

The tidal marshes, creeks, and ditches provide spawning, nursery, and feeding habitat for a variety of fish common to the Delaware Bay, Estuary, and River. Mummichog (*Fundulus heteroclitus heteroclitus*) is the most abundant forage fish. Striped bass (*Morone saxatilis*) and white perch (*Morone americana*) are two of the more important anadromous species. American eel (*Anguilla rostrata*), a catadromous species, is currently a species of concern in New Jersey and the Mid-Atlantic Fisheries Council. Prior to the closure of the season on elvers (immature eels), commercial netting of elvers on and around the refuge, and from road right-of-ways within the refuge boundary, was common. Other important fish species found near, and potentially affected by, refuge activities include the federally listed endangered short-nosed sturgeon, and the Atlantic sturgeon. The refuge provides nursery habitat for menhaden (*Brevoortia tyrannus*), blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), American shad (*Alosa sapidissima*), and striped bass. Blue crabs (*Callinectes sapidus*) are also found within tidal waters near the refuge and are part of the local recreational shellfishery.

Invertebrates

A wide diversity of terrestrial and aquatic invertebrate species inhabit the refuge tidal marsh and other habitats, including the eastern amberwing (*Perithemis tenera*), common green darner (*Anax junius*), seaside dragonlet (*Erythrodiplax berenice*), and the calico pennant (*Calithemis elisa*). Butterfly species include the orange sulfur (*Colias eurytheme*), black swallowtail (*Papilio polyxenes*), spicebush swallowtail (*Papilio troilus*), and eastern tailed-blue (*Everes comyntas*).

| | |
|---|---|
| Wildlife-dependent Public Use | The priority public uses of the Refuge System are hunting, fishing, wildlife observation and photography, and environmental education and interpretation. The FPRRL, a historic lighthouse on the refuge, also draws visitors (USFWS 2005a). Further details on the various public uses occurring on the refuge are presented in chapter 3 (pp. 3-5 and 3-22) and in appendix B. |
| Visitor Numbers | In 2009, an estimated 15,000 visits were made to the refuge. A visit is defined as an individual, uninterrupted visit to the refuge for any length of time in a day. One person may make multiple visits to the refuge in one day if they leave and return. Over the past 5 years, visitation has ranged from 15,000 to 20,000 visits. Visitors participated in the following activities: hunting, fishing, wildlife observation, photography, interpretation, and other refuge approved activities. |
| Hunting | Portions of Supawna Meadows NWR are currently open for deer and waterfowl hunting (map 3.5). The refuge is open to deer hunting for all four of New Jersey's bow hunting seasons according to the State Deer Management Zone 63 regulations. Portions of the refuge are open to waterfowl hunting per State regulations. Waterfowl are hunted mainly by boat entry to the refuge from the Delaware River and Salem River. |
| Fishing and Crabbing | Fishing and crabbing in the tidal marsh, according to State laws and regulations, are currently allowed in specific areas of the refuge (map 3.5). While boating is prohibited on all of the freshwater ponds and impoundments within the refuge, an annual youth fishing event is authorized on a freshwater tidal pond (see chapter 4, objective 4.2 for more details). |
| Wildlife Observation, Photography, and Interpretation | There are two walking trails for wildlife observation, photography, and interpretation (see also chapter 4, map 4.3). The Grassland Trail, along Lighthouse Road, offers visitors the opportunity to view grassland, forest, and tidal marsh habitat. A portion of the trail and the marsh overlook are wheelchair accessible. The Forest Habitat Trail is located off Fort Mott Road on Xmas Tree Lane. This trail goes through a forested upland and wetland section of the refuge through scrub/shrub habitat and surrounds the Tract 11D impoundment. Wildlife observation, photography, and interpretation at the refuge can also be accessed by boat using the tidal streams. |



| | |
|----------------------------|--|
| Cultural Resources | <p>Human occupation of the New Jersey coast began with the arrival of Native American hunter-gatherer bands approximately 10,000 B.C. The Lenni Lenape Tribe inhabited the land that is now the refuge as well as the surrounding area (USFWS 2005a).</p> |
| Archaeological Resources | <p>An archaeological study conducted for ACE in 1992 (USACE 1994) identified four sites inhabited during the late Woodland period, circa A.D. 700 to A.D. 1600. Two additional pre-European contact sites were reported on current refuge lands in 1915, but they have not been scientifically investigated since that time. One is known to have contained pottery, so may also be Woodland in date.</p> <p>Permanent settlement of the area by Europeans began in the 17th century. Beginning in the late 18th century, farmers began to extensively dike the tidal marsh and excavate ditches to convert it to salt hayfields. In 1900, a rock dike was built along the marsh edge to prevent erosion that was increasingly damaging the earlier dike system. The rock dike failed early in the 1930s, reflooding the tidal marsh. Remains of the dike are still present between the marsh and the Delaware Bay, possibly restricting tidal flow and decreasing the quality of the marsh habitat. Some of the drainage ditches and earth dikes are also still present within the tidal marsh, altering its hydrology.</p> <p>There are 20 historic period archaeological sites recorded on the refuge, only one of which has been identified in the field. The locations of the other 19 are known only from historical maps. Up to five of them, including the Finn's Point Front Range Lighthouse (built in 1876) and a pair of small structures possibly associated with Fort Mott (begun in 1897), may have been lost to late 20th century coastal erosion. The majority of the others are farmsteads established in the mid-19th century or earlier and abandoned in the late 19th and early 20th century, many of which are now in marsh settings due to sea level rise.</p> <p>There is also a family cemetery on the refuge containing three gravestones that all date from 1880 located along the refuge's Grassland Trail on Tract 18. It is maintained by refuge volunteers and often visited by Pennsville residents (USFWS 2005a).</p> |
| Historic Period Structures | <p>The FPRRL, built in 1876 to aid navigation on the Delaware River, is on the National Register of Historic Places. It was extensively restored by the Service in 1983, with additional repairs in 1990 and 2003. In the past, volunteers maintained the site and opened the structure to the public the third Sunday of the month from April through October. Due to staff shortages, the site is currently only open to the public during the New Jersey Lighthouse Challenge in mid-October. A 2007 engineering inspection of the structure indicated a potential safety hazard of the catwalk that would require repair to assure public safety. Therefore, until repair, the catwalk is closed to the public. There is also a small shed located nearby that was historically used to store oil for FPRRL.</p> <p>The former Yerkes (Urion) farmstead, a 19th century dwelling with 20th century outbuildings, is located on Tract 18. All or part of the farmstead is potentially eligible for the National Register of Historic Places (National Park Service 2001). We plan to consult with the State Historic Preservation Office to formally determine its eligibility within fiscal years 2011 or 2012.</p> |