

Chapter 4



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Supawna Meadows NWR Impoundment

Management Direction and Implementation

- Introduction
- General Refuge Management
- Goals, Objectives, and Strategies

Introduction	<p>This chapter describes the array of management actions that, in our professional judgment, work best toward achieving refuge purposes, vision and goals, and respond to public issues.</p>
Summary	<p>These actions prioritize protecting and restoring the refuge’s native tidal marsh habitat to benefit Pea Patch Island colonial-nesting wading birds, secretive marsh birds, migratory waterfowl, shorebirds, and other birds of conservation concern. A secondary consideration will be to manage a diversity of other refuge wetland and upland habitats to benefit breeding and migrating songbirds, waterfowl, and raptors as well as amphibians, reptiles, and mammals of conservation concern.</p> <p>Our Visitor Services program will be enhanced to provide more opportunities for a wide variety of compatible wildlife-dependent activities. In 2005, the Northeast Region Visitor Services Review Team identified visitor programs of emphasis for each refuge. The programs identified for this refuge were interpretation and wildlife observation and photography, the same as Cape May NWR, which administers Supawna Meadows NWR. This determination was based on careful consideration of our natural resources, existing staff, operational funds, existing and potential facilities, and which programs we would be most effective in providing “quality” opportunities for visitors.</p> <p>We have developed a habitat map (see map 4.1, p. 4-47) to help readers visualize how the refuge habitats, as broadly reflected by future vegetation cover, will look over the long term. Using GIS mapping tools and data sets, our habitat map is a graphic representation of the potential vegetation that will result. While the CCP describes potential vegetation management actions within a 15-year time frame, many of the habitat changes will not be visible until well beyond 15 years.</p>
General Refuge Management	<p>The actions presented in this section are actions required by law or policy, or represent actions that have undergone a separate NEPA analysis, public review, agency review, and approval. Or, they are administrative actions that do not necessarily require public review, but are actions we wanted to highlight in our implementation plan. Finally, most of the actions outlined in this part of chapter 4 support multiple goals and objectives and therefore do not lend themselves to the organization in the Goals, Objectives, and Strategies portion of this chapter.</p>
Acquiring Land within the Current Refuge Acquisition Boundary	<p>The Service will continue its policy of buying land from willing sellers and focus its land acquisition efforts on developable upland properties first. We will continue to purchase portions of the 1,257 acres of inholdings within the 4,527-acre acquisition boundary from willing sellers as funding allows.</p>
Managing Conservation Easements	<p>The refuge purchased a conservation easement in June 2009 on the 254.3-acre Davis Property. A conservation easement is a legal agreement voluntarily entered into by a property owner and a qualified conservation organization such as a land trust or a government agency. The easement contains permanent restrictions on the use or development of land in order to protect its conservation values. The owners have reserved certain rights on 20 acres of this easement.</p> <p>Many refuges have utilized the Service’s “Partners for Fish and Wildlife Program” to work with private landowners to conduct annual invasive species control measures on private lands. The acquisition of this conservation easement has allowed refuge staff to take advantage of this type of opportunity at Supawna Meadows NWR as well. The refuge will continue to enforce and monitor the terms of the conservation easement. This includes consultation with the landowner, invasive species control, inventory and survey requirements, and law enforcement. Staff time for this effort amounts to one to two days annually.</p>

Protecting Federally listed Threatened and Endangered Species	<p>The following federally listed threatened or endangered species occur or have historically occurred on refuge lands or in the tidal Delaware River:</p> <ul style="list-style-type: none">▪ Atlantic hawksbill▪ Atlantic loggerhead▪ Atlantic ridley▪ Atlantic leatherback▪ Shortnose sturgeon▪ Sensitive joint-vetch <p>None of these species are known to currently utilize refuge lands or waters. Shortnose sturgeon occur in the Delaware River and refuge activities could have minimal effects on their habitat or prey. We will continue to work closely with our Ecological Service's New Jersey Field Office, NMF'S, the Delaware Bay Estuary Project, and the New Jersey Department of Environmental Protection (NJDEP), if there are confirmed observations of these species or other federally listed species (for example, Indiana bats) in the future at the refuge and if we determine that actions taken on the refuge could be of value to their survival or recovery.</p>
Distributing Refuge Revenue Sharing Payments to Salem County	<p>As described in chapter 3, we pay Salem County refuge revenue sharing payments based on the acreage and the appraised value of refuge lands. These annual payments are calculated by a formula determined by Congress with funds appropriated by Congress. The Service will continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands or new appropriation levels dictated by Congress.</p>
Protecting Cultural Resources	<p>As a Federal land management agency, we are entrusted with the responsibility to locate and protect all cultural resources, specifically archaeological sites and historic structures listed or eligible for listing in the National Register of Historic Places. This applies not only to refuge lands, but also on lands affected by refuge activities.</p> <p>We will conduct an evaluation of the potential for our projects to impact archaeological and historical resources; we will continue to consult with the Service's archaeologists, architectural historian, and the New Jersey SHPO. This will be especially important for those projects that include moving or displacing soil or removing buildings. A preproject evaluation of activities will ensure we comply with section 106 of the National Historic Preservation Act. That compliance may require any or all of the following: a State Historic Preservation Records survey, literature review, or field survey.</p>
Animal Damage Control	<p>We will take necessary actions to address animal damage that threatens to destroy refuge resources, jeopardizes public safety, or causes potential harm to neighboring properties. Refuge staff will either control these animal populations with refuge resources, invite State-licensed volunteers to control them, or hire commercial trappers.</p>
Conducting a Wilderness Review	<p>The refuge system planning policy requires that we conduct a wilderness review during the CCP process. We inventoried all refuge lands and waters the Service owns in fee simple. Our inventory of this refuge determined that no areas meet the eligibility criteria for a wilderness study area as defined by the Wilderness Act. Therefore, we did not further analyze the refuge's suitability for wilderness designation. See appendix D for the results of the wilderness inventory. The refuge will undergo another wilderness review in 15 years as part of the next comprehensive conservation planning process.</p>

Issuing Special Use Permits	Special use permits (SUPs) may be issued for special or unique activities allowed on refuges. Each activity will be evaluated on a case-by-case basis.
Vegetation Mapping	Vegetation mapping will be conducted based on National Vegetation Classification System criteria and we will map all habitat types, vegetation communities, and the location of habitats of focal species as identified in this CCP.
Water Quality Inventory and Monitoring	Adequate supplies of clean water are critical to plants, wildlife, and people. The Refuge System has a legislative mandate under the National Wildlife Refuge System Administration Act, as amended by the Refuge Improvement Act, to help maintain adequate water quality and quantity to fulfill the mission of the Refuge System and the purposes of each refuge. To better address this, the Refuge System is currently in the process of developing an inventory and monitoring program to document the status, assess conditions, and detect changes in the system's resources, including water quality and quantity. We will implement guidance provided by this effort when completed, provided staffing and funding allow. In addition to this legal mandate, the refuge will also participate in Spill Prevention, Control, and Countermeasure (SPCC) Plans, or other environmental emergency action plans, to aid in the protection of the Delaware Bay and River as needed.
Public Use of Land within the Current Refuge Acquisition Boundary	As the Service continues to acquire the remaining 1,254 acres of inholdings within the 4,527-acre acquisition boundary, each individual parcel of property acquired will be subject to authorized public use activities (this includes priority and non-priority public uses), unless subject to specific deed restrictions. The added parcels of property will also be subject to all refuge and Service policies and regulations. The EA analysis and Compatibility Determinations for this CCP will apply to these additional parcels.
	Priority Public Uses
	The 1997 Refuge Improvement Act designated six wildlife-dependent priority public uses on National Wildlife Refuges: hunting, fishing, wildlife observation and photography, and environmental education and interpretation. Per the General Guidelines for Wildlife-Dependent Recreation (605FW 1), we will strive to ensure that the wildlife-dependent recreation program:
	<ol style="list-style-type: none"> 1. Promotes safety of participants, other visitors, and facilities. 2. Promotes compliance with applicable laws and regulations and responsible behavior. 3. Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan. 4. Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation. 5. Minimizes conflicts with neighboring landowners. 6. Promotes accessibility and availability to a broad spectrum of the American people. 7. Promotes resource stewardship and conservation. 8. Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources. 9. Provides reliable/reasonable opportunities to experience wildlife. 10. Uses facilities that are accessible to people and blend into the natural setting. 11. Uses visitor satisfaction to help to define and evaluate programs.

In 2005, the Northeast Region Visitor Services Review Team identified visitor programs of emphasis for each refuge. The two programs identified for this refuge were wildlife observation and photography, the same as Cape May NWR. This determination was based on careful consideration of our natural resources, existing staff, operational funds, existing and potential facilities, and which programs we would be most effective in providing “quality” opportunities for visitors. While all of the priority public uses are important and offered to some degree on this refuge, wildlife observation and photography will receive greater emphasis when prioritizing refuge resources. As always, we look to our partners, Friends of Supawna Meadows NWR, and other volunteers to develop and assist with all refuge public use programs.

Chapter 1 describes the requirements for appropriateness and compatibility determinations. Appendix B includes approved findings of appropriateness and compatibility determinations to support the activities described here. We will only allow activities determined appropriate and compatible to meet or facilitate refuge purposes, goals, and objectives.

Currently, the State does not issue permits to hunt black bear in black bear hunting area 6 (BHA 6) where Supawna Meadows NWR is located, and refuge staff is not aware of any conflicts with bears on the refuge. However, New Jersey’s black bear population is increasing, and it is possible that bears could become a nuisance on or near the refuge within the next 15 years. If the State changes hunting regulations to allow black bear hunting in BHA 6 and we receive enough interest, we will evaluate whether or not to authorize this activity on the refuge. Before opening the refuge to bear hunting, we would need to thoroughly evaluate the effects of this activity. This process would include, amongst other things, completing additional analyses, providing opportunities for public review and comment, and making an announcement in the Federal Register.

Although we are not proposing to open the refuge to turkey hunting at this time, we are willing to discuss opening the refuge to spring turkey season with assistance from the State. As with evaluating opening the refuge to bear hunting, we would need to complete additional analysis to evaluate the effects of allowing turkey hunting through a separate NEPA process.

Non-Priority Public Uses Allowed

In addition to the six priority recreational and educational uses, we have determined that some other activities, for example FPRRL visitation and scientific research are appropriate and compatible on refuge lands under certain circumstances. These activities are either discussed earlier in this section or described in detail in the next chapter. Findings of Appropriateness and Compatibility Determinations for these activities are in appendix B.

Non-Priority Public Uses Not Allowed

We have received several requests for permission to engage in non-priority, non-wildlife dependent activities on the refuge. Activities evaluated by the refuge manager and determined not to be appropriate on refuge lands include, but are not limited to: bicycling, geocaching, horseback riding, jogging, non-wildlife dependent group gatherings, and organized or facility-supported picnicking. **Appendix B documents the refuge manager’s decision on appropriate activities.** Most of these activities are sufficiently allowed elsewhere on other nearby ownerships, so the lack of access on the refuge does not eliminate the opportunity in the area. According to Service policy 603 FW 1, if the refuge manager

determines a use is not appropriate, it can be denied without determining compatibility.

Controlling Animal Pests

At times, certain wildlife species and pest animals interfere with management objectives. The Refuge Manual (7 RM 14.4A) defines a pest as “Any terrestrial or aquatic plant or animal which interferes, or threatens to interfere, at an unacceptable level, with the attainment of refuge objectives or which poses a threat to human health.” In this section, we describe some situations involving native species and under what conditions we will initiate control.

In controlling pests, we use an integrated approach. The Refuge Manual (7 RM 14.4C) defines integrated pest management as “A dynamic approach to pest management which utilizes a full knowledge of a pest problem through an understanding of the ecology of the pest and ecologically related organisms and through continuous monitoring of their populations. Once an acceptable level of pest damage is determined, control programs are carefully designed using a combination of compatible techniques to limit damage to that level.”

An integrated approach uses various methods, including natural, biological, cultural, mechanical, and chemical controls. Some examples and potential remedies of pest management follow.

We will use the following general strategies in pest management:

1. Determine the need for site-specific control based on the potential to affect our management objectives for a given area. Although we will employ an adaptive management strategy, we also expect the lethal control or removal of individual animals to be the exception rather than the rule. Unfortunately, to establish general thresholds for that action is difficult. Instead, we will determine our solution on a case-by-case basis.
2. Employ integrated pest management techniques when a species is having a significant impact on an area resulting in major habitat replacement and loss of valuable canopy trees.
3. Monitor results to ensure that pests do not exceed acceptable levels.

Mute Swans

Despite their aesthetic appeal, mute swans can cause problems. The mute swan is native to Europe and Asia, but is nonnative species in the United States. Mute swans are established throughout New Jersey and are responsible for excessive herbivory to submerged aquatic vegetation in wetland habitats during key portions of the growing season. Mute swans are well distributed throughout New Jersey but are most abundant in park ponds and small lakes in northern New Jersey, as well as coastal ponds and impoundments along both the Atlantic Coast and Delaware Bay. The New Jersey Wildlife Action Plan (NJWAP) goal (NJDFW 2008a) is to reduce the impacts of mute swan herbivory to native vegetation in wetlands and managed impoundments based on population objectives identified for New Jersey in the Atlantic Flyway Mute Swan Management Plan (Atlantic Flyway Council 2003). The New Jersey mute swan population objective is 500 swans statewide. Populations should be particularly reduced in coastal impoundments managed for migrant and wintering waterfowl. Population growth and range expansion of this species has increased the number of swan-related problems for people and native wildlife.

A major concern is the effect of interspecific competition between mute and tundra swans. Mute swans have been observed exhibiting aggression toward tundra swans, driving them from protected coves and feeding areas, which are important habitats for native tundra swans. Since the mid-1970s, Maryland's

wintering tundra swan population has declined by about 30 percent (Hindman 2010); however, research is needed to determine if this decline is related to an increase in competition between native tundra swans and exotic mute swans. New Jersey hosts a smaller population of wintering tundra swans than Maryland, and currently there is no evidence to suggest mute swans are outcompeting tundra swans in New Jersey (Nichols 2009 personal communication).

The Service worked with states in the Atlantic Flyway to develop the Atlantic Flyway Mute Swan Management Plan (Atlantic Flyway Council 2003). This plan established mute swan population goals for the Atlantic Flyway, along with strategies to begin reducing populations to those levels within the parameters of the Migratory Bird Treaty Act.

In partnership with NJDFW, the refuge's treatment goal is to prevent competition with native migratory waterfowl. Eradication is the definitive goal; however, this may be unachievable if adjacent landowners are not willing or able to control mute swans. It is important to be vigilant in management efforts and monitor all areas throughout the year.

We will:

1. visually monitor all areas throughout the year, and take appropriate actions to discourage mute swans from becoming established or congregating on the refuge; and
2. to the extent possible, eradicate mute swans found on the refuge to reduce competition with native waterfowl. We may limit swan reproduction by oiling or adding eggs and removing adult swans. We will coordinate control efforts with NJDFW and U.S. Department of Agriculture Animal and Plant Health Inspection Services (USDA APHIS).

Snow Goose Monitoring

The greater snow goose population in the Atlantic flyway has increased significantly over the past decade and continues to increase. Damage to winter grain and salt hay fields and marsh areas in New Jersey is also increasing. We are aware of concerns by Service and State waterfowl experts that greater snow geese may be changing their migrating and wintering habits in the Atlantic Flyway, and their use may dramatically increase on protected areas, such as the refuge, over the next 15 years. With completion of an Environmental Impact Statement (EIS), the Atlantic Flyway Council and individual states have implemented a Light Goose Conservation Order. Light goose is the collective name applied to greater snow geese, lesser snow geese, and Ross's geese. The principal action to be taken in the State of New Jersey is an extended hunting season on light geese. We will monitor for increased use of the refuge by snow geese in conjunction with the State mid-winter waterfowl survey.

Refuge marshes and impoundments provide valuable late winter habitat for black ducks and pintails. As snow goose use of the refuge increases, hunting of greater snow geese on designated areas of the refuge may be permitted after the close of the duck season for the southern zone of New Jersey to achieve population goals for greater snow geese or reduce damage to refuge habitats and surrounding marsh and agricultural areas. Hunting during late winter has the potential to disturb wintering ducks, particularly black ducks, and decrease the value of the refuge as wintering habitat. However, impacts to wintering waterfowl will be minimal because greater snow geese are currently found primarily in the marshes, not in the impoundments. Other actions that may be considered include select control of snow geese or other proposals to discourage snow goose, as recommended by Service and State waterfowl experts.

Resident Canada Geese

The Service's Division of Migratory Bird Management prepared an EIS for Resident Canada Goose Management (USFWS 2005b). This document discusses the problems associated with resident Canada geese along with strategies to begin reducing populations. The following information was taken from this document.

The number of Canada geese that nest and/or reside predominantly within the conterminous United States has increased dramatically in the past 20 years. It has increased to levels that are increasingly coming into conflict with people and causing personal and public property damage.

Most resident Canada goose populations exhibit consistently high annual production and survival because they live in temperate climates with relatively stable breeding habitat conditions and a low number of predators; tolerate human and other disturbances; have a relative abundance of preferred habitat (especially those located in urban and suburban areas with current landscape techniques); and fly relatively short distances to winter (compared to other Canada goose populations). The virtual absence of waterfowl hunting in urban areas provides additional protection to those urban portions of the resident Canada goose population. Given these characteristics, resident Canada goose populations are increasingly coming into conflict with human activities in many parts of the country, both in rural and urban areas. Conflicts between geese and people affect or damage several types of resources, including property, concerns about human health and safety, agriculture, and natural resources.

Agricultural and natural resource impacts include losses to grain crops, overgrazing of pastures, and degrading water quality. In heavy concentrations, goose droppings can overfertilize lawns and degrade water quality, resulting in eutrophication of lakes and excessive algae growth (Manny et al. 1994). This can lead to oxygen depletion and fish kills. Degradation of water quality also occurs by fecal contamination and by erosion from areas stripped of vegetation by goose grazing and trampling. Habitat impacts from overgrazing by resident Canada geese are also evidenced by the loss of natural vegetation in marshes and impoundments. Resident geese can impact natural wild rice beds, crops, and other habitat maintained as both food sources and cover for migrant geese and other waterfowl.

Concentrations of resident Canada geese threaten wildlife with disease. Local concentrations of resident Canada geese may congregate around impoundments where water levels have been lowered. The remaining stagnant pools can be contaminated by fecal material and are a potential source of avian diseases, especially when temperatures are high. Canada geese serve as a reservoir for the highly contagious disease duck virus enteritis and pose a serious threat to other birds utilizing the habitat.

We will:

1. visually monitor all areas throughout the year, and take appropriate actions to discourage resident Canada geese from becoming established or congregating on the refuge; and
2. to the extent possible, eradicate resident Canada geese found on the refuge to reduce competition with native waterfowl, limit goose reproduction by oiling or addling eggs and removing adult geese, and coordinate control efforts with NJDFW and USDA APHIS.

Furbearers and Predators

Furbearers such as muskrat, woodchuck, and beaver (*Castor canadensis*) may cause damage to refuge habitats. These animals may burrow into soils, undermining or otherwise damaging impoundment dikes. Beavers may also dam and flood creeks or other drainage areas, killing native trees or flooding roads and private property, therefore preventing access or threatening public safety.

Mammalian predators such as red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), and raccoon, and avian predators such as crow, grackle, and gulls may cause unacceptable levels of predation on nesting birds. Domestic or house cats (*Felis catus*), both free ranging domestic and feral, also have negative effects on wildlife. Cats prey on wildlife, compete with native wildlife, and can transmit diseases to wildlife, pets, and people. Cat predation is an added stress to wildlife populations already struggling to survive habitat loss, pollution, pesticides, and other human impacts (American Bird Conservancy, 2009). The cumulative negative effects of cats on wildlife are impossible to quantify; however, the growing body of literature strongly indicates that domestic cats are a significant factor in the mortality of native small mammals, birds, reptiles, and amphibians (California Department of Fish and Game 2009).

We do not intend to initiate a public trapping program for furbearers at this time. Because we consider trapping on refuges a commercial activity, it must meet a higher standard of compatibility than priority wildlife-dependent public recreational uses or other non-commercial uses. We will consider opening the refuge to trapping if we determine it is needed to manage furbearers to achieve refuge purposes of the mission of the Refuge System. Prior to opening the refuge to trapping, we would need to determine if it is compatible and complete additional NEPA analysis and then include it as part of an approved Furbearer Management Plan.

We will:

1. use predator guards on nest boxes;
2. to the extent possible, remove animals or concentrations of animals that may pose a problem, inviting State-licensed individuals, hiring commercial trappers, or working with partners such as USDA Wildlife Services;
3. endorse the Cats Indoors! campaign; and
4. implement a zero tolerance policy for feral cats by visually monitoring all areas of the refuge for feral cats throughout the year and take appropriate actions to euthanize cats found on the refuge.

Monitoring and Abating Wildlife Diseases

The Service Manual chapter on disease prevention and control is not yet published. Until it is, we derive guidance on this topic from the Refuge Manual and specific directives from the Director of the Fish and Wildlife Service or the Secretary of the Interior. Refuge Manual 7 RM 17.3 lists three objectives for disease prevention and control:

1. to manage wildlife populations and habitats so the likelihood of disease contraction and contagion are minimized;
2. to provide for early detection and identification of disease mortality when it occurs; and
3. to minimize losses of wildlife from disease outbreaks.

These objectives were published in 1982. Since that time, in addition to diseases that cause serious mortality among wildlife, more attention has been given to those diseases that are transmitted through wildlife to humans. One example is Lyme disease. In 2002, a Service Manual chapter on Lyme Disease Prevention

was published (242 FW 5) to make employees, volunteers, and national service workers on refuges aware of this disease and how to prevent and treat it.

Another serious wildlife disease receiving considerable attention worldwide is avian influenza. Of particular concern is the highly pathogenic Eurasian form (H5N1). In 2006, all refuges were instructed to prepare an Avian Influenza Surveillance and Contingency Plan. The Supawna Meadows National Wildlife Refuge Avian Influenza Surveillance and Disease Contingency Plan was approved in October 2007 (USFWS 2007b) and discusses methods for dealing with this disease.

Chronic Wasting Disease (CWD) is a fatal disease that attacks the brain and spinal cord of deer and elk. While the exact cause is unknown, it is believed to be caused by a prion, an altered protein that causes other normal proteins to change and cause sponge-like holes in the brain. CWD was first identified in the 1960s in a Colorado research facility. Since that time, it has been found in numerous states including New York and West Virginia. CWD has not been found in white-tailed deer (*Odocoileus virginianus*) in New Jersey. Prion diseases like CWD do not move easily between species. There is no scientific evidence that CWD has been transmitted to animals other than deer, elk, and moose. The Chronic Wasting Disease Surveillance and Contingency Plan for Supawna Meadows NWR was approved October 2007 (USFWS 2007c) and discusses early detection and response to any potential CWD occurrence at the refuge.

Supporting Biological and Ecological Research and Investigations

Guidance on conducting and facilitating biological and ecological research and investigations on refuges is found in the Refuge Manual and the Service Manual. In 1982, the Service published three objectives for supporting research on units of the Refuge System in the Refuge Manual (4 RM 6.2):

- to promote new information and improve the basis for, and quality of, refuge and other Service management decisions;
- to expand the body of scientific knowledge about fish and wildlife, their habitats, the use of these resources, appropriate resource management, and the environment in general; and
- to provide the opportunity for students and others to learn the principles of field research.

In 2006, the Service Manual (603 FW 1.10D (4)) provided supplemental guidance in terms of the appropriateness of research on refuges as follows:

We actively encourage cooperative natural and cultural research activities that address our management needs. We also encourage research related to the management of priority general public uses. Such research activities are generally appropriate. However, we must review all research activities to decide if they are appropriate or not as defined in section 1.11. Research that directly benefits refuge management has priority over other research

Unless it is determined to be a management activity, all research conducted on the refuge must be determined in writing to be both appropriate and compatible. We have found several research projects to be appropriate and compatible. We expect that additional opportunities to conduct research on the refuge will arise in the future. In making determinations on the appropriateness and compatibility of future research proposals, we will follow guidance in the Refuge and Service Manuals, and will employ the following general strategies:

1. Seek qualified researchers and funding to help answer refuge-specific management questions.

2. Participate in appropriate multi-refuge studies conducted in partnership with the U.S. Geological Survey.
3. Facilitate appropriate and compatible research by providing temporary housing and equipment, if available, for persons conducting field work.
4. Pursue peer-reviewed publications of research, and/or ensure the Service is acknowledged as a contributor in research conducted on the refuge by others.

Practicing Adaptive Management

We will employ adaptive management as a strategy to ensure we respond quickly to new information or events in adherence to the Department of the Interior's Technical Guide on Adaptive Management (Williams et al. 2009). According to this document, "adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood" (Williams et al. 2009). The need for adaptive management is very compelling today because our present information on refuge species and habitats is incomplete, provisional, and subject to change as our knowledge base improves.

We must adapt our strategies to respond to new information and spatial and temporal changes or environmental events that may or may not have been predicted. We will continually evaluate management actions, both formally and informally, through monitoring or research, to consider whether our original assumptions and predictions are still valid. In that way, management becomes a proactive process of learning what really works.

The refuge manager is responsible for changing management strategies if they do not produce the desired conditions. Significant changes may warrant additional NEPA analysis and public comment. Minor changes will warrant documentation in project evaluation reports, or in our annual reports.

Generally, we can increase monitoring and research that support adaptive management without additional NEPA analysis, and assuming the activities, if conducted by non-refuge personnel, are determined compatible by the refuge manager in a compatibility determination. Many of our objectives identify monitoring needs. Our 2004 Wildlife Inventory Plan has determined what is planned in the foreseeable future. We will update this plan based on the final objectives and strategies in the CCP. See discussion on additional NEPA analysis requirements below. Implementing this strategy supports all refuge goals.

Determining the Appropriateness and Compatibility of Refuge Public Uses

Chapter 1 describes the requirements for appropriateness and compatibility determinations. Appendix B includes approved appropriateness and compatibility determinations to support the activities on the refuge. We will only allow activities determined appropriate and compatible to meet or facilitate refuge purposes, goals, and objectives. Further appropriateness and compatibility determinations will be prepared if new refuge uses are requested by the public.

Conducting Additional NEPA Analysis

NEPA generally requires site-specific analysis and disclosure of impacts for all major Federal actions, which may result in either an EA or an EIS. Other routine activities are categorically excluded from the NEPA requirements to prepare detailed environmental documents. Those generally include administrative actions. Before we implement the new hunting and fishing actions proposed in this plan, we must complete additional NEPA analysis. This information will be made available to the public. A new compatibility determination will be completed at that time.

Wildlife Habitat Management

We will expand our management to benefit trust species and other species of conservation concern in all refuge habitats. We will focus management efforts on providing native tidal marsh habitat to benefit key Federal trust species and groups of species. Specifically, we will provide foraging habitat for Pea Patch Island wading birds during the breeding season and nesting, migratory, and wintering habitats for marsh birds, waterfowl, shorebirds, raptors, and songbirds. We will actively manage tidal marsh and grassland habitats and will maintain dikes and water levels on our impoundments with water control structures, but we will not actively manage other refuge habitats. We will permit compatible research programs requested by other entities on refuge lands, but will not directly support them. If we are successful in achieving our habitat management objectives, the habitat composition of the refuge will be that listed in table 4.1 (below) and illustrated in map 4.1 (see page 4-48).

We will expand our invasive plant management efforts to include more extensive control of phragmites in the tidal marsh and use of a variety of treatment methods for invasive plant control elsewhere on the refuge. Specifically, we will coordinate with the New Jersey Department of Agriculture’s weevil release program to control mile-a-minute weed in some areas of the refuge.

Our primary tools will be mowing, prescribed burning, and use of herbicides to control phragmites and other invasive plant species and the continuation of hunting to control the white-tailed deer population.

Table 4.1. Land Use and Land Cover Acreage for Supawna Meadows NWR

Land Use/Land Cover Type	Current Acreage	Acquisition Acreage	Total Acreage
Tidal Marsh			
Native Marsh	902	131	1033
Phragmites-Dominated	1029	231	1260
Total Marsh	1931	362	2293
Developed	26	97	123
Forested Uplands	242	174	416
Forested Wetlands	190	156	346
Grassland	123	409	532
Herbaceous Wetland	42	13	55
Managed Impoundments	86	1	87
Unmanaged Impoundment	4	1	5
Scrub/Shrub Uplands	36	19	55
Scrub/Shrub Wetlands	48	4	52
Scrub/Shrub Wetlands (Tidal)	28	2	30
Open Tidal Waters	492	42	534
TOTAL	3,247¹	1,280	4,527

¹ Includes 231 acres held under conservation easement by the refuge. An additional 20 acres held in easement have a future building clause and are not included.

We will:

1. monitor known infestation sites for significant adverse impacts on wildlife habitat;
2. seed or plant disturbed sites with native species;
3. control 60 percent of phragmites where native plants are inhibited or where fire hazards need to be reduced;
4. control phragmites in any area where water level and wildlife habitat is unacceptable due to phragmites growth;
5. maintain healthy stands of native plants; and

6. monitor the deer population and its effects on refuge habitats. If the herd needs to be further culled, we will work with the State to offer a doe-first season, a firearms season, or another method for taking more deer off the refuge.

Managing Invasive Plants

The establishment and spread of invasive plants is a significant problem that reaches across all habitat types on the refuge. We will pursue a broad program of invasive plant management based on Service principles. For the purposes of this discussion, we use the definition of invasive species contained in the Service Manual (620 FW 1.4E): “Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm, or harm to human health. Alien species, or non-indigenous species, are species that are not native to a particular ecosystem.” We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere.

The unchecked spread of invasive plants threatens the biological diversity, integrity, and environmental health of all refuge habitats. In many cases, these plants have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. Over the past several decades, government agencies, conservation organizations, and the general public have become more acutely aware of the negative effects of invasive species. There are many plans, strategies, and initiatives targeted toward more effective management of invasive species, including The National Strategy for Management of Invasive Species for the National Wildlife Refuge System (USFWS 2003a), Silent Invasion – A Call to Action by the National Wildlife Refuge Association (NWRA 2002), and Plant Invaders of Mid-Atlantic Natural Areas by the Service and the National Park Service (Swearingen et al. 2002). New information and updates on recent advances in control techniques are continually provided through the Refuge System biological discussion database and relevant workshops. There are also more funding sources, both within the Service’s budget and through competitive grants, to conduct inventories and control programs.

Guidance for managing invasive species on refuges is found in the Service Manual (620 FW 1.7G). These actions serve to define our general strategies on the refuge:

1. Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species.
2. Conduct refuge habitat management activities to prevent, control, or eradicate invasive species using techniques described through an integrated pest management plan, or other similar management plan, which comprehensively evaluates all potential integrated management options, including defining threshold/risk levels that will initiate the implementation of proposed management actions.
3. Evaluate native habitat management activities with respect to their potential to accidentally introduce or increase the spread of invasive species and modify our habitat management operations to prevent increasing invasive species populations.
4. Refuge integrated pest management planning will address the abilities and limitations of potential techniques, including chemical, biological, mechanical, and cultural techniques.
5. Manage invasive species on refuges under the guidance of the National Strategy for Invasive Species Management and within the context of applicable policy.

More specific strategies for the refuge include:

1. Continue treatment of the most problematic species as funding and staffing permit.
2. Maintain early-detection/early-response readiness regarding new invasions.
3. Remove parent sources of highly invasive species (species that are high seed producers or vigorous rhizome producers) from along edges of management units.
4. Maintain accessibility to affected areas for control and monitoring.
5. Continue and increase efforts to involve the community in promoting awareness of invasive species issues and to seek assistance for control programs on and off the refuge.

In addition to these general strategies, we will refine our control program to address the most critical problems first. Further, our priorities may be adjusted to reflect regional Service priorities, new information, or resource availability. We will continue to track the spread and control of all invasive plants on the refuge using GIS, GPS, permanent vegetation monitoring plots, and photo points.

Staffing and Project Funding

We used the Refuge System 2008 national staffing model to guide proposed staffing. Staffing models were developed to answer the question, “What level of staffing is needed to operate and manage a station to achieve the station’s purpose, contribute to the mission and goals of the Refuge System, and comply with the Refuge Improvement Act and other laws, regulations, and policy?” Earlier efforts suggest there are 10 functional categories that describe the work we do or need to do on stations in the Refuge System. These are: wildlife and habitat, visitor services, facilities and equipment, maintenance, realty, planning, communications, business management, information technology, law enforcement, and fire management. The model gives a total number of full time employees needed at a station to do the work, but management must still decide the best mix of disciplines to do that work and whether to deploy part-time, seasonal, or permanent employees.

In addition to this national staffing model, the Refuge System and the International Association of Chiefs of Police began working together in 2003 on a law enforcement staffing and deployment model. The goal for this effort was to develop a defensible staffing model to quantify law enforcement resource needs for the Refuge System, help refuge managers deploy law enforcement resources, and justify budget requests. The result was a “Deployment Model for the National Wildlife Refuge System” (International Association of Chiefs of Police), completed in May 2005 and slated for updating every 5 years.

The refuge will continue to be administered as a satellite refuge with management responsibility residing at Cape May NWR. We used the national staffing model to help determine the appropriate level of non-law enforcement staffing and the law enforcement deployment model to determine the proposed number of law enforcement staff. Based on our priorities, we are proposing four full-time staff stationed at Supawna Meadows NWR, and one full-time staff person that will be stationed at Cape May NWR and shared between the Cape May NWR and Supawna Meadows NWR. Supawna Meadows NWR will have an assistant refuge manager, a wildlife biologist, a park ranger (law enforcement), and a maintenance worker. A park ranger (visitor services) position will be shared with Cape May NWR. While the staff at Supawna Meadows NWR will continue to be supported by the current and any new staff at Cape May NWR, we anticipate that the visitor services position will spend substantial time at Supawna Meadows NWR to improve and implement the public use programs. Please see appendix E for the proposed staffing chart.

Refuge Buildings and Facilities	<p>We will operate and maintain the refuge office, both garages, (bat) barn, intern house on Route 49, and FPRRL. We propose demolition of all other buildings on refuge lands. We will work with the New Jersey SHPO and the Service's regional archaeologists to ensure compliance with applicable State and Federal laws and regulations. The demolition of refuge facilities will result in the conversion of developed land into wildlife habitat such as grassland and scrub/shrub upland habitat.</p> <p>The refuge headquarters office will be used full time by refuge staff, will be available for use by the Friends group as requested, and will be open to the public on a regularly scheduled basis. The four-bay garage at the refuge office and the garage at the previous headquarters site will be maintained. The quarters on Route 49 will be maintained for occasional use as needed. The barn currently used by bats will also be maintained.</p>
Resource Protection and Visitor Safety	<p>As described under staffing and project funding, we will add one full-time law enforcement officer to enforce laws and regulations on Supawna Meadows NWR. New onsite staff and a visitor services professional stationed at Cape May NWR will help to install and maintain appropriate signage and prepare and distribute resource protection information as appropriate.</p>
Land Protection	<p>We will continue to purchase portions of the 1,257 acres of inholdings within the 4,527-acre acquisition boundary as funding allows. The Service will continue its policy of accepting donations and buying from willing sellers and will focus on acquiring developable upland properties first.</p> <p>In addition, within 3 years of final approval of the CCP, we will begin to reevaluate the refuge's acquisition boundary through the Service's Preliminary Project Proposal process to address rising sea level caused by climate change because much of what is currently within the refuge boundaries will likely be under water in the next 50 to 100 years. Therefore, we need to start acquiring adjacent uplands to continue our stewardship of vital marsh habitat as the marsh gradually migrates inland. Additional impetus for land purchase will be:</p> <ol style="list-style-type: none">1. to maintain the ecological integrity of the current refuge by protecting the natural resources on adjacent lands;2. to acquire important nearby upland and wetlands areas that will expand our protection of those habitats and the trust resources and other sensitive species that rely on them; and3. to expand opportunities for public uses, particularly wildlife observation and photography and interpretation. <p>We will apply appropriate management to benefit species of conservation concern to any newly acquired lands.</p>
Baseline Plant and Animal Surveys	<p>We will conduct surveys and develop comprehensive inventories of all plants and animals found on Supawna Meadows NWR, including data on species abundance and distribution as staff and funding is made available. A Wildlife Inventory Plan was developed for Supawna Meadows NWR in 2004 (USFWS 2004e). This plan identifies the priority surveys and monitoring that should be completed on the refuge based on enabling legislations, Service initiatives, unit objectives, management plans, and related management activities. We believe we will have the staffing and funding necessary to implement this plan. The surveys to be completed, ranked in order of importance, are shown below in table 4.2.</p>

Table 4.2. Baseline Flora and Fauna Surveys to be Completed

Surveys	Priority Species Involved
1. Saltmarsh Sparrow Breeding Bird	coastal plain swamp sparrow seaside sparrow marsh wren
2. Landbird Breeding	coastal plain swamp sparrow marsh wren wood thrush yellow-breasted chat Baltimore oriole
3. Reptile and Amphibian Inventory	bog turtle eastern tiger salamander spotted turtle eastern box turtle northern diamondback terrapin Fowler's toad
4. Marshbird Callback	black-crowned night-heron great blue heron king rail least bittern little blue heron yellow-crowned night-heron
5. Nonbreeding Bird Use of Tidal Marshes	little blue heron yellow-crowned night-heron black rail
6. Nonbreeding Bird Use of Grasslands	northern harrier short-eared owl horned lark vesper sparrow bobolink grasshopper sparrow savannah sparrow eastern meadowlark
7. Grassland Breeding Bird	horned lark bobolink grasshopper sparrow savannah sparrow eastern meadowlark
8. Wading Bird Impoundment	great blue heron little blue heron
9. Shorebird Migration Impoundment	solitary sandpiper short-billed dowitcher
10. Anuran Call Count	Fowler's toad
11. Wintering Waterfowl Impoundment	American black duck
12. Christmas Bird Count	migratory birds
13. Butterfly and Dragonfly Inventory	dotted skipper Harris' checkerspot Hessel's hairstreak two-spotted skipper
14. Fish Inventory	unknown
15. Small Mammal Inventory	unknown
16. Woodcock Singing Ground	American woodcock
17. Muskrat Ground Dwelling	muskrat

Other priority surveys identified during scoping meetings that should be conducted (not in order of importance) are shown in table 4.3.

Table 4.3. Other Priority Surveys Identified During Public Scoping

Surveys	Priority Species Involved
Marsh Rice Rat	marsh rice rat
Bird Productivity in Phragmites Control Areas	clapper rail northern harrier marsh wren coastal plain swamp sparrow
Coastal Plain Swamp Sparrow	coastal plain swamp sparrow
Biological, Chemical, Sediment, and Contaminant (Contaminant Assessment Process) Baseline	tidal marsh habitat fish open water
Fish Inventory in Impoundments	alewife blueback herring Atlantic sturgeon Shortnose sturgeon
Native Animals and Plants in Scrub/Shrub Wetlands (Tidal)	northern harrier sedge wren
Plants	sensitive joint vetch

Goals, Objectives, and Strategies

Introduction

As described in chapter 1, developing refuge goals was one of the first steps in the planning process. Goals are intentionally broad, descriptive statements of the desired future condition for refuge resources. By design, they are more prescriptive than quantitative in defining the targets of refuge management. They also articulate the principal elements of refuge purposes and our vision statement and provide a foundation for developing specific management objectives and strategies.

The next step was to consider a range of possible management objectives that will help us meet those goals. Objectives are essentially incremental steps toward achieving a goal; they further define the management targets in measurable terms. They provide the basis for determining more detailed strategies, monitoring refuge accomplishments, and evaluating our success. The Service guidance in “Writing Refuge Management Goals and Objectives: A Handbook” (USFWS 2004d) recommends that objectives possess five properties to be “SMART”: (1) specific; (2) measurable; (3) achievable; (4) results-oriented; and (5) time-fixed.

A rationale accompanies each objective to explain its context and why we think it is important. We will use the objectives in writing refuge step-down plans. We will measure our successes by how well we achieve those objectives.

We next identified strategies for each of the objectives. These are specific actions, tools, techniques, or a combination of those that we may use to achieve the objective. The list of strategies under each objective represents the potential suite of actions to be implemented. By design, most will be further evaluated as to how, when, and where they should be implemented in refuge step-down plans.

Lastly, for biological objectives we identified a specific subset of strategies as monitoring elements. Monitoring elements are intended to help us measure our success with respect to our objectives. The results may trigger adjustments to management strategies, a reevaluation or refinement of our objectives, or both.

The management direction that comprises the rest of this chapter is based on **alternative B**, presented in the draft CCP/EA. **Alternative B** was the Service's preferred alternative, and we believe it best fulfills the refuge's purposes, vision and goals, and responds to public issues. It emphasizes management of specific refuge habitats to support Federal trust resources and species of conservation concern in the area. In particular, the priority will be to protect and restore the refuge's **native tidal marsh habitat** to benefit Pea Patch Island colonial-nesting wading birds, as well as secretive marsh birds, migratory waterfowl, shorebirds, and other birds of conservation concern. The description of the management direction is followed by maps 4.1, 4.2, and 4.3, which illustrate the proposed habitat management and public use strategies.

Goal 1

Protect, enhance, and restore biological integrity, diversity, and environmental health of tidally influenced habitats to support native wildlife and plant communities including species of conservation concern.

Objective 1.1 Tidal Marsh

Maintain up to 2,293 acres of brackish tidal marsh, with primary management focus on the area northwest of Mill Creek, providing critical foraging habitat for Pea Patch Island wading birds (for example, little blue heron, glossy ibis, snowy egret, black-crowned night heron, least bittern), migrating shorebirds (for example, semi-palmated sandpiper, greater yellowlegs, dunlin), migrating and wintering waterfowl, and other species of conservation concern (for example, bald eagles).

- Increase cover to 60 percent native emergent plant cover such as smooth cordgrass, pickerelweed, water hemp, wild rice, and rice cutgrass.
- Reduce cover of phragmites so that it comprises less than 40 percent cover of the tidal marsh.

Rationale

Supawna Meadows NWR provides critical foraging habitat for more than 6,000 pairs of 9 species of wading birds that nest on Pea Patch Island, a Continentally Important Bird Area. It is home for the largest heronry of mixed species on the East Coast. The island supports significant populations of breeding pairs of nine species of wading birds, including great blue heron, great egret, little blue heron, snowy egret, cattle egret, yellow-crowned night-heron, black-crowned night-heron, glossy ibis, and tri-colored heron. Pea Patch Island and the surrounding area, including the refuge, have been designated a SMA by the States of New Jersey and Delaware in accordance with the Coastal Zone Management Act.

The refuge receives significant use by shorebirds during both spring and fall migrations. The refuge also provides habitat for the State-listed bald eagle as well as a number of other State-listed species and species of conservation concern.

The refuge 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 area not only serves as an important migration area but also provides wintering habitat for large numbers of waterfowl. The 2009 midwinter waterfowl inventory flights for the Salem River watershed averaged more than 2,100 dabbling ducks and more than 11,500 Canada geese.

Our principal management challenge in sustaining the refuge's tidal marsh is control of phragmites. Phragmites invades tidal and non-tidal brackish and freshwater marshes, river edges, shores of lakes and ponds, roadsides, and disturbed areas. Once introduced, phragmites spreads quickly and will crowd out

native plants, changing marsh hydrology, altering wildlife habitat, and increasing fire potential. Its high aboveground biomass blocks light to other plants and occupies much of the growing space belowground. Phragmites is also considered a hazardous fuel and easily ignites during arson or wildfire. Based on the 2009 National Vegetation Classification System, phragmites has invaded approximately 74 percent (1,438 of 1,931 acres) of the refuge's tidal marsh.

The hydrology of Supawna Meadows NWR tidal marsh has historically been influenced by humans and continues to be affected today. The tidal marsh west of Route 49 was diked and drained in the 18th century. The dike failed 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), but flow is now restricted to a few points and Mannington Meadow is fresher than the marshes on the west side of Route 49. These hydrologic factors are thought to influence the degree to which phragmites has been able to colonize and supplant native marsh plants on major portions of the refuge.

The changes to tidal marsh habitat over the course of this CCP will be a decrease in the phragmites dominated tidal marsh. Due to control of phragmites in the 500 acres of tidal marsh habitat west of Mill Creek, 70 to 80 percent of the phragmites-dominated tidal marsh in that area will be restored to native tidal marsh habitat. Due to the control of phragmites in the 17 acres of tidal marsh west of Fort Mott Road, the area will be restored to native tidal marsh habitat.

Strategies

1. Purchase up to 362 additional acres of tidal marsh within the approved acquisition boundary.
2. Within 5 years of CCP approval, evaluate removal of the remnant farm dike to restore tidal flow and reestablish natural marsh function.
3. Develop an Adaptive Management Framework for phragmites control so that treatments are monitored and evaluated for effectiveness. The refuge will be using an integrated approach to phragmites control, which will consider restoration of natural processes, herbicides, prescribed burning, biological control, and other tools as they are developed.
4. Continue to ensure compliance with the ESA by coordinating with the Service's New England Field Office on phragmites control efforts annually.
5. Work with adjacent private landowners to reduce phragmites on their properties.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, such as prescribed burning and mowing to achieve structural and species diversity of native emergent wetland species. Results may trigger a reevaluation or refinement of our objectives.

Examples of monitoring or surveys that we may implement follow:

1. Begin collection of baseline data to evaluate the existing tidal marsh biological integrity, diversity, and environmental health and parameters related to sea level rise (vegetation, elevation, sediment accretion, salinity, tidal fluctuation, water quality, and mean sea level rise changes along the Delaware River). Utilize data and evaluate trends to assess the impact of climate change and/or management activities in order to appropriately adjust management as necessary.
2. Prevent new invasive species from becoming established within the tidal marsh by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those

populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.

3. Conduct inventories and monitoring of shorebird, waterfowl, waterbird, and wading bird use and abundance in the tidal marsh. Utilize data to document the effectiveness of management activities and adjust management protocols as necessary.
4. Conduct callback surveys for secretive marsh birds to monitor overall diversity, evaluate habitat use patterns and identify potential areas for habitat protection or enhancement projects for focal species.
5. Conduct baseline small mammal inventory to obtain baseline information on species diversity and habitat utilization.

Objective 1.2
Tidal Scrub/Shrub
Wetlands

Manage up to 30 acres of tidal scrub/shrub habitat, containing a mix of shrub species including bayberry and marsh elder (*Iva frutescens*) consistent with local reference sites, to ensure that the quality and natural function of the marsh are sustained, provide breeding habitat for coastal plain swamp sparrow, and are comprised of less than 30 percent overall cover of invasive plants.

Rationale

Tidal scrub/shrub habitat is an important component of the refuge's tidal marsh complex that provides breeding habitat for birds of conservation concern. The coastal plain swamp sparrow is a subspecies of the swamp sparrow known to breed in Delaware, Maryland, and New Jersey tidal marshes. The refuge population of coastal plain swamp sparrows may constitute a significant portion of the total population of this unique subspecies of swamp sparrow that is being studied as a potential candidate species for listing under the ESA. The coastal plain swamp sparrow is restricted to an often narrow band of shrubby habitat at the interface of upland and high marsh. This habitat is particularly susceptible to recent changes such as rising sea level, ditching, impoundment, the invasion of phragmites, and the development of roads, farm fields, and housing tracts. Research indicates that these birds perch on phragmites; however, they do not nest in it. This species nests in dense grass at the base of shrubs, usually well concealed, and often anchored to the base of a high tide bush such as marsh elder. A dense tuft of salt hay such as salt meadow grass (*Spartina patens*) often camouflages the nest and provides some structural support (SMBC 2009).

The prairie warbler (*Dendroica discolor*) is a highest priority species in BCR 30, as well as being a high priority species in North America and in Partners in Flight Physiographic Area 44 (PIF 44). This species is experiencing relatively steep population declines. It uses moderately sized patches of shrubland and early successional forest. The PIF 44 report describing shrubland birds of highest conservation concern indicates that the prairie warbler utilizes a range of types from relatively young (abandoned) fields with scattered shrubs and trees to older fields with moderate shrub cover; however, it does not prefer later successional stages where shrubs and samplings form dense continuous tangles (Watts 1999).

The berry-producing shrubs of this habitat type are also beneficial to migrating birds. Other species of conservation concern that will benefit from our continued protection of the tidally influenced scrub/shrub habitat include the northern diamondback terrapin. These areas are difficult to access, but are currently maintained by naturally occurring processes.

Invasive plants are the greatest threat to this high quality habitat. Thickets contain autumn olive and phragmites. Maintaining scrub/shrub habitat on the refuge is problematic for a number of reasons that include

- ditches that drain the wetlands do not allow natural hydrology to support native plants;
- water level management options are limited due to concerns with flooding neighboring properties;
- woody trees are encroaching in scrub/shrub areas;
- scrub/shrub has historically comprised a small habitat area. The refuge cannot support much of this habitat due to approximately 75 percent of refuge habitat being tidal marsh; and
- there is overbrowse from deer limiting regeneration and exacerbating invasive plant species problems.

Within mid-Atlantic estuaries, coastal plain swamp sparrows are restricted to an often narrow band of shrubby habitat at the interface of upland and high marsh. This habitat is particularly susceptible to recent changes such as rising sea level, ditching, impoundment, the invasion of phragmites, and the development of roads, farm fields, and housing tracts. This is an important management consideration for the species (Beadell et al. 2003).

Management intervention may be necessary to enhance or restore habitat. Since poorly drained sections of tidal wetlands where medium-length cordgrass growth is favored, managers should consider blocking selected ditches on altered marshes to create additional habitat. Intervention that forms a mosaic of habitat patches consisting of favorable nesting substrate and suitable foraging sites should increase local populations significantly. Predator control may be necessary in some areas. On high marshes, shallow pools constructed near spoil deposits, which tend to be colonized by native shrubs, such as *Iva* spp., should encourage sparrows to settle, albeit at relatively low densities (Greenlaw 1992, Post and Greenlaw 1994). Controlled burning during the August-November wet season maintains favorable habitat (Post and Greenlaw 1994). Densely vegetated areas should be burned every 5 years and less dense areas every 8 to 10 years, with no more than 10 percent of the available habitat for a population burned in any given year (NatureServe 2009).

Strategies

1. Purchase up to two additional tidal scrub/shrub wetland acres within the acquisition boundary.
2. Maintain scrub/shrub habitat through selective cutting and/or herbicide to set back succession and, if necessary, treat invasive plants so that 70 percent of scrub/shrub habitat is in native species. The exact number of acres treated will depend on funding and management capability. Keep records of treated areas in GIS.
3. Coordinate with regional efforts and initiatives where possible and applicable with respect to climate change and sea level rise.
4. Manage 16,000 linear feet of scrub/shrub habitat along the high-tide line specifically to benefit coastal plain swamp sparrow.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, such as selective cutting and herbicide treatments, to achieve structural and species diversity of tidal scrub/shrub wetland species. Results may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within tidal scrub/shrub wetlands by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. Conduct inventories and monitoring of priority passerine species, such as the coastal plain swamp sparrow, to establish a baseline and research use of habitat by these species.
3. Conduct inventories and monitoring of landbird and wading bird use and abundance in the scrub/shrub habitat. Utilize data to document the effectiveness of management activities and adjust management protocols as necessary.
4. Conduct callback surveys for secretive marsh birds to monitor overall diversity, evaluate habitat use patterns, and identify potential areas for habitat protection or enhancement projects for focal species.
5. Using SLAMM results, monitor and evaluate conditions in the marshes over the next 15 years with respect to climate change and sea level rise.
6. To evaluate the effectiveness of prescribed burning, conduct post-burn surveys to measure the area, the intensity, and the success of the burn.
7. To determine the effectiveness of the white-tailed deer hunting program, evaluate regeneration of native shrubs and forbs by conducting vegetation surveys to gather information on species composition, abundance, and diversity.

Objective 1.3
Open Tidal Waters

Maintain and improve water quality and available aquatic habitat of tidally influenced rivers and estuaries through an active role in local, State, and Federal partnerships in order to reduce contaminants and to continue to provide year-round habitat for northern diamondback terrapins, shortnose sturgeon, blue crabs, and other aquatic species of conservation concern in the area's tidal waters.

Rationale

The refuge's wetlands are bordered by and hydrologically connected to the tidal creeks and the Delaware River. Therefore, refuge habitats are affected by water quality and refuge management may affect water quality of these waterways.

The refuge's tidal marsh supports a wide variety of aquatic organisms, many of which are of conservation concern. The waters of the Delaware River Estuary also support an important recreational fishery and shellfishery, which includes the blue crab. Fish and shellfish also serve as the food source for birds and other species of conservation concern. Fish in the tidal waters support local populations of osprey, bald eagle, and Forster's tern (*Sterna forsteri*). Thousands of waterfowl, including American black duck, American wigeon, Canada goose, blue-winged teal and green-winged teal, gadwall, mallard, northern pintail, snow goose, and tundra swan use the tidal marsh during winter and migration.

The federally listed endangered shortnose sturgeon and the Atlantic sturgeon are fish species of concern near Supawna Meadows NWR. These waters also provide nursery habitat for interjurisdictional fish species such as menhaden, blueback herring, alewife, American shad, and striped bass. Also of concern are mussel species including the yellow lampmussel (*Lampsilis cariosa*), tidewater mucket (*Leptodea ochracea*), and triangle floater (*Alasmidonta undulata*), all of which are listed as threatened by the State of New Jersey (NJDFW 2009a).

As noted under objective 1.1, the human-altered hydrology of the marsh appears to be an important factor in the success of invasive phragmites. Numerous other factors influence the refuge marsh and the water quality of tidal waters, including personal watercraft impacts, lack of major flooding, siltation/sedimentation, contaminants in the water and soil from past usage, temperature changes, sea level rise, mosquito control both on and off the refuge, upstream non-point source contaminants, and oil and hazardous material spills along the Delaware River, the second largest oil transport channel on the East Coast.

Due to the regional scale of water quality impacts, the refuge is reliant on actively engaging in partnerships with local communities, anglers, watershed associations, conservation groups, and researchers in order to meet this habitat objective.

Strategies

1. Implement best management practices, such as adhering to instructional labels when applying herbicides, to protect against potential contamination of the tidal rivers and other open tidal waters that could be impacted by refuge management activities.
2. Actively engage in partnerships with local communities, anglers, watershed associations, conservation groups, and researchers to help address water quality and other issues in the watershed.
3. Using SLAMM analysis results, monitor and evaluate conditions at Supawna Meadows NWR over the next 15 years with respect to climate change and sea level rise. Coordinate with regional efforts and initiatives where possible and applicable.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Conduct inventorying and monitoring of biological elements, chemical elements, sedimentation, and contaminants to benefit tidal marsh habitat, fish and open water.
2. Work in partnership with local universities, as well as State and Federal agencies, to complete a series of fish inventories to obtain baseline biological information of fish species diversity and species health in order to evaluate impacts of tidal marsh water quality changes.
3. Work with NJDEP and other appropriate agencies to develop data on the presence and distribution of fish and other aquatic species within the refuge.

Goal 2

Protect, enhance, and restore biological integrity, diversity and environmental health of upland habitats to support native wildlife and plant communities with emphasis on migrating and wintering birds and other species of concern.

Objective 2.1 Early Successional Grassland Habitat

Manage up to 532 acres of grassland habitat to create a mix of cool and warm season grasses and forbs to provide habitat diversity, forage, and cover for migrating and wintering grassland birds, such as bobolink, vesper sparrow, eastern meadowlark, and savannah sparrow; raptors, such as northern harrier, common barn owl (*Tyto alba*), and short-eared owl; and habitat for pollinators, such as bronze copper butterfly (*Lycaena hyllus*). Focus grassland management on fields larger than 20 acres, with an emphasis on those fields with minimal edge, less surrounding forest, and more surrounding open habitats (old fields,

emergent wetlands), and where possible, maintain grasslands in close proximity to one another. Encourage cover of desirable grassland plants in the following ways:

- increase cover to 80 percent desirable grassland plant cover (for example, switch grass, goldenrod spp., eupatorium spp.).
- reduce cover of invasive species (for example, Canada thistle, autumn olive) so that they comprise less than 20 percent cover of grassland habitat.

Rationale

Birds that depend on early successional habitats, such as grasslands and shrublands, are one of the fastest declining bird groups due to habitat loss and changes in farming practices in the Northeast. Habitat loss, conversion of pasture to intensive row crops, increased frequency of mowing, and lack of fire are cited as the causes of population declines in grassland-dependent species (Vickery 1996). Grasslands on the refuge are used extensively by migrating and wintering obligate grassland birds. Bobolink, eastern meadowlark, northern harrier, savannah sparrow, and vesper sparrow are examples of grassland bird species that increase in abundance during migration and in the winter.

In addition, the refuge will also emphasize monitoring pollinators in early successional habitats (particularly butterflies, which play a crucial role in plant pollination) using the refuge as many of these species are of conservation concern due to losses in habitat and nectar corridors that facilitate migration. A recent study of the status of pollinators in North America by the National Academy of Sciences found that populations of some native pollinators are declining, which may in part result from habitat loss, degradation, fragmentation, non-target effect of pesticides, competition from invasive species, and introduced diseases (National Academy of Sciences 2007). Flower-visiting Lepidoptera, many of which are actual or potential pollinators, currently dominate the list of endangered species: 17 species of butterfly and 3 species of moth constitute more than half of all insect species listed as endangered (USFWS 2010a). The State-listed endangered bronze copper butterfly, State-listed threatened frosted elfin butterfly, and a number of other moths and butterflies have been documented in the refuge's grassland habitat.

The northern diamondback terrapin is not federally listed; however, it is a State species of concern. While not traditionally considered a grassland species, members of the refuge staff have observed individuals in this habitat. It is possible that terrapins are attempting to use the grassland habitat for nesting purposes, which may negatively affect reproductive success. Terrapin nests in grassland areas may be subject to increased predation associated with increased predator access, as well as decreased hatch rates because of suboptimal hatching conditions (for example, nest temperature, environmental exposure).

Although total acres and patch sizes are less stringent during migration and winter, larger blocks (more than 20 acres) of grassland are recognized as optimal for grassland bird species survival requirements. Service biologists consider the grasslands at Supawna Meadows NWR to be limited in quality for breeding birds, so management measures will be employed to continue to provide grassland habitat for migrating and wintering birds.

Grasslands, being an early successional community type, require significant maintenance and time inputs to be maintained over a long-term period. In some areas, it will be more economically and ecologically beneficial to manage existing grassland habitats in a successional trajectory toward shrubland and ultimately

coastal or floodplain forest. Each individual grassland patch will require evaluation based on existing and potential habitat benefits.

Strategies

1. Purchase up to 409 additional grassland acres within the acquisition boundary.
2. Actively manage grasslands through the use of mowing and prescribed fire. Mow or burn 50 percent of the grassland acreage every 3 years.
3. Evaluate the potential for allowing managed grasslands, particularly those less than 20 acres in size, to succeed through natural processes to scrub/shrub habitat for priority migratory species.
4. Determine the value of grassland habitats to wintering and migrating birds using an adaptive management approach.
5. Use information gathered from Christmas Bird Counts and other non-standardized but repeated observations to determine habitat use and distribution.
6. Control Canada thistle, autumn olive, and other invasive plants to establish 80 percent cover of native species. The exact number of acres treated will depend on funding and management capability. Keep records of treated areas in GIS.
7. Provide a shrubland component to the fields, for migrating and breeding shrubland species, by creating a softer transition zone from grass to shrubs to forest at the edges of fields. Cull woody and invasive plants periodically to ensure native shrub species dominate.
8. Determine the value of grasslands for butterflies and other pollinators using refuge grassland habitat and incorporate surveys and/or monitoring efforts.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Conduct winter grassland transect surveys for measuring composition and relative abundance of grassland birds and raptors in grassland fields.
2. Prevent new invasive species from becoming established within early successional grassland habitats by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
3. To evaluate quality of grasslands for migrating grassland-dependent songbirds, conduct periodic vegetation surveys at landbird point counts for height, density measurements, and species composition or grass-forb ratio.
4. To evaluate achievement of the objective for migrating and wintering birds, conduct migration and winter bird counts.
5. Conduct baseline inventories of butterflies and other pollinator species to determine species abundance, density, and diversity as needed.
6. Conduct baseline small mammal inventory to obtain baseline information on species diversity and habitat utilization.
7. To evaluate the effectiveness of prescribed burning on grassland habitats, conduct post-burn surveys to measure the area, the intensity, and the success of the burn.

8. Monitor grasslands to determine if northern diamondback terrapins are using this habitat. If terrapins are using refuge grasslands, monitor individuals to determine how they are using this habitat and determine if management activities are appropriate to help protect this species.
9. Monitor presence of mute swans and Canada geese and work with USDA APHIS or other licensed agent to control these species as necessary to meet objectives.

Objective 2.2
Early Successional
Scrub/Shrub Habitat

Protect and manage up to 55 acres of upland scrub/shrub habitat to benefit migrating landbirds (for example, blue-winged warblers, American woodcock), breeding landbirds (for example, American Woodcock, prairie warblers), and other species of conservation concern with the following habitat attributes:

- >70 percent of a mixture of desirable native fruit-producing shrubs, such as blackberry (*Rubus* spp.), *Viburnum* spp., and bayberry; forbs, such as goldenrods; vines, such as grapevines and greenbrier (*Smilax laurifolia*); and tree species, such as sweetgum and black cherry < 20 feet in height;
- >50 percent of unmanipulated residual cover remaining annually for nesting species; and
- <30 percent cover of invasive species (for example, autumn olive, multiflora rose, Japanese honeysuckle, mile-a-minute weed).

Rationale

American woodcock is a high priority upland game bird that is of conservation concern at the continental, BCR 30, and PIF 44 scales. There is significant interest in managing early successional habitats for this species. Meeting these habitat requirements will also provide good habitat for many other species that use this habitat type. The refuge may also be as important for migratory stopover habitat as it is for breeding habitat for this species. American woodcock nesting habitat varies geographically, including drier woodland sites, young open woodlands, low shrubby cover, old fields, tall herbage bordering clearings, thickets, scrub oaks or pines, open woodland with dead leaf cover on the ground, and flat bottomlands near water. High shrub stem density and presence of edge habitat may be important in nest site selection in some areas.

The prairie warbler is also a high priority species at the continental, BCR 30, and PIF 44 geographic levels. The prairie warbler became a focal species in this CCP because of its geographic importance and its steep population declines. This species uses moderate sized patches of shrubland and early successional forest, which the refuge can be managed to sustain. It usually nests in a shrub, sapling, thicket, or fern clump from 0.3 to 3 meters above ground and occasionally higher.

The blue-winged warbler is a 2008 Service listed bird of conservation concern in BCR 30. During migration and winter, blue-winged warblers occur in brushy areas, scrub, and open woodland.

The New Jersey Wildlife Action Plan identifies the protection, maintenance, enhancement, and/or restoration of scrub/shrub habitats as a conservation goal necessary to maintain viable populations of declining scrub/shrub species (NJDFW 2008a). Shrub habitat comprised of various shrub species, or a diverse mix of young trees, provides an abundance of insect food for breeding birds and fruit for fall migrating birds. Many species of birds rely on shrub habitats at various times throughout the year. Because of this, responsibility for providing quality shrubland bird habitat is not limited to their breeding season.

The refuge lies in an important migratory bird pathway along the Atlantic flyway and provides an important stopover site for many migrating bird species.

Many scrub/shrub plant species bear fruit in the fall, which helps boost the fat reserves for migrating or wintering birds. During migration, vegetation structure, microhabitat conditions, and landscape context are the most important habitat features for these birds, rather than specific plant species (Dettmers 2003). In a study in Central New Jersey, Suthers et al. (2000) found that of the different successional habitat types, the one most frequently used by fall migrating birds were shrublands. Factors that contributed to the selection or abandonment of these habitats included vegetation structure and abundance and quality of resources. The study showed that migrant birds abandoned habitats that were shaded out by invading trees. It also showed that migrant birds were attracted to areas by abundance and quality of fruits.

As shrub habitats are transitional in nature, active management is necessary to periodically set back succession through mechanical treatments (for example, selective cutting) to provide a continued source of shrub habitat. Management actions even on smaller tracts can be effective as shrub-dependent birds are not typically sensitive to habitat patch size and many will use small patches of shrub habitat (Watts 2000).

Strategies

1. Purchase up to 19 additional scrub/shrub acres within the acquisition boundary.
2. Maintain scrub/shrub habitat through selective cutting and/or herbicide to set back succession.
3. Conduct invasive species control on scrub/shrub habitat so that 70 to 80 percent of habitat is in native species. The exact number of acres treated will depend on funding and management capability. Keep records of treated areas in GIS.
4. Continue the use of biological control measures to control invasive plant species.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within early successional scrub/shrub habitats by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. To evaluate achievement of the objective for breeding and migrating birds, conduct landbird surveys and migration and winter bird counts.
3. To evaluate achievement of the objective for migrating landbirds, conduct surveys during peak migration to determine bird abundance, density, and diversity. Surveys include area searches, constant-effort mist-netting and banding, and activity budgets.
4. Conduct woodcock singing ground surveys to evaluate habitat quality and utilization and species abundance on the refuge.
5. To evaluate quality of shrubland habitat for migrating landbirds, conduct periodic vegetation surveys for plant species composition, community structure, and berry production.

6. Gather baseline data on butterflies and other pollinators using refuge scrub/shrub habitat, and incorporate annual surveys and/or monitoring efforts.

Objective 2.3
Upland Forest Habitat

Maintain 2 additional acres of upland forest beyond those currently managed (up to 416 acres) benefiting breeding wood thrush, northern flicker, migrating black-and-white warblers and Kentucky warblers, migrating and wintering rusty blackbirds (*Euphagus carolinus*), roosting bats, and other forest-dependent species of conservation concern. Upland forest habitats are characterized by the following attributes:

1. Canopy cover of mixed deciduous forest >75 percent (including sweetgum, sour gum, black cherry, black oak, southern red oak, persimmon, American holly, and red maple);
2. Native deciduous shrubs and small sub-canopy trees <15 feet tall (highbush blueberry and southern arrowwood) and vines (common greenbriar) collectively cover >30 percent;
3. >30 percent native ground cover consisting of forbs and ferns with a major native component of flowering perennial herbaceous plants; and,
4. <20 percent cover of invasive plants (for example, Japanese stiltgrass, multiflora rose, Japanese honeysuckle) in understory/herbaceous layer.

Rationale

A large number of forest-dependent bird species are becoming increasingly rare because their habitats are diminishing in acreage or being broken into smaller blocks that do not provide optimal conditions for survival. The refuge does not provide sufficient unbroken forest to sustain forest interior birds; however, more tolerant species such as the wood thrush and flicker would benefit from active forest management, particularly control of invasive plants and white-tailed deer overbrowse.

The wood thrush is a high priority species at the continental, BCR, and PIF 44 scales. According to the Breeding Bird Survey, the wood thrush declined during the period of 1966 to 2007 (Sauer et al. 2008). The mid-Atlantic region is generally a stronghold for wood thrush, and this species is a good representative of many other species needing a structurally diverse understory within mature deciduous forest conditions.

The BBS data indicate a significant northern flicker population decrease in eastern North America between 1966 and 1989 (Sauer and Droege 1990). BBS data for 1966 to 1993 indicate large declines throughout eastern North America and the prairies. The flicker requires open forest (both deciduous and coniferous), open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, and parks (AOU 1983). It nests in dead tree trunks or stumps, or the dead top of a live tree; it sometimes nests in a wooden pole, building, or earth bank. Northern flickers either dig a nest cavity or reuse an old one.

The black-and-white warbler and Kentucky warbler are listed as BCR30 species of high concern and New Jersey non-game birds of conservation concern. Both species require forest habitats for feeding during migration (NatureServe 2009). During migration and winter, rusty blackbird habitat is primarily wooded wetlands and riparian areas, but also includes various open woodlands, scrub, pastures, and cultivated lands (AOU 1983).

Major threats to the refuge's forest health and condition are overbrowse caused by white-tailed deer overabundance and infestation of invasive plant species. White-tailed deer thrive in fragmented non-urban areas and the resulting

overbrowse in forested landscape severely limits forest regeneration (NJDFW 2008c). White-tailed deer selectively browse native vegetation, giving invasive species (for example, mile-a-minute weed, etc.) a competitive edge in the forest understory (NJDFW 2008c). Deer browse pressure significantly impacts the regeneration of native woody species. Regeneration is essential to the success of the development of Supawna Meadow NWR's forest understory. Numerous studies have found that when white-tailed deer browse pressure is high, it can alter the growth, reproduction (Knight 2003), diversity (Lathan et al. 2005), and ultimately survival of plants within a specific population (Alverson and Waller 1997, Cote et al. 2004). In areas where deer density exceeds 20 deer per square mile, deer herbivory is related to declines in mid-story bird species (deCalesta 1994).

Supawna Meadows NWR has a severe infestation problem with the non-native mile-a-minute weed. This plant is an herbaceous trailing vine that is native to India and Eastern Asia. It is an aggressive plant that grows over native vegetation, which blocks light from penetrating to the plant. This reduces photosynthesis capability and may kill native plants (Okay et al. 2010). We will continue to work with New Jersey Department of Agriculture to maintain this habitat by using an Asian weevil (*Rhinoncomimus latipes*) to control mile-a-minute weed.

Based on results of host-range tests, a limited amount of native foliage was consumed by weevils (between 0.1 and 2.3 cm² over 30 days). However, none of the non-target plant species were consumed when the weevils were given a choice between them and mile-a-minute weed. Additionally, no eggs were laid on non-target plant species (Colpetzer 2003). The conclusions from field studies indicate the weevil establishes easily, produces multiple generations per year, and that adults can kill mile-a-minute plants through foraging (Hough-Goldstein 2008). The intention of the releases is that the weevils will consume mile-a-minute weed stems and leaves, which would result in reducing the spread of and, eventually, killing the plants.

The refuge includes an old barn that provides important habitat for bats and owls, wildlife that are dependent on upland forest habitat. A maternity colony of more than 1,500 bats, primarily little brown bats, 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 and it is not yet known if the species is present within the Coastal Plain (USFWS 2007a). Regardless of whether or not Indiana bats use the barn, the Service believes the barn should be maintained to support the maternity colony of little brown and big brown bats. If the barn is torn down, displaced bats may make their way into nearby homes and may be susceptible to harm by homeowners not willing to tolerate their presence. The barn would also support common barn owls, which is a New Jersey species of concern. Maintaining the barn would allow us to sustain this unique environment on the refuge as a resource for bats, owls, and other wildlife and as a component of refuge diversity in general.

Forested uplands provide important habitat for many species of bats. Quality habitats include the following: trees with shingle-like or shaggy bark ≥ 9 inches dbh, snags or diseased trees ≥ 5 meters tall, trees with cavities, habitat patches of mature trees ≥ 50 acres, and an open understory (Scherer 2009 personal communication). Indiana bats, a federally listed and endangered species and a trust resource of the U.S. Fish and Wildlife Service, have been confirmed breeding and hibernating in the State of New Jersey but are not documented on

the refuge. Typically, Indiana bats utilize trees or snags with exfoliating bark for maternity roosts; however, roosting Indiana bats have been documented in structures. The refuge's barn, adjacent to refuge grasslands and tidal marsh, provides artificial roosting habitat that houses the largest maternity colony of little brown bats and big brown bats in Salem County, New Jersey. Given the known range and maternity roost requirements of the Indiana bat, it is possible, although unlikely, that Indiana bats might use the barn for maternity roosting.

If Indiana bats are using the refuge for foraging and roosting, protecting, maintaining, and improving habitat quality on the refuge would contribute to the viability of the species and its recovery. Gathering more information about use of the refuge by this endangered species, in addition to other species of bats, would allow more informed management decisions and, if necessary, ensure the protection and improvement of habitats used as roost or maternity colonies.

The scrub/shrub habitat off Xmas Tree Lane and the Forest Habitat Trail was previously hydro-axed to maintain it in early successional habitat. This area will be restored to forested uplands to create a large block of forested habitat to benefit forest birds such as the red shouldered hawk. The scrub/shrub habitat off Lighthouse Road, east of the refuge office, would also be converted to forested upland habitat to create a larger forested block in that area and to benefit forest birds.

Strategies

1. Continue to coordinate with New Jersey Department of Agriculture's weevil release program to control mile-a-minute weed in some areas of the refuge, as described in the refuge's 2006 Compatibility Determination (USFWS 2006), and the accompanying U.S Department of Agriculture. Environmental Assessment (Firko 2004) that were completed for this activity. A more recent version of that compatibility determination is in appendix B.
2. Expand invasive species control on current and additional acreage on mile-a-minute weed, Japanese stiltgrass, multiflora rose, and Japanese honeysuckle so that 70 to 80 percent native vegetation is achieved. The exact number of acres treated would depend on funding and management capability. Keep records of treated areas in GIS.
3. Purchase up to 174 additional upland forest acres within the acquisition boundary.
4. Work with State and other partners to conduct limited surveys for bat species of conservation concern and implement appropriate action if white-nose syndrome is discovered in the colony.
5. Identify, locate, and manage additional native bat habitat.
6. Maintain and improve the structural integrity of the barn, located adjacent to the refuge's grasslands and tidal marshes, to continue to provide maternity roosting habitat for little brown and big brown bats, common barn owls, and other species of conservation concern.
7. Work with partners to monitor the barn owl nest box in the barn.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within upland forest habitats by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately addresses those populations through the appropriate control measure. This strategy would incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. Conduct landbird surveys, migration and winter bird counts to evaluate achievement of the objective for breeding, migrating, and wintering birds.
3. Conduct reptile and amphibian inventories to obtain baseline information on species diversity and habitat utilization.
4. Conduct acoustical monitoring surveys to determine presence of Indiana bats during their breeding season and detect occurrences of Indiana bats during migration.
5. Conduct acoustical monitoring surveys to determine species diversity and composition of bats on the refuge during breeding and migration.
6. Conduct baseline small mammal inventory to obtain baseline information on species diversity and habitat utilization.
7. In the barn, conduct comprehensive surveys for bat species of conservation concern and implement appropriate action if white-nose syndrome is discovered in the colony.
8. In the barn, monitor the barn owl nest box to determine use and hatching success.
9. To determine the effectiveness of the white-tailed deer hunting program, evaluate regeneration of native trees, shrubs, and forbs by conducting vegetation surveys to gather information on species composition, abundance, and diversity.
10. Work with the State on white-tailed deer control.
11. Monitor presence and impact of beaver in adjacent habitat, which impacts forested uplands, and work with USDA APHIS or other licensed agents to control these species as necessary to protect public safety and refuge resources.

Goal 3

Protect, enhance, and restore biological integrity, diversity, and environmental health of non-tidal wetland habitats to support native wildlife and plant communities with emphasis on breeding, migrating, and overwintering birds and other species of conservation concern.

Objective 3.1 Non-tidal Scrub/Shrub Wetlands

Protect and manage up to 52 acres of non-tidal scrub/shrub wetland habitat to benefit migrating landbirds such as eastern towhee (*Pipilo erythrophthalmus*), gray catbird (*Dumetella carolinensis*), brown thrasher (*Toxostoma rufum*), and other species of conservation concern with the following attributes

- >75 percent cover of native fruit-bearing shrubs (for example, dangleberry (*Gaylussacia frondosa*), southern arrowwood);
- <20 percent cover of native moist soil grasses and forbs (for example, coast cockspur, spike-rush (*Elocharis* spp.), smartweed (*Polygonum* spp.), switch grass); and
- <30 percent cover of invasive plants (for example, mile-a-minute weed, common velvet grass [*Holcus lanatus* L.], autumn olive).

Rationale

Scrub/shrub habitat is essential in supporting a number of bird species of conservation concern. The yellow-breasted chat, a year-round resident of Supawna Meadows NWR, is listed in the NJWAP as a species of concern in the Southern Piedmont Plains region (NJDFW 2008a). It nests in bushes, brier

tangles, vines, and low trees, generally in dense vegetation less than 2 meters above ground. In winter, it establishes territories in young second-growth forest and scrub. Early successional habitat is essential to its survival. The prairie warbler, another species of concern, has been described in objective 2.2 above (see page 4-25).

Scrub/shrub habitats are becoming increasingly rare in the Delaware Estuary region and correspondingly less able to sustain healthy populations of birds and other species of conservation concern. See objective 2.2 for additional rationale for scrub/shrub habitat management.

It is anticipated that management of shrublands for migrating landbirds will continue to provide habitat for breeding landbirds, such as gray catbirds and eastern towhees, and other species of conservation concern dependent on shrublands.

Strategies

1. Purchase up to 4 additional scrub/shrub acres within the acquisition boundary.
2. Maintain scrub/shrub habitat through selective cutting and herbicide application to set back succession.
3. Control invasive plants so that 70 percent of scrub/shrub habitat is comprised of native species. The exact number of acres treated will depend on funding and management capability. Keep records of treated areas in GIS.
4. Continue the use of biological control measures to control mile-a-minute weed.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, such as selective cutting and herbicide treatments to achieve structural and species diversity of non-tidal scrub/shrub wetland habitat. Results may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within non-tidal scrub/shrub habitat by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. To evaluate achievement of the objective for breeding and migrating birds, conduct landbird surveys, migration and winter bird counts.
3. To evaluate achievement of the objective for migrating landbirds, conduct surveys during peak migration to determine bird abundance, density, and diversity every 5 years. Surveys include area searches, constant-effort mist-netting and banding, and activity budgets.
4. To evaluate quality of scrub/shrub habitat for migrating landbirds, conduct periodic vegetation surveys for plant species composition, community structure, and berry production every 3 to 5 years.
5. Gather baseline data on butterflies and other pollinators using refuge non-tidal scrub/shrub wetland habitat and incorporate annual surveys and/or monitoring efforts within 5 to 10 years.

Objective 3.2
Non-tidal Herbaceous
Wetlands

Protect up to 55 acres of non-tidal herbaceous wetland habitat to benefit marsh wrens, southern bog lemmings, and other species of conservation concern with the following attributes

- >70 percent cover of herbaceous wetland species, such as rice cutgrass, *Polygonum* spp., *Juncus* spp., *Drosera* spp., and *Serracenia* spp; and
- <30 percent cover of invasive plants, such as phragmites and reed canary grass (*Phalaris arundinacea*).

Rationale

Non-tidal herbaceous wetlands at Supawna Meadows NWR provide habitat for species of conservation concern, including the marsh wren, which inhabits freshwater and brackish marshes in cattails, tule, bulrush, and reeds. Its success may be greatest in marshes with relatively dense vegetation and deep water. Though no longer listed by the Service as a bird of conservation concern in the region, it is considered a non-game species of conservation concern by the State of New Jersey (NJDFW 2008a). The southern bog lemming is also listed by New Jersey as a non-game species of conservation concern (NJDFW 2008a).

Non-tidal herbaceous wetlands are a small but important habitat component of the refuge because of the relative scarcity of this type of habitat in the vicinity of the refuge and the diversity of vertebrate and invertebrate species and plant life these wetlands typically support. Overbrowse from white-tailed deer limits regeneration of native herbaceous plants and exacerbates invasive plant species problems.

Strategies

1. Purchase up to 13 additional non-tidal herbaceous wetland acres within acquisition boundary.
2. Develop an Adaptive Management Framework for phragmites control so that treatments are monitored and evaluated for effectiveness. The refuge will be using an integrated approach to phragmites control, which will consider restoration of natural processes, herbicides, prescribed burning, biological control, and other tools as they are developed.
3. Monitor habitat destruction impacts of white-tailed deer. Implement population control measures on white-tailed deer if significant habitat destruction is observed.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, such as prescribed fire and herbicide treatments to achieve structural and species diversity of non-tidal herbaceous wetland habitat. Results may trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within non-tidal scrub/shrub habitat by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.

2. To determine the effectiveness of the white-tailed deer hunting program, evaluate regeneration of native shrubs and forbs by conducting vegetation surveys to gather information on species composition, abundance, and diversity.
3. Work with the State on white-tailed deer control.

Objective 3.3
Freshwater Impoundments

Manage the existing five impoundments, consisting of up to 87 acres, using existing water control structures and up to 5 acres of non-tidal open water impoundments (without water control structures) to enhance habitat available for shorebirds, waterfowl, marsh birds, and wading birds during their peak spring and fall migration periods while maintaining essential habitat for other species of management concern, such as amphibians and dragonflies, through a combination of water level management, wetland restoration, and invasive species control. These measures will include:

- Annually provide high quality foraging habitat for wading and marsh birds, specifically black-crowned night-herons, glossy ibis, least bitterns, snowy egrets, and little blue herons (summer: July-late August). This habitat will consist of open, shallow water (2 to 10 inches water depth) with patches of emergent wetland plants that support fish, invertebrates, and amphibians.
- Annually support migratory shorebirds through a mix of shallow water (<6 inches water depth), mudflat with sparse vegetation (<10 percent cover), and mudflats with no vegetation at times of peak migration (spring: May; and fall: mid-August through September).
- Annually support migratory waterfowl through a mix of shallow (6 to 24 inches water depth) flooded vegetation (*Carex*, *Polygonum*, *Peltandra*) at times of peak migration (spring: late March, and fall: late October).
- Annually support migratory wading birds through a mix of shallow remnant pools (6 to 12 inches water depth) at times of peak migration (spring: late March, and fall: late August).

Rationale

Supawna Meadows NWR's impoundments and emergent wetlands provide important foraging habitats for wading birds nesting on Pea Patch Island, which is the largest wading bird colony in the mid-Atlantic and one of the largest colonies on the East Coast. Managing these wetlands to provide the necessary food for a subset of these birds will result in resources available to a larger suite of wading birds, such as black-crowned night herons, glossy ibis, least bitterns, snowy egrets, and little blue herons, which are priority species within BCR 30. Also, created wetland environments can provide key life cycle components for a variety of birds and aquatic species.

Invasive plant species, such as phragmites, purple loosestrife, Canada thistle, and mile-a-minute weed, are increasingly displacing native species in the impoundments and along the dikes. Water levels are controlled using water control structures. An increase in water levels can occur from allowing tidal water to flow into the impoundment, rainfall, and natural springs. The water levels in impoundments without water control structures are influenced by rainfall, natural springs, and drying conditions such as drought. Prescribed fire can be used to control vegetation in the impoundments. Mowing, prescribed fire, and flooding can be used to reduce overcrowding vegetation.

The Service has a policy emphasizing restoring the biological integrity, diversity, and environmental health of refuges (601 FW 3). We also need to think about creating and restoring natural systems that have resilience (that is, the capacity to absorb disturbance while retaining basic structure and function) to help

address predicted sea level rise and other climate change issues. As sea level rises, management and maintenance of coastal wetland impoundments will become increasingly challenging and expensive. Due to the continued high cost of managing impoundments and maintaining associated infrastructure and coupled with the natural forces that strive to eliminate them, Supawna Meadows NWR will continue to study the feasibility of whether or not to continue individual impoundment management. Returning impoundments to more natural hydrological regimes will result in impoundments and the surrounding habitats becoming slightly brackish.

Strategies

1. For each impoundment, evaluate potential for restoring or reverting to non-impounded natural marsh or forested wetland habitats (natural hydrology) rather than continuing impoundment management. Participate in a Northeast Region structured decisionmaking study to determine the highest conservation value for each impoundment. Where restoring natural processes is not feasible, the refuge will strive to mimic natural processes within impoundments.
 - Begin evaluation with Tract 11C impoundment for potential to restore natural hydrologic conditions.
 - In impoundments without water control structures, evaluate potential for creating vernal pool-like shallow waters for amphibians and implement if feasible.
2. Until the HMP is developed, actively manage Tract 11 and Tract 11D Lighthouse Road Impoundments. Vary water level management schemes on each impoundment year-to-year to benefit priority species, particularly Pea Patch Island wading birds.
3. Develop an Adaptive Management Framework for phragmites control so that treatments are monitored and evaluated for effectiveness. The refuge will be using an integrated approach to phragmites control, which will consider restoration of natural processes, herbicides, prescribed burning, biological control, and other tools as they are developed.
4. Actively manage impoundments using mowing, prescribed fire, flooding, and biological control for purple loosestrife and mile-a-minute weed as needed to achieve objectives.
5. Maintain dike and water control structures as needed. Mow and reduce woody vegetation on Tract 11 dike.
6. Collect data and assess habitat and dikes to determine damage by furbearers, such as muskrat and groundhog. Determine threshold that requires species management. Issue a Special Use Permit if trapping is needed.
7. In impoundments without water control structures, maintain nearby nest boxes for wood ducks and eastern screech owls.
8. In Tract 11D Xmas Tree Lane Impoundment, determine appropriate water level management of impoundment and implement control measures.
9. In Tract 11D Xmas Tree Lane Impoundment, monitor habitat destruction of beaver. Implement beaver population control measures if significant habitat destruction is observed.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or trigger a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within impoundments by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. Conduct inventories and monitoring of shorebirds, waterfowl, waterbirds, and wading birds use and abundance within the impoundments. Utilize data to document the ongoing effectiveness of water level management activities and adjust management protocols as necessary.
3. Conduct fish inventories to obtain baseline information of fish species diversity.
4. To evaluate habitat use and monitor overall diversity of anuran species, conduct call count surveys to evaluate impoundment protection and management.
5. In early spring, identify and map areas of concentration of amphibians and impoundments to ensure their conservation and protection.
6. Monitor habitat destruction of Canada goose, mute swan, and beaver, and work with USDA APHIS or other licensed agents to control these species as necessary to protect public safety and refuge resources.

Objective 3.4 Forested Wetlands

Protect up to 346 acres of forested wetland habitat to benefit breeding wood thrush and wood ducks, migrating and wintering rusty blackbird, breeding and wintering eastern screech owls, and other forest-dependent species of conservation concern. Forested wetland habitat is characterized by the following attributes

- understory with 30 to 50 percent cover of native shrubs (3 to 12 feet tall), such as southern arrowwood and sweet pepperbush, with scattered openings containing native herbaceous species, such as New York fern and false nettle;
- <20 percent cover of invasive plants (for example, Japanese stiltgrass) in understory/herbaceous layer; and
- >90 percent canopy cover of native trees (>12 feet tall), such as red maple, willow oak, sweetgum, and sour gum.

Rationale

The wood duck is a refuge focal species because it is a high priority species both within the Atlantic Flyway and at the regional scale, and it is a good representative of forest wetland habitat types. Wood duck populations began declining in the late nineteenth century because of overharvest, deforestation, and loss of wetland habitats. Populations have since stabilized but not recovered, even though harvest rates have declined. Wood ducks prefer quiet inland waters, such as wooded swamps, flooded forest, ponds, marshes, along streams where they nest in holes in large trees in forested wetlands, and in bird boxes, usually within 0.5 kilometers of water and near forest canopy openings. They winter on freshwater and brackish marshes, ponds, streams, and estuaries.

The rusty blackbird breeds in Canada and Alaska and migrates to New Jersey and other Eastern and Central States to winter. During migration and winter, habitat is primarily wooded wetlands and riparian areas but also includes various open woodlands, scrub, pastures, and cultivated lands (American Ornithologists' Union 1983). A significant, range-wide decline of approximately 90 percent over the past four to five decades is indicated by data from the Breeding Bird Survey, Christmas Bird Counts, and Quebec Checklist Program

(Greenberg and Droege 1999, Niven et al. 2004, Savignac 2004, Sauer et al. 2005). Analyses of abundance classifications in bird distribution books and annotated checklists reveal a long-term decline dating back to at least the early part of the 1900s (Greenberg and Droege 1999).

The eastern screech owl, a non-game species of conservation concern in the State of New Jersey (NJDFW 2008a), is common year round at Supawna Meadows NWR. It prefers open woodland, deciduous forest, woodland/forest edge, swamps, scrub, and riparian woodland. It roosts in tree hollows, among foliage close to trunk, in nest boxes, under eaves, or at similar sites.

A large number of bird species, including the wood duck, rusty blackbird, and eastern screech owl, use forested wetlands. Birds use the refuge's forested wetlands for breeding, migration, and wintering. The refuge's mature forested wetland habitat represents an excellent example for the area of great quality and size class diversity. A water control structure is located within forested wetland habitat along the Forest Habitat Trail. Managing the water levels here will provide additional forested wetland habitat, as in a Green-tree Reservoir. The forest has been ditched in some areas, thus altering the original hydrology. Encroachment of invasive species threatens this habitat. Also, the habitat north of the Tract 11 impoundment contains a wooded section within the scrub/shrub habitat that will be converted to forested wetlands for the benefit of short-eared owls. Additional management actions will allow us to better sustain this important habitat type.

Major threats to the refuge's forest health and condition are overbrowse caused by white-tailed deer overabundance and infestation of invasive plant species. White-tailed deer thrive in fragmented non-urban areas, and the resulting overbrowse in forested landscape severely limits forest regeneration (NJDFW 2008c). White-tailed deer selectively browse native vegetation, giving invasive species (for example, mile-a-minute weed, etc.) a competitive edge in the forest understory (NJDFW 2008c). Deer browse pressure significantly impacts the regeneration of native woody species. Regeneration is essential to the success of the development of Supawna Meadow NWR's forest understory. Numerous studies have found when white-tailed deer browse pressure is high, it can alter the growth, reproduction (Knight 2003), diversity (Lathan et al. 2005), and ultimately survival of plants within a specific population (Alverson and Waller 1997, Cote et al. 2004). In areas where deer density exceeds 20 deer per square mile, deer herbivory is related to declines in mid-story bird species (deCalesta 1994).

Strategies

1. Purchase up to 156 additional acres of forested wetlands within the acquisition boundary.
2. Conduct an adaptive management study to determine if natural hydrology should be restored.
3. Remove wood duck nest boxes as boxes fall into disrepair.
4. Expand invasive species control on current and additional acreage of Japanese stiltgrass and other dominant invasive species so that 70 to 80 percent native vegetation cover is achieved. The exact number of acres treated will depend on funding and management capability. Keep records of treated areas in GIS
5. Continue the use of biological control measures to control mile-a-minute weed.
6. Monitor habitat destruction by white-tailed deer and beaver. Implement population control measures on white-tailed deer and beaver if significant habitat destruction is observed.

Monitoring Elements

Conduct appropriate monitoring and survey programs, as funding and staffing permit, to measure our success with respect to our objectives. The results may trigger adjustments to management strategies, or a reevaluation or refinement of our objectives. Examples of monitoring or surveys that we may implement include:

1. Prevent new invasive species from becoming established within forested wetland habitat by utilizing Early Detection Rapid Response Techniques that detect newly established invasive species and immediately address those populations through the appropriate control measure. This strategy will incorporate a combination of plant identification and inventories, maintaining updates of new invasive species present in the region, as well as having knowledge of the appropriate management techniques prior to conducting control efforts.
2. Conduct amphibian and reptile inventories to obtain baseline information on species diversity and habitat utilization.
3. To evaluate habitat use and monitor overall diversity of anuran species, conduct call count surveys to evaluate vernal pool protection and management.
4. In early spring, identify and map areas of concentration of amphibians and vernal pools to ensure their conservation and protection.
5. Monitor habitat destruction of Canada goose, mute swan, and beaver, and work with USDA APHIS or other licensed agents to control these species as necessary to protect refuge resources.

To determine the effectiveness of white-tailed deer hunting program, evaluate regeneration of native trees, shrubs, and forbs by conducting vegetation surveys to gather information on species composition, abundance, and diversity.

Goal 4

Provide opportunities for compatible, high-quality, wildlife-dependent public uses.

Objective 4.1 Hunting

Expand hunting opportunities for deer and waterfowl hunters.

Rationale

Hunting in southern New Jersey is a traditional outdoor past time and is deeply rooted in our American heritage. A quality hunt program helps develop an appreciation for fish and wildlife. It is also a tool to assist in deer population control and habitat management efforts on the refuge.

Opportunities for public hunting are decreasing with increasing private land development. Refuge lands thus become increasingly important in the region as a place to engage in this activity.

We will strive to meet the following guiding principles for a refuge hunting program identified in new Service policy (605 FW 2)

- Manage wildlife populations consistent with Refuge System-specific management plans approved after 1997 and, to the extent practicable, State fish and wildlife conservation plans;
- Promote visitor understanding of and increase visitor appreciation for **America's natural resources**;
- Provide opportunities for quality recreational and educational experiences.
- Encourage participation in this tradition; and
- Minimize conflicts with visitors participating in other compatible wildlife-dependent recreational activities.

The refuge hunt program is implemented consistent with State regulations and additional refuge regulations stipulated in Code of Federal Regulations 50 (50 CFR). Included in our deer hunt plan objectives is the intent to maintain the deer population at a level commensurate with available habitat, in order to maintain the health of the herd, and prevent habitat degradation that accompanies overpopulation. Included in our waterfowl hunt plan objectives is the intent to provide opportunities for compatible wildlife-dependent recreation as required by the National Wildlife Refuge Improvement Act of 1997, permit use of a sustainable natural resource, and permit hunting as a management strategy to meet state, flyway, and national population goals for non-migratory Canada goose and greater snow goose populations.

Our current deer hunt program is archery-only. Our deer and waterfowl hunts follow State seasons. In general, we believe the extent of our current programs meets the needs of our public and provides a quality experience. However, we will continue to evaluate the programs on an annual basis and modify them, as warranted, given new biological or visitor data.

The refuge will rely on State hunting regulations to define hunting safety zones. We believe that State regulations are adequate for ensuring safety. Since the refuge owns a limited amount of upland habitat, this will allow safe hunting on additional lands inhabited by deer. To be consistent with State regulations and management actions at Cape May NWR (which is in the same state and under the same refuge manager) we will not post or maintain signs marking safety areas. To address risks of trespass onto neighboring property, refuge staff will continue to post and maintain refuge boundary signs.

We are proposing some changes to the authorized hunting and fishing areas (map 4.2). The open water in the Tract 11 Impoundment will be closed to hunting as well as all other public use. This will provide undisturbed habitat for waterfowl, while allowing public use in the upland portion of this area, which was previously only open to hunters.

Portions of the Supawna Meadows NWR were designated, acquired, reserved, or set apart as an inviolate sanctuary; therefore, we may only allow hunting of migratory game birds on no more than 40 percent of the refuge. The waterfowl hunting zone will be reconfigured and 1,206 acres will be open to waterfowl hunting. During scoping meetings, the NJDFW asked the refuge to open tidal streams with a 150-foot buffer to allow hunting from the marsh habitat. In order to protect resources of concern while allowing adequate hunting areas, a new waterfowl hunting zone was delineated.

Providing new hunting opportunities on Tract 48 (AID) and any other new properties will be accomplished by updating the 2006 White-Tailed Deer Hunt Management Plan and the 2000 Waterfowl Hunting Plan and conducting additional NEPA analysis.

Strategies

1. Continue deer and waterfowl hunting on the refuge according to State regulations. Only archery deer hunting is allowed on the refuge for all four of New Jersey's bow hunting seasons according to the State Deer Management Zone 63 regulations.
2. Monitor the deer population and its effects on refuge habitats. If the herd needs to be further culled, work with the State to offer a doe-first season, a firearms season, or another method for taking more deer off the refuge. Continue to keep the upland areas of Tract 11 Impoundment open to archery deer hunting according to State seasons. The open water habitat and dike around the open water will be closed to hunters.

3. Remove hunting closure signage; rely on State hunting regulations to define hunting safety zones.
4. Reconfigure the waterfowl hunting zone so that 1,206 acres will be open to hunting. Access will be from the water. No blinds will be allowed to be built on the marsh.
5. Within 3 years of completing the final CCP, conduct additional NEPA analysis to open Tract 48 (AID) property, and any other new properties as identified in the CCP, to deer and waterfowl hunting.

Objective 4.2 Fishing and Crabbing

Expand fishing and crabbing opportunities for the public.

Rationale

Fishing and crabbing are popular recreational activities along the Delaware Estuary and Salem River shorelines, and the refuge can be accessed by an extensive series of tidal channels that support both activities. Fishing and crabbing have been historical, consumptive recreational uses on the refuge that we believe are compatible with our resource objectives.

We will strive to meet these guiding principles for a refuge recreational fishing program identified in Service policy (605 FW3 and 4):

- Effectively maintain healthy and diverse fish communities and aquatic ecosystems through the use of scientific management techniques.
- Promote visitor understanding of, and increase visitor appreciation for, **America's natural resources.**
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality as defined in 605 FW 1.6.
- **Encourage participation in this tradition deeply rooted in America's natural heritage and conservation history.**
- Minimize conflicts with visitors participating in other compatible wildlife-dependent activities.

In 2009, approximately 750 fishing and crabbing visits were made to the refuge; however, this number tends to fluctuate with the quality and availability of crabbing. We believe that onsite staff and additional funding will allow us to expand fishing and crabbing on the refuge.

In order to protect resources of concern and set aside 60 percent of the refuge as an inviolate sanctuary to wildlife, fishing and crabbing will occur in the same areas as waterfowl hunting so as to keep the sanctuary areas free of disturbance from fishing and hunting. Also, we will open Tract 11D Xmas Tree Lane impoundment (XTL) to freshwater fishing and conduct additional NEPA analysis, as needed, within 1 year of the final CCP. This will be the only freshwater fishing site available at Supawna Meadows NWR. Finally, we will prohibit fishing at Lighthouse Road due to safety concerns, such as the lack of parking and the lack of suitable habitat for bank fishing.

We will open fishing and crabbing opportunities on Tract 48 (AID), and any other new areas as identified in this CCP, within 3 years of the adoption of this final CCP and only after updating the 2000 Sport Fishing Plan and conducting any additional NEPA analysis.

Strategies

1. Rezone fishing and crabbing to coincide with waterfowl hunting areas. Conduct additional NEPA analysis, as needed, within 3 years of the final CCP. Areas open for saltwater fishing and crabbing will be open in accordance with State regulations. Open Tract 11D XTL impoundment to freshwater fishing and conduct NEPA analysis within 1 year of final CCP.
2. Close fishing at Tract 11D Lighthouse Road impoundment because of safety hazards associated with access.
3. Continue to host the one-day refuge youth fishing event at the Tract 18 impoundment. Seek assistance from the Friends and/or volunteers.

Objective 4.3 Wildlife Observation, Photography and Interpretation

Expand wildlife observation, photography, and interpretation opportunities.

Rationale

The refuge's Public Use Plan was approved on August 3, 2000. It states that through the public use program, visitors and local residents will be introduced to the role of the Service as a land management agency. Visitors will be encouraged to visit and learn more about other Service field areas, including refuges in New Jersey, Pennsylvania, and Delaware. Visitors will be introduced to the basic concepts of wildlife management and sustainable public use of natural resources. The public use program will be used to increase visitor understanding of refuge

management objectives and programs and to foster support for fulfilling its mandated mission.

We will strive to meet these guiding principles for refuge wildlife observation and photography programs identified in Service policy (605 FW 4 & 5):

- Provide safe, enjoyable, and accessible wildlife viewing and photography opportunities and facilities.
- Promote visitor understanding of, and increase visitor appreciation for, America's natural resources.
- Provide opportunities for quality recreational and educational experiences consistent with criteria describing quality found in 605 FW 1.6.
- Minimize conflicts with visitors participating in other compatible wildlife-dependent recreation activities.

While our primary mission is to protect wildlife and promote wildlife conservation, the 1997 Refuge Improvement Act directs us to provide six priority wildlife-dependent recreational uses in the Refuge System: hunting, fishing, wildlife observation and photography, and environmental education and interpretation where it is compatible. By providing the public with safe, accessible quality opportunities and well-maintained facilities for those uses, we hope to raise public awareness, understanding, appreciation, and stewardship of the Delaware Estuary ecosystem and the benefits of its conservation for fish, wildlife, and people. Ultimately, these will contribute to the mission of the refuge and the Refuge System. Wildlife observation, photography, and interpretation are major public uses of the refuge throughout the year. Over 15,000 people visit the refuge each year and, given our informal monitoring, most come to the refuge on the land side to view and photograph wildlife. Maintaining quality infrastructure and providing some new facilities will enhance visitor opportunities to view the relationships among resource management, wildlife, habitat, and people. Our facilities for public visitation include parking, information kiosks, nature trails, photo blinds, boardwalks, and interpretive literature/signs.

We will work with partners to facilitate quality wildlife observation and photography opportunities. The boat trail will be eliminated since all of the tidal

creeks are open to public use and there is no need to highlight a specific area for boating. Upland habitat surrounding the Tract 11 impoundment will be opened to the public to permit viewing of this habitat. An observation platform will be constructed so visitors could also view the open water in the impoundment without disturbing the wildlife that utilize the impoundment.

We will open Tract 48 (AID) property to wildlife observation within 3 years of completing the final CCP. This may require additional NEPA analysis.

Strategies

1. Continue to provide wildlife viewing, photography, and interpretation opportunities along existing refuge trails.
2. Continue to provide interpretive signs at all existing refuge public use sites, including the family plot cemetery along the Grassland Trail.
3. Improve the observation blinds along the Grassland Trail.
4. Continue to seasonally close bald eagle area.
5. Install/upgrade signs along Highway 49 directing motorists to the refuge.
6. Consider extending the current trail system onto newly acquired lands and providing observation blinds along new trails. Conduct additional NEPA analysis as necessary.
7. Expand refuge boundary signage on newly acquired lands.
8. Develop new brochures specific to trails.
9. Update Web site.
10. Construct a spur trail from the Grassland Trail into the wetland, with help from the Friends group if needed.
11. Eliminate the designation of a boat trail and remove trail markers, but continue to allow public boat access in the tidal streams.
12. Improve or install additional observation facilities on the refuge, for example:
 - Install an observation platform for wildlife observation and photography at the impoundment at Tract 11 and upgrade the nearby grassy parking area to accommodate 8 to 10 vehicles. The open water portion of the Tract 11 impoundment and the dike surrounding the open water will remain closed to the public all year. Gates will be installed to define the closed area.
 - Construct a wheelchair accessible photo-blind and other amenities to improve facilities for wildlife photographers at the Grassland Trail.
13. Construct a trail linking the FPRRL site to the Grassland Trail to connect visitors to wildlife viewing areas.
14. Use FPRRL to expand opportunities for refuge interpretation with panels and brochures on ground level and in the interior of FPRRL, if approved by SHPO. Take advantage of landscape view from FPRRL to interpret refuge marshlands, invasive plants, and a mosaic of other cover types as well as viewing birds in flight on the refuge.
15. Work with a neighboring private landowner to enhance viewing opportunities at the Sinnickson Landing boat ramp site for eagle viewing.
16. Seek year-round local New Jersey residents for volunteer-based interpretative programs.

Open Tract 48 (AID) property to wildlife observation, photography, and interpretation within 1 year of completing the final CCP. Conduct additional NEPA analysis as necessary.

Objective 4.4
Environmental Education
and Outreach

Expand and enhance environmental education and outreach programs.

Rationale

The refuge offers a unique opportunity to explore, in close proximity, tidal and non-tidal wetlands, grassland, and forested habitats, as well as to learn about managing those landscapes to benefit wildlife. We believe we can facilitate other educators to use the refuge and offer excellent environmental education opportunities without expending significant refuge staff or funding resources.

County school districts at other refuges in the region have curricula that include field trips to the refuge for elementary grade students. In recent years, no staff has been available to assist at Supawna Meadows NWR for these types of visits. Development of environmental education lessons tailored to State curricula will provide programs and activities for schools and other groups while increasing public understanding of wildlife needs, ecosystems, conservation, and habitat management for wildlife. Using our educational partners to assist in this endeavor has many benefits. These partners also act as supporters of the refuge and natural resource conservation, advocates for environmental education, and help us conduct outreach to the local community.

Service policy identifies six guidelines on which to base environmental educational programs. These guidelines include connecting people's lives to the natural world, strengthening conservation literacy and knowledge, stressing the role of the Refuge System in conservation, and instilling a sense of stewardship and understanding of our conservation history.

In order to build a stronger base of public understanding, support, and activism beyond the portion of the American public who visit refuges, the Service has actively supported nationwide strategies, partnerships, legislation, and departmental mandates with a strong emphasis on community outreach. These include the 100-On-100 Outreach Campaign, the National Outreach Strategy: A Master Plan for Communicating in the U.S. Fish and Wildlife Service, the Cooperative Alliance for Refuge Enhancement (CARE), the Volunteer and Community Partnership Act, and the Challenge Cost-Share Program.

We are particularly interested in outreach to the local communities in Salem County. Our desire is to be a welcomed and valued asset to these communities. A positive community relationship is a crucial link between public support for refuges and effective management of the Refuge System. We are aware that there are many residents who either do not know that a national wildlife refuge is nearby or do not recognize its regional importance to the Delaware Estuary ecosystem.

We are striving for a well-rounded program of public outreach to enable large and diverse segments of the public to learn about the importance of refuge wetland and upland habitats, species of conservation concern, cultural resources, refuge management, and the refuge's role in the Refuge System. An effective public outreach program can also help win friends and proactively deal with controversial refuge management activities. Outreach can be used to anticipate and avoid potential conflicts between the needs of wildlife and other refuge uses.

We believe that regular communications within the community are very important. News articles and personal appearances inform our neighbors about what we are doing and why, which will lead to increased understanding, appreciation, and support of our programs. Feedback we will receive from these

outreach efforts allows us to better understand issues that are important in our communities and how our management may affect them.

We also believe that actively engaging people in meaningful refuge programs or projects will make a more lasting impression. We will offer many opportunities for people to get involved. Partners, volunteers, and members of the Friends of Supawna Meadows NWR are vital to accomplishing our outreach activities. They will assist us in community events and refuge visitor programs as well as support data gathering and maintenance projects. This assistance will support us in meeting the refuge's goals and objectives, supporting the missions of the Refuge System and the Service, and fostering good community relationships.

Visitors will be introduced to the concept of ecosystem management and the role of the refuge in the Delaware River and Bay Ecosystem. The Visitor Services program will be used to enhance local interest in wildlife and to increase understanding of the social and economic benefits that wildlife and open space bring to the area.

Strategies

1. Actively work with schools and other organizations to develop and encourage onsite programs.
2. Refuge staff will actively participate in off-site outreach activities.
3. Expand volunteer base and Friends group programs.
4. Open Tract 48 (AID) property to environmental education and outreach within 3 years of completing the final CCP. Conduct additional NEPA analysis as necessary.

Goal 5

Protect cultural resources on the refuge.

Objective 5.1: Finns Point Rear Range Light

Maintain and protect Finns Point Rear Range Light.

Rationale

We believe it will become feasible and beneficial to retain ownership of the FPRRL and to integrate it into the interpretive program for the refuge. As mentioned in chapter 2, FPRRL is on the National Register of Historic Places and is well-known in the area as an historic resource of interest. It can receive substantial visitation.

Strategies

1. Continue to maintain the FPRRL in compliance with the National Historic Preservation Act.
2. Pursue expanding public access to and interpretative use of the FPRRL to promote refuge values.
3. Prioritize repair/restoration of the FPRRL in SAMMS in concert with recordation and demolition of other deteriorated structures on the refuge.
4. Consider entering an agreement with New Jersey Lighthouse Society (NJLHS) to assist the refuge in supporting the use of FPRRL and associated interpretative programs.
5. Coordinate with Friends of Supawna Meadows NWR to integrate history of FPRRL into interpretive programs.
6. Repair FPRRL catwalk to allow public access.
7. Incorporate history of FPRRL into staff-led interpretive programs.
8. Update FPRRL information and enhance interpretive signage.
9. With assistance from the NJLHS and Friends of Finns Point Lighthouse (FOFPL), seek to stabilize, protect, and interpret FPRRL lens, if possible, in the refuge office.

Objective 5.2 Other Cultural Resources	<p>Maintain and protect cultural sites and artifacts.</p> <p>Rationale Besides FPRRL, there are other cultural resources on the refuge, such as a family cemetery and the Yerkes farmstead. While not actually listed, New Jersey Historical Preservation Office staff determined that the Yerkes farmstead is eligible for listing on the National Register of Historic Places under the National Historic Preservation Act. There may be other historical or archaeological resources that come to light in the course of refuge management in the future. By law, we must consider the effects of our actions on archaeological and historic resources. Service-initiated actions likely to affect archaeological sites are routinely reviewed and assessed under the provisions of Section 106 of the NHPA. To date, projects requiring such review on the refuge have been confined to the location of facilities and impoundments. We will continue to comply with</p> <p>Section 106 of the NHPA before disturbing any ground. Refuge lands have never had a systematic archaeological survey in their entirety.</p> <p>Strategies</p> <ol style="list-style-type: none">1. Allow Friends of Supawna Meadows NWR to continue maintaining the family cemetery located on refuge lands.2. Hire a contractor to conduct a paleo-environmental review of the refuge. This review will include in-depth discussions of the refuge's archaeological sites and past history.
Goal 6	<p>Enhance refuge management through partnerships, friends, volunteers, and community outreach.</p> <p>Citizen involvement is critical to the well-being of the Refuge System and to the natural resources that depend on those lands. Working in partnership with other government agencies, academic institutions, organizations, and individuals is vital to our operations. When local citizens and other stakeholders of a refuge can see firsthand our conservation work, they become an informed constituency on behalf of conservation.</p> <p>Working in partnership with others also provides additional resources with which we can achieve our refuge goals and objectives. Our volunteers, Friends Group, and other conservation partners provide valuable assistance in accomplishing refuge projects in all our program areas.</p>
Objective 6.1: Refuge Partnerships	<p>Maintain active involvement in partnerships among all public land management agencies in South Jersey and the Lower Delaware River and Estuary to achieve refuge habitat and public use management objectives.</p> <p>Rationale Achieving refuge goals in many instances is feasible only through successful partnering with other agencies and groups.</p> <p>Strategies</p> <ol style="list-style-type: none">1. Communicate and coordinate regularly with the other agencies to discuss common goals, issues and concerns, share technical information, and identify opportunities for cooperative management with other agencies.2. Pursue formal Memorandum of Understanding/Memorandum of Agreements (MOU/MOA) and cooperative agreements with partnering agencies, where warranted, to facilitate sharing of resources and implementation of programs.3. Maintain the existing MOU with Salem County to share in law enforcement.

4. Evaluate opportunities for new partnerships with conservation organizations, educators, research and academic institutions, and other State and Federal agencies who share similar missions and goals.
5. With existing and future partners, make a greater effort to highlight our programs, opportunities, and successes through the use of media links (for example, Web sites) and the development of quality outreach materials that contain clear and consistent messages.

Objective 6.2
Refuge Friends Group

Enhance our relationship with the Friends of Supawna Meadows NWR to ensure we have a mutually beneficial working relationship and one that cooperatively promotes an appreciation of natural and cultural resource conservation and facilitates the implementation of priority refuge projects.

Rationale

There are over 50 Friends groups in the Northeast Region of the Service. These groups are private non-profit organizations formed and managed by local citizens to support the mission of a refuge and advocate for their local refuge and the National Wildlife Refuge System. The work these groups do is invaluable to our wildlife mission as well as the public activities that take place on refuges, fish hatcheries, and other Service stations.

Friends group members enjoy a variety of benefits depending on the group. Benefits include interacting with other people who share a common interest in wildlife and conservation, engaging in opportunities to learn more about refuge management and conservation practices, and notification of upcoming Friends and refuge events.

The Friends of Supawna Meadows NWR have been valuable supporters of the refuge purposes and the Refuge System mission. Many important programs and projects get accomplished each year through their hard work, dedication, and fundraising. Since many members live in the local community, they are also very effective in helping us conduct outreach about opportunities on the refuge and in providing us feedback from the community.

Strategies

1. Conduct monthly information and strategy meetings.
2. Contribute information to the **Friends' newsletter and Web site.**
3. **Support the Friends' efforts at sponsoring community events and programs.**
4. Encourage the Friends to work with other local citizens groups as an **extension of the refuge's community outreach program.**
5. Work with the Friends of Supawna Meadows NWR to seek outside support for refuge projects, develop public use programs, coordinate refuge projects, plan and conduct public events, conduct community outreach, promote national Service initiatives as they develop, and respond to public inquiries about the refuge.
6. Appoint a primary liaison between the Friends of Supawna Meadows NWR and the Service.
7. Provide resources, as needed, to help the Friends create and distribute their regular newsletter. Provide photographs illustrating habitat management and visitor services programs to include in the newsletter.
8. Work with the Friends of Supawna Meadows NWR on a regular basis to seek alternative funding sources and partnerships for various projects to benefit the refuge.

Objective 6.3
Refuge Volunteers

Encourage and facilitate an active, quality volunteer program that supports biological, maintenance, and visitor services priorities.

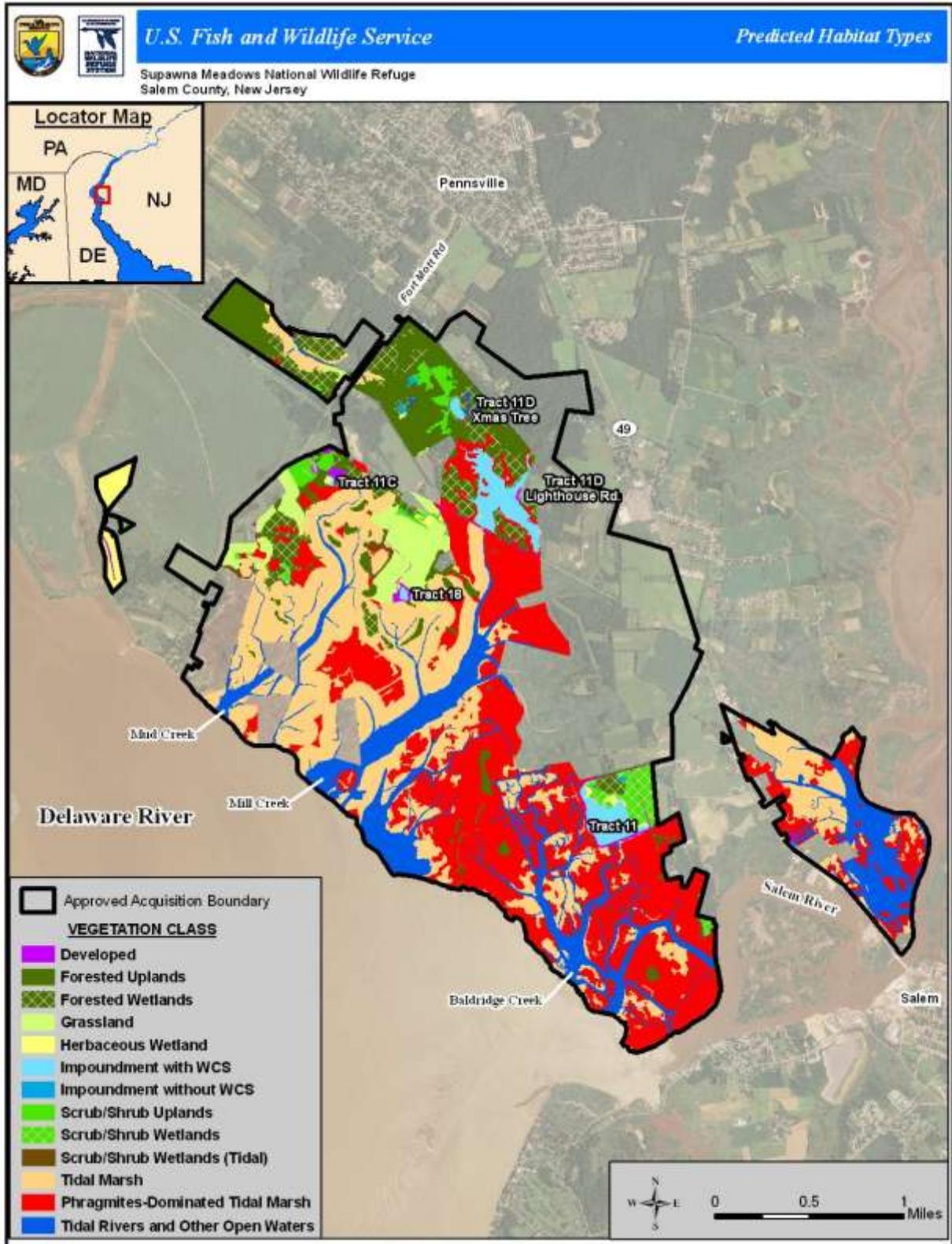
Rationale

The Fish and Wildlife Act of 1956, as amended by the Fish and Wildlife Improvement Act of 1978, and the National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act of 1988 authorize the Service to accept volunteer services. Volunteers help the Service in a variety of ways. Some work full-time, while others assist a few hours per week or month or during a special event. Many volunteers conduct fish and wildlife population surveys, band ducks, lead tours, provide information to school groups and other visitors, work on cultural resources projects, perform clerical and administrative duties, work with computers and other technical equipment, and much more.

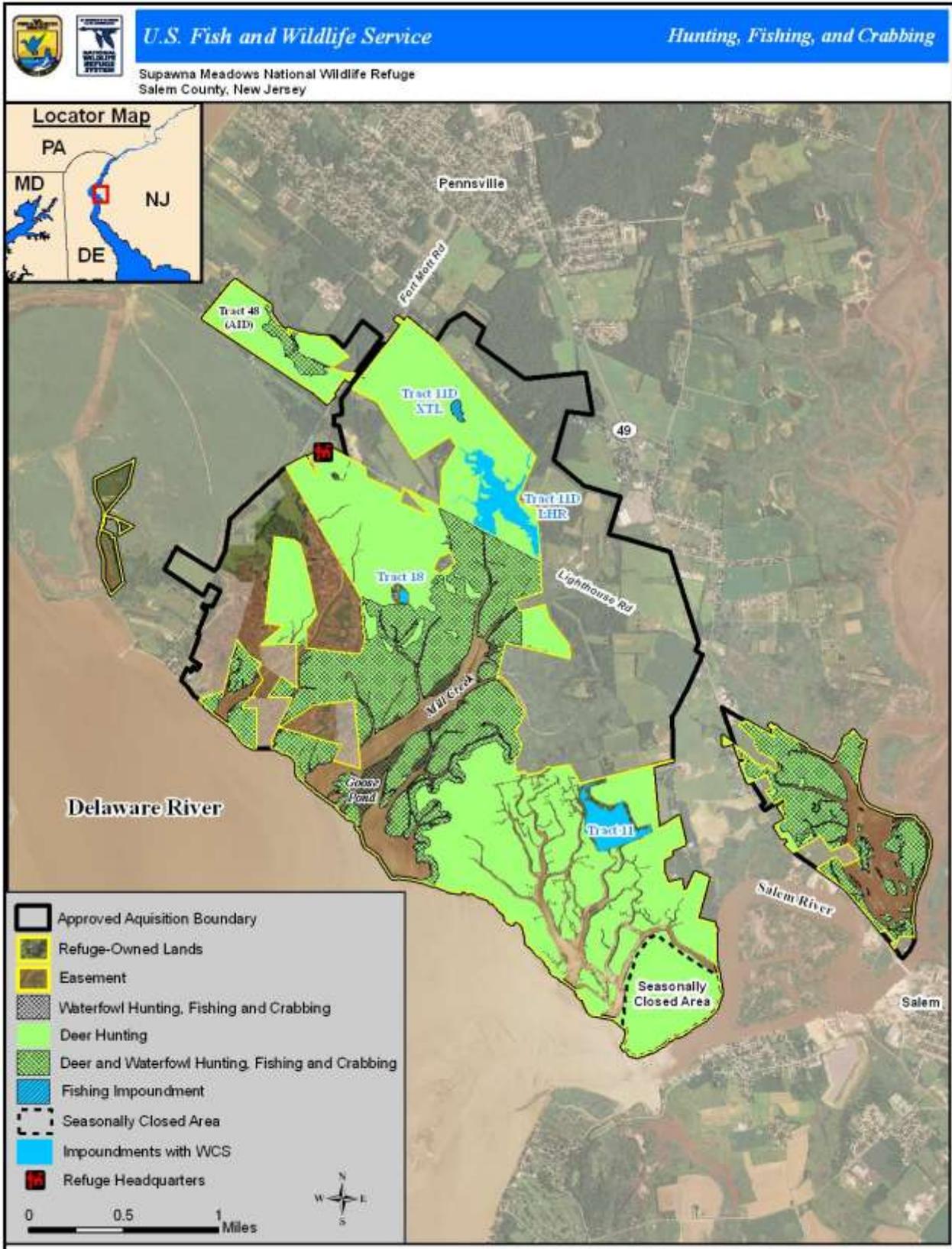
Volunteers are integrated into all aspects of refuge management including maintenance, habitat management, and visitor services and outreach programs. Their hard work and enthusiasm enhances which programs we can offer. In fact, many of the Service's visitor use programs at Supawna Meadows NWR are run by volunteers, thus making it feasible for the refuge to offer these programs at all.

Strategies

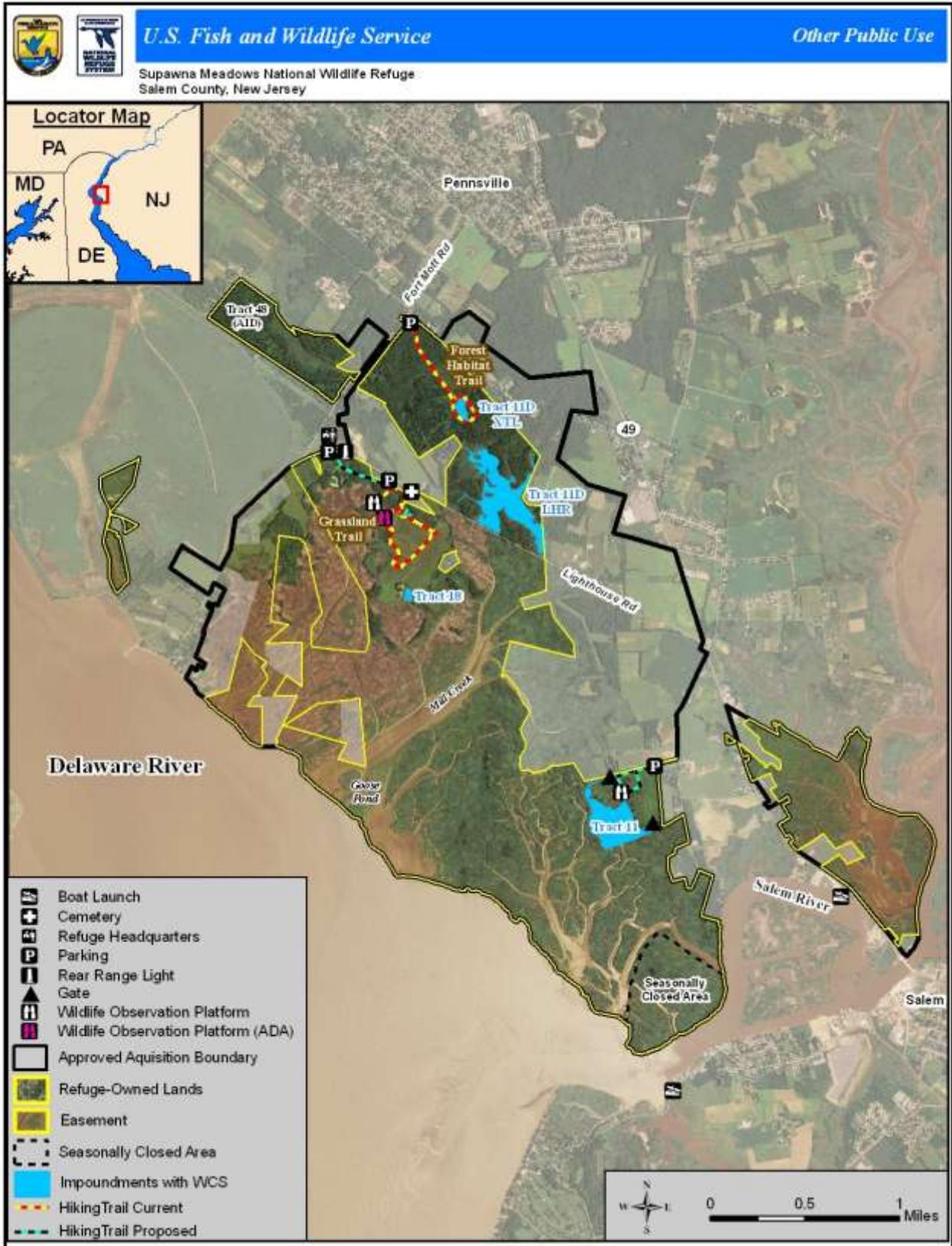
1. Actively recruit volunteers at events, through existing partners, the media, and the refuge Web site.
2. Develop and implement annual volunteer recruitment, training, and appreciation/recognition events.
3. Utilize volunteers in annual community events as deemed necessary and appropriate.
4. Utilize volunteers in meaningful refuge work, such as performing various biological surveys, assisting with maintenance, and visitor services activities.



Map 4.1. Predicted habitat types under proposed habitat management at Supawna Meadows National Wildlife Refuge. Map is for illustrative purposes only.



Map 4.2. Future hunting and fishing areas at Supawna Meadows National Wildlife Refuge.



Map 4.3. Current and proposed trails and other facilities for Supawna Meadows National Wildlife Refuge.

