

## Chapter 4



Duane Raver/USFWS

*Alewife*

# Management Direction and Implementation

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

## Introduction

This chapter begins with a description of the process we used to formulate the management direction and implementation for Great Bay Refuge and the Karner blue butterfly conservation easement. We then present those actions that are required by law or regulation, have been previously approved, or that help to achieve multiple refuge goals. We also identify decisions we are not making at this time and that will require additional NEPA analysis before a final decision can be made. We conclude with details on our goals, objectives, and strategies for managing the refuge. The array of management actions described are those that, in our professional judgment, will best achieve the refuge's purposes, vision, goals, and best respond to public issues. Goals 1 through 4 apply to Great Bay Refuge management, while goal 5 applies to the Karner blue butterfly conservation easement.

Refuge goals are intentionally broad, descriptive statements of the desired future condition of refuge resources. By design, they are less quantitative, and more prescriptive, in defining the targets of our 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. As noted in chapter 1, developing a strategic plan to achieve refuge goals is the purpose for developing the CCP.

Objectives are essentially incremental steps toward achieving a goal and 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 2004) recommends that objectives meet five criteria to be "SMART":

1. Specific
2. Measurable
3. Achievable
4. Results-oriented
5. Time-fixed

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

The strategies for each objective are the specific or combined actions, tools, and techniques we may use to achieve an objective. The list of strategies under each objective represents the potential suite of actions that we may implement. We will further evaluate most of the strategies in refuge step-down plans, such as the HMP and Visitor Services Plan, as to how, when, and where they should be implemented.

For most objectives we also identified monitoring components. Monitoring will help us measure our success toward meeting the objectives.

## Overview of Great Bay Refuge Management

It is important to reemphasize that CCPs provide long-term guidance for management decisions through goals, objectives, and strategies. They represent our best estimate of future needs. This CCP details program levels and activities that are substantially above current budget allocations and, as such, should be viewed as strategic in nature. Our budgets are determined annually by Congress, and distributed through our Washington and Regional Offices, before arriving at field stations. In summary, the actions proposed in this CCP represent our strategic vision for the future. Final CCPs do not constitute a Service commitment for staffing increases, or funding for operations, maintenance, or future land acquisition. Implementation must be adjusted annually given the reality of budgets, staffing, and unforeseen critical priorities.

Our highest priority is the management of specific refuge habitats to support focal species whose habitat needs benefit other species of conservation concern that are found around Great Bay and in the larger landscape of coastal New Hampshire. In particular, we emphasize habitat for priority birds identified in BCR 30 such as migratory waterfowl, waterbirds, forest-dependent songbirds, shrubland species, and estuarine species of concern including oysters and eelgrass that are indicators of ecosystem health.



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Woodman Point

Along the Peverly Brook stream, we plan to conduct activities to enhance water quality, improve habitat for migratory fish, and maintain habitat for waterfowl, marsh birds, and other aquatic species. Specifically, we will remove the Lower Peverly Pond Dam to create stream habitat, while maintaining the dams at Upper Peverly Pond and Stubbs

Pond to benefit a range of fish and wildlife. We believe that this combination of maintaining the largest freshwater impoundments and restoring a stretch of stream habitat enhances our contribution to protecting the diversity resources of concern in the Great Bay Estuary. In addition, the plan addresses ongoing concerns of contaminant levels in the sediments within Upper Peverly Pond caused by previous land uses. We will expand our conservation, research, and management partnerships to help restore and conserve the Great Bay estuarine ecosystem and to address emerging issues, including climate change and landscape-scale conservation.

Under this plan, we will manage approximately half of the former Weapons Storage Area as shrubland as a possible location for establishing a captive breeding program for New England cottontail, a Federal candidate species. We will manage the other half as grassland to provide nesting habitat for upland sandpipers and other grassland species of conservation concern. We will also evaluate the underground bunkers for their potential as bat hibernacula.

We will enhance our visitor services programs, which have been limited under current management due to lack of staff. For example, we will enhance the entrance to the refuge, create new interpretive materials, expand on an existing quality volunteer program, offer visitors more opportunities to learn about the refuge and the surrounding environs, and evaluate an expansion of hunting opportunities to include wild turkey and a fall bow deer season. These expanded programs will be possible through the proposed increased staffing and new refuge headquarters/visitor contact facility.

On the Karner blue butterfly conservation easement, we will enhance our partnership with NHFG to manage habitat in support of recovery of this species. In particular, we will continue to support the captive-rearing program and management of pine barrens habitat. We will also enhance interpretive opportunities by installing new interpretive signs, offering guided interpretive walks, and enhancing our Web-based information.

The habitat types that will result on the refuge under this plan are depicted on map 4.1. Maps 4.2 and 4.3 show refuge infrastructure and facilities, including those that will support the refuge's public use program. Map 4.4 shows how we will manage the Karner blue butterfly conservation easement under this plan.

Map 4.1. Planned Habitat Management for Great Bay National Wildlife Refuge



Map 4.2. Existing and Planned Public Use at Great Bay National Wildlife Refuge



Map 4.3. Public Use Facilities and Refuge Infrastructure at Great Bay National Wildlife Refuge



Map 4.4. Existing and Planned Trails at Karner Blue Butterfly Conservation Easement



## General Refuge Management

There are some actions we propose to take in managing Great Bay Refuge over the next 15 years that are required by law or policy, or represent actions that have undergone previous NEPA analysis, public review, agency review, and approval. Others may be administrative actions that do not necessarily require public review, but we want to highlight in this public document. They may also be actions we believe are critical to achieving the refuge's purpose, vision, and apply to multiple refuge goals.

All of the following actions, which we discuss in more detail below, are current practices or policies that will continue:

- Using an adaptive management approach, where appropriate.
- Reducing impacts from climate change.
- Developing refuge step-down plans.
- Providing refuge staffing, facilities, and administration.
- Protecting the rocky shore.
- Recognizing special designations.
- Managing invasive species.
- Protecting cultural resources.
- Distributing refuge revenue sharing payments.
- Findings of appropriateness and compatibility determinations.
- Issuing special use permits.
- Conducting additional NEPA analysis when required.
- Consulting with other Federal and State agencies.
- Evaluating land protection focus areas.

## Adaptive Management

We will employ an adaptive management approach for improving resource management by better understanding ecological systems through iterative learning. In 2007, Secretary of Interior Dirk Kempthorne issued Secretarial Order No. 3270, "Adaptive Management" (dated March 9, 2007) to provide guidance on policy and procedures for using adaptive management in Department of Interior agencies. In response to that order, an intradepartmental working group developed a guidebook to assist managers and practitioners, "Adaptive Management: The U.S. Department of Interior, Technical Guide." It defines adaptive management, the conditions under which we should consider it, the process for implementing it, and evaluating its effectiveness (Williams et al. 2007). You may view the guidebook at: <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html> (accessed May 2011).

The guidebook provides the following definition for adaptive management:

"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. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

This definition gives special emphasis to the uncertainty about management impacts, iterative learning to reduce uncertainty, and improved management as a result of continuous learning. This approach recognizes that we can never achieve perfect understanding of the natural world and that we must implement management in the face of uncertainty. At the refuge level, adaptive management

is an integral part of management planning, research design, and monitoring. Uncertainties about ecological systems are addressed through targeted monitoring of resource response to management actions and predictive models that mimic the function of the natural world.

Adaptive management gives the refuge manager flexibility to adjust management action or strategies if they do not meet goals or objectives. Significant changes from what we present in this final CCP may warrant additional NEPA analysis and public comment. Minor changes will not, but we will document them in our project evaluation or annual reports. Examples of management activities discussed in this CCP that may require an adaptive management approach include actions related to New England cottontail captive rearing and bat hibernacula in bunkers in the former Weapons Storage Area, management of shrubland and impoundments, and stream restoration.

Implementing an adaptive management approach supports all refuge goals. Furthermore, adaptive management is all the more compelling in light of climate change concerns.

## Climate Change

There is consensus among the scientific community that global climate change, occurring in part as a result of emissions of carbon dioxide and other greenhouse gases from human activities, will lead to significant impacts across the U.S and the world (Joint Science Academies' Statement 2005, <http://www.nationalacademies.org/onpi/06072005.pdf>, accessed May 2011). This includes sea level rise adding stress to coastal communities and ecosystems (Wigley 2004). The effect of climate change on wildlife and habitats is expected to be variable and species-specific, with a predicted general trend of species ranges and vegetation communities shifting northward and higher in elevation.

Uncertainty about the future effects of climate change requires refuge managers to use adaptive management to maintain healthy ecosystems in light of unpredictability (Inkley et al. 2004). This involves improving or adjusting policies and practices based on the outcomes of climate change and other monitoring or management activities and may result in changes to regulations, shifts in active habitat management, or changes in management objectives. A few recommendations include (see Inkley et al. 2004 for more recommendations):

- Preparing for diverse and extreme weather conditions (e.g., drought and flood).
- Maintaining or restoring healthy, connected, and genetically diverse wildlife populations to increase resiliency in wildlife and habitats.
- Protecting coastal habitats to accommodate marsh migration in response to sea level rise.

GBNERR and the Great Bay Stewards were awarded a grant to study climate change impacts in the Great Bay Estuary in 2010. We used results from this study to inform our management direction and to support Great Bay Stewards in community outreach efforts aimed at reducing human activities that impact wildlife or habitat migration. We will also pursue the following strategies to reduce our greenhouse gas emissions and help reduce our impact on climate change:

- Support community proposals to develop a regional bike trail. The proposal includes linking a regional trail to the entrance road to the refuge, allowing visitors to reach the refuge using alternative transportation. However, bicycling off-road is not allowed on the refuge.



Greg Thompson/USFWS

*Beaver pond on the refuge*

- Reduce the carbon footprint of facilities, vehicles, workforce, and operations. Some examples include:
  - \* Use energy efficient equipment, where feasible.
  - \* Maintain buildings using sustainable, green building technologies.
  - \* Conduct an energy audit by 2014.

We will help implement the Service's Climate Change Strategic Plan and work with our State and other conservation partners on mitigating and adapting to this conservation challenge. We describe that strategic plan and other important Service guidance on climate change in chapter 1.

## Step-down Plans

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. We have identified the following plans listed below as the most relevant to this planning process, and have prioritized their completion. Sections of the refuge HMP which require public review are presented within this document and will be incorporated into the final version of the HMP immediately upon CCP approval. The highest priority step-down plans to complete are the HMP, the Annual Habitat Work Plan (AHWP), and the Inventory and Monitoring Plan (IMP). These are described in more detail below. They will be modified and updated as new information is obtained so we can continue to keep them relevant.

The following step-down plans are completed for the refuge and are incorporated by reference into the CCP:

- Chronic Wasting Disease Plan (2008).
- Avian Influenza Disease Contingency Plan (2006).
- Fishery Management Plan (1994).
- Hunt Plan (1993).

We will schedule the completion of the following step-down management plans as shown.

- An HMP, within 1 year of CCP approval (see discussions below on HMP and NEPA requirements; an AHWP will also be generated each year habitat management actions are planned).
- An IMP, within 5 to 10 years of CCP approval (see discussion below).
- A Visitor Services Plan, within 3 years of CCP approval.
- A Law Enforcement Plan, within 3 years of CCP approval.
- A Facilities and Sign Plan, within 3 years of CCP approval.
- An updated Fire Management Plan (FMP), rewritten and completed by 2013.

### Habitat Management Plan

A HMP for the refuge is the requisite first step to achieving the objectives of goals 1, 2, and 5. The HMP will provide more details on the habitat management strategies we will use to accomplish CCP goals and objectives over the next 15 years. In particular, the HMP will detail the specific areas and habitat types we will manage for, as well as the tools and techniques we will use and the timing of our management actions. Additional analysis of the impacts of specific methods may be necessary. The HMP will also incorporate the results of appendix B, which identifies how we derived focal species and habitats for the refuge.

In this CCP, the goals, objectives, and strategies identify how we intend to manage habitats on the refuge. Both the CCP and HMP are based on current resource information, published research, and our own field experiences. Our methods, timing, and techniques will be updated as new, credible information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major vegetation changes on at least a 5-year basis.

#### **Annual Habitat Work Plan**

The AHWP is generated each year from the HMP, and outlines specific management activities to occur in that year. It will detail the tools, techniques, timing of management actions and their specific locations. These plans are also vital for implementing habitat management actions and measuring our success in meeting the objectives.

#### **Inventory and Monitoring Plan**

The IMP will outline and prioritize inventorying and monitoring activities for the refuge. We will use our inventory and monitoring program to assess whether our original assumptions and proposed management actions are supporting our habitat and species objectives. The results of inventories and monitoring will provide us with more information on the status of our natural resources and allow us to make more informed management decisions. The Service's Inventory and Monitoring Policy is currently in draft form, and national and regional staff are currently developing a new template for IMPs. We will incorporate recommendations from the "Strategic Plan for Inventories and Monitoring on National Wildlife Refuges: Adapting to Environmental Change" (USFWS 2010) to ensure a coordinated approach to inventory and monitoring across refuges. The IMP also incorporates the monitoring elements identified under each of the biological objectives.

#### **Visitor Services Plan**

The Visitor Services Plan will build off the visitor services goals, objectives, and strategies included in the CCP. This plan will provide more detailed information on the current visitor services programs; future offerings, programming, and facilities; target audiences; and how we will monitor and evaluate the quality and success of our visitor services programs. It will also identify essential staffing and funding needs, refuge law enforcement needs, and partnerships needed to support the refuge's visitor services programs.

#### **Law Enforcement Plan**

The Law Enforcement Plan provides a detailed assessment of the refuge's law enforcement program and how this program relates to refuge purposes, objectives, and other refuge programs. It will also analyze existing and predicted future law enforcement issues and needs, including staffing, and identify opportunities to cooperate with other law enforcement entities.

#### **Facilities and Sign Plan**

This plan will detail the maintenance of existing facilities and signs, as well as the design and placement of new facilities and signs on the refuge.

#### **Fire Management Plan**

According to Service fire policy, all FMPs should be reviewed annually and updated with current information. Great Bay Refuge's FMP is currently being rewritten and will be completed in 2013.

## Refuge Staffing, Facilities, and Administration

### Staffing and Operational Budgets

Staffing and operations and maintenance funds over the last 5 years are presented in chapter 3. Our objective is to sustain annual funding levels that allow us to achieve our refuge goals, objectives, and strategies. The lack of staff over the last 3 years has limited our capability to conduct priority work, such as major maintenance projects, biological inventory and monitoring, outreach, and public use programs. We will seek to fill the following four approved, but vacant, staff positions which we believe are needed to accomplish our highest priority projects:

1. Assistant refuge manager.
2. Refuge wildlife biologist.
3. Visitor services specialist.
4. Maintenance worker.

If funding is not available, we will continue to seek alternative means of accomplishing our projects, for example through our volunteer program, challenge cost share grants, other partnership grants, or internships.

### Facility Construction and Maintenance

The existing refuge office does not have enough space to serve as both an administrative office and visitor contact station, given our anticipated needs over the next 15 years. Expanding visitor services and resource management will require additional space for both staff and visitors.

To accommodate increases in staff, we propose to construct a new administration/visitor contact facility. We will build the facility in an already disturbed area in the former Weapons Storage Area. The new energy-efficient building will be approximately 7,000 square feet and follow the Service's standard design for a small building and visitor contact facility (see appendix J). The new facility will have space for the four proposed positions. The facility will also have space for two Wapack Refuge staff and a shared refuge law enforcement officer for Parker River, Great Bay, and Wapack Refuges. Finally, it will continue to provide office space for up to four regional office staff.

We also propose to build a separate new maintenance facility, given problems with the existing facility. The existing maintenance area is poorly sited and flooding has been a problem.

### Strategies:

- Relocate the recreational vehicle (RV) pad, used by volunteers as housing, from its present location at the Caretakers Cottage to across from staff residence (at former kennel area); and increase number of power connections.
- Construct maintenance and storage building in a new location.
- Construct a new headquarters/visitor contact station (in the former Weapons Storage Area east of the existing office) to house and support approximately 11 existing and proposed staff positions, as well as seasonal positions.
- Convert all Service roads beyond the residence and maintenance shop from pavement to a more permeable surface, such as gravel.
- Remove existing headquarters building.
- Convert existing shop to storage area.

We will continue to maintain and renovate existing facilities to ensure the safety and accessibility for staff and visitors. Our current facilities are described in chapter 3.

### **Refuge Operating Hours**

We will open the refuge for public use from sunrise to sunset, 7 days a week, with a priority to ensure visitor safety and protect refuge resources. However, the refuge manager does have the authority to issue a special use permit to allow access outside these timeframes. For example, researchers or hunters may be permitted access at different times or in areas that may not be open to the general public. The refuge manager may also permit organized groups to conduct nocturnal activities, wildlife observation, environmental education, and interpretive programs. The Great Bay Refuge office is currently closed to the public because the refuge is unstaffed. The office will remain closed to the public until staff positions are filled.

### **Protecting the Rocky Shore**

Great Bay Refuge has about 2 acres of rocky shoreline near Woodman Point, Thomas Point, and on Nannie Island. This habitat type is important for many bird species of conservation concern, including bald eagles, and we will continue maintain these areas as undisturbed habitat for these species. In particular, Woodman Point is an important roost site for bald eagles wintering on Great Bay.

In April 2011, a new, active bald eagle nest was discovered on Fabyan Point. This is the first bald eagle nest for the refuge. While this nest is not in rocky shore habitat, the bald eagles nesting here will likely use the refuge's shoreline habitat for roosting and perching sites while foraging. Due to the location of the nest site, no management actions have been necessary to restrict public use or access. The only change we have made is to place a gate across the top of Fabyan Point Road, which was already closed to public access. The gate was installed to provide further protection from trespassers who might disturb the nesting pair.

We will continue to implement the following strategies:

- Evaluate the importance of Nannie Island and surrounding waters to migratory birds and other Federal trust resources to determine if the island should remain closed to public access or open for recreation or education purposes.
- Monitor the wintering and nesting bald eagle population on and around the refuge.

### **Special Designations**

#### **Marine Protected Areas**

All coastal national wildlife refuges are part of the national system of marine protected areas (MPA). The goal of the MPA program is to conserve the nation's natural and cultural marine heritage and to ensure the sustainable production of marine resources. Specifically, Great Bay Refuge will continue to support the following MPA conservation objectives:

- Provide reproductive and nursery grounds and foraging areas for fish and shellfish.
- Support areas for migratory birds.
- Provide linked areas important to life histories of marine organisms.
- Offer compatible opportunities for education and research.

## Invasive Species Management

The Service identifies an “invasive species” as a species that is nonnative to an ecosystem, and whose introduction causes, or is likely to cause, harm to the economy, environment, or human health (Executive Order 13112).

The unchecked spread of invasive plants threatens the biological diversity, integrity, and environmental health of all refuge habitats. In many cases, invasive species outcompete native species and become the dominant cover. This reduces the availability of native plants as food and cover for native wildlife. Over the past several decades, government agencies, conservation organizations, and the public have become more aware of the negative effects of invasive species. One report estimated the economic cost of invasive species in the U.S. at \$137 billion every year (Pimentel et al. 2000). Up to 46 percent of the plants and animals federally listed as threatened and endangered have been negatively impacted by invasive species (Wilcove et al. 1998, National Invasive Species Council 2001).

The Service’s Northeast Region initiated an effort to systematically identify, locate, and map invasive plant species occurring on refuge lands leading to an effective integrated management plan. Great Bay Refuge initiated a baseline inventory and mapping of invasive species in 2002. Field surveys during 2002 to 2010 detected 34 invasive species (see table 3.13 in chapter 3). The Refuge will use this information to guide the development of monitoring, control, and eradication projects. When control is deemed necessary, the refuge will use the most effective combinations of mechanical, biological, and chemical controls to achieve long-term control or eradication. Only herbicides approved by the regional contaminants coordinator will be used, and only in accordance with approved rate and timing of application.

Great Bay Refuge is also part of CWIPP, a partnership among 11 agencies and organizations formed in 2008 to address the effects of invasive plants across jurisdictional boundaries. The CWIPP signatories agreed that it was to their mutual benefit and interest to work cooperatively to inventory, monitor, control, and prevent the spread of invasive plants across jurisdictional boundaries within New Hampshire’s coastal watershed. The goal through this cooperative effort is to achieve better management of invasive plants while improving working relationships between the signatories and the public. Great Bay Refuge, although not a signatory to CWIPP, is a “sustaining partner.” Sustaining partners are organizations or agencies with a significant interest in the success of the partnership (<http://des.nh.gov/organization/divisions/water/wmb/coastal/cwipp/index.htm>, accessed May 2011).

We will continue to implement the following strategies:

- Follow the national guidance on invasive species provided in the Service Manual (620 FW 1.7G).
- Complete the inventory and mapping of invasive plant species and prioritize invasive species to be controlled or eradicated. Implement controls using biological, ecological, mechanical, prescribed fire, or chemical techniques, as needed.
- Participate in the CWIPP for early detection and monitoring of invasive species, and become a signatory to CWIPP.
- Work with NHFG to control and remove mute swan from the refuge. The Service goal is zero productivity for mute swans in the Northeast Region, due to the negative impact of this nonnative swan on native waterfowl and their habitats.

Great egret



Tim Williams

### Protecting Cultural Resources

As a Federal land management agency, we are responsible for locating and protecting cultural resources, including archaeological sites and historic structures that are eligible for the National Register of Historic Places. That applies not only to resources that are located on refuge lands, but also those on lands affected by refuge activities, as well as any museum properties.

To ensure compliance with section 106 of the National Historic Preservation Act, we consult with SHPO on management activities, particularly ground-disturbing activities, which have the potential to impact cultural resources. We prepare a section 106 review report that describes our proposed project, the historic resources that may be impacted, the effect of the project on these historic resources, recommendations for avoiding adverse effect to the historic resources, and mitigation measures in the case where adverse effect cannot be avoided. Mitigation measures may include photographic and written documentation, interpretive exhibits, and archaeological surveys. The section 106 review process also includes public involvement, with information on the undertaking submitted to the Newington Certified Local Government and Newington Historical Society for comment.

We completed Section 106 consultation with SHPO on the CCP (appendix G). We have also initiated a separate consultation with SHPO to assess the National Historic Register eligibility of all structures in the former Weapons Storage Area and the Fabyan Point cabins. We expect this review to be completed within 1 year of CCP approval. If any structures are determined to be ineligible, we will plan to remove them, as funding and staffing allows. The only exception is if the bunkers are determined ineligible, we will plan to keep at least one or two of them for possible use as bat hibernacula. If any of the structures are determined eligible, we will evaluate management options and/or mitigation measures with SHPO.

The Margeson Estate is on the National Register, but is in poor condition due to a lack of funding and resources available to maintain it. Our consultation with SHPO includes evaluating management options and/or mitigation measures for the estate. We have indicated to SHPO that our preferred action is recording the site and then demolishing the buildings. If we pursue demolition, with SHPO concurrence, additional NEPA analysis may be required.

### Refuge Revenue Sharing Payments

National wildlife refuges contribute to local economies through shared revenue payments. Federally owned lands are not taxable; but, under the provisions

of the Refuge Revenue Sharing Act, the municipality or other local unit of government receives an annual refuge revenue sharing payment to offset the loss of property taxes that would have been collected if the land had remained in private ownership. In addition, federally owned land requires few services from municipalities, yet it provides valuable recreational opportunities for local residents. As we describe in chapter 3, we pay the town of Newington annual refuge revenue sharing payments based on the acreage and the appraised value of refuge lands. The annual payments are calculated by formula determined by, and with funds appropriated by, Congress. We 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.

### **Findings of Appropriateness and Compatibility Determinations**

Chapter 1 describes the requirements for findings of appropriateness and compatibility determinations. Appendix C includes all approved findings of appropriateness and compatibility determinations for the refuge. These activities were evaluated based on whether or not they contribute to meeting refuge purposes, goals, and objectives.

#### **Activities Not Allowed**

We occasionally receive requests for activities that we do not allow under 50 CFR on Great Bay Refuge. The refuge manager has determined that these activities are not appropriate on the refuge or are sufficiently provided elsewhere nearby on other ownerships. These activities will continue to be prohibited on refuge lands under all alternatives. The only exceptions will be at the discretion of the refuge manager, under specific, special circumstances (e.g., to accommodate visitors with disabilities), and will require the issuance of a special use permit. Appendix C documents the refuge manager's justification for why certain uses are deemed not appropriate. The activities not allowed on refuge lands include: motorized vehicles, bicycles, pets, and horseback riding.

### **Special Use Permits**

The refuge manager will continue to evaluate activities that require a special use permit for their appropriateness and compatibility on a case-by-case basis. All research, commercial, and economic uses, and groups of 10 or more people, require special use permits. In the past, the refuge manager has issued special permits for wildlife inventories, research, hunting, and partner-led educational programs.

### **Additional NEPA Analysis**

For all major actions, NEPA requires site-specific analysis and disclosure of their impacts, either in an EA or an EIS. Most of the major actions in this CCP were fully analyzed and described in enough detail in the draft CCP/EA to comply with NEPA, and do not require additional environmental analysis. Although this is not an all-inclusive list, the following projects fall into this category:

- Biological inventories and monitoring.
- Minor modifications to our public use programs.
- Controlling invasive plants and animal pests.
- A new refuge headquarters and visitor contact facility.
- Extending existing trails.
- Removal of Lower Peverly Pond Dam.
- Converting existing grasslands to shrub habitat to benefit the Federal candidate New England cottontail.

Although we analyzed the impacts of most management actions in the draft CCP/EA alternatives, additional or supplemental NEPA analysis will be necessary for certain types of actions. An example of this is our proposal to expand the hunting program. We analyzed the impacts of the expanded program at a general level, but this analysis will have to be supplemented before a final decision on whether to go forward with the proposed expanded hunt particular

design is reached. Similarly, if we determine the need to remove all three dams along Peverly Brook, adoption of such recommendations will require additional analysis. In each case, these are management actions whose precise details, and therefore consequences, cannot be known by the Service at this time.

### **Interagency Coordination**

As described in chapter 3, refuge lands were formerly part of the Pease Air Force Base. During its use as a base, the lands were highly developed and intensively used. Also, some of the activities on the base created hazardous wastes or environmental contamination. Because of these previous activities, there is a continuing need to monitor for potential environmental contamination on refuge lands. In the interest of protecting wildlife and restoring refuge habitats, we hope to improve the coordination among Federal and State agencies (e.g., the U.S. Air Force, EPA, and NHDES) with an interest and/or responsibility in the clean-up or restoration of the former Pease Air Force Base. In order to accomplish this, we plan to complete the following actions within 1 year:

- Meet with all Federal and State agencies involved in monitoring of environmental parameters with regard to operations of the former Pease Air Force Base on lands now part of Great Bay Refuge. Identify responsibilities of each agency with regard to monitoring, what monitoring is currently being done, where and how often it is being done, what the results have been to date, what has been completed, and anticipated completion dates for future monitoring.
- Determine if all appropriate agreements (e.g., MOU) for contaminants monitoring and/or other actions, such as the removal of buildings in the former Weapons Storage Area, are in place as recommended or required.
- Obtain copies of all contaminants permits, research, and/or monitoring reports and studies associated with the refuge portion of the former Pease Air Force Base, not currently on file at the refuge. Insure that copies of all subsequent documents and reports are automatically sent to the refuge.

### **Land Protection Focus Areas**

During the CCP process, several focus areas were identified by partners and the public for our planning team to consider for Service acquisition. Conservation of lands within these focus areas will support Great Bay Refuge's purposes, and the Refuge System and Service missions, with particular emphasis on protecting species of conservation concern, such as the Karner blue butterfly (federally endangered), the New England cottontail (Federal candidate species), and salt marsh sparrow (a State species of concern), and other Federal trust resources in the Great Bay/Coastal and Concord Pine Barrens ecosystems of New Hampshire.

We will evaluate these focus areas within the next 5 years to assess whether additional land protection is warranted to conserve Federal trust resources and, whether Service land acquisition from willing sellers is recommended. If the review determines that additional land protection by the Service should be pursued then we will initiate all necessary administrative procedures to expand the boundary of the refuge. If the Service's Director grants approval to continue the effort, we will prepare a separate EA and Land Protection Plan (LPP) to analyze all factors involved in a refuge expansion and propose an alternative for public consideration. We expect that any proposal which might emerge from this process will include significant public involvement in decision-making, involve partners in the protection effort, and will utilize the full range of protection methods, including management agreements, conservation easements, and fee acquisition.

We have organized the following discussion of proposed focus areas under two subheadings:

1. Focus areas in coastal New Hampshire.
2. Focus area for Karner blue butterfly near the Concord Pine Barrens.

### **Focus Areas in Coastal New Hampshire**

We have identified several focus areas of high value habitats, including early successional habitat for New England cottontail, and coastal and estuarine salt marsh. In consultation with our conservation partners in the region, we identified these high priority areas:

- *West Dover/East Dover/Rollinsford Focus Areas* (map 4.5): NHRFG identified a focus area from the existing Bellamy River Wildlife Management Area in Dover west and east of Route 16 and into Rollinsford, about 5 miles north of the existing Great Bay Refuge. The goals are to recover:
  - \* The New England cottontail, a Federal candidate species, before it is listed.
  - \* A suite of declining early successional migratory birds, such as American woodcock, whip-poor-will, eastern towhee, brown thrasher, blue-winged warbler, and prairie warbler.
  - \* Species of greatest conservation need in the coastal plain of New England, such as Blanding's turtle, black racer, and hognose snake.
- *Great Bay Estuary* (map 4.6): The refuge seeks a more active and expanded role in the GBRPP, particularly in working with interested private landowners on the eastern side of the bay, extending from the current refuge boundaries south to Pierce Point in Greenland and east to the airport. In addition to protecting important habitats along the bay, these lands could offer potential boat access to the bay and opportunities for wildlife observation, hunting, and ice fishing.
- *Hampton-Seabrook-Salisbury Marsh* (map 4.7): The 5,000-acre Hampton-Seabrook Estuary is the largest contiguous area of salt marsh and tidal flats in New Hampshire. It forms the northern part of an extensive salt marsh system that extends south to Cape Ann, Massachusetts. Parker River Refuge is also part of this "Great Marsh." Although the Hampton-Seabrook Estuary is surrounded by development, and affected by ditching and tidal restrictions, it retains significant ecological value and supports a diversity of wildlife (McKinley and Hunt 2008). Several Federal trust species occur here, including a population of breeding salt marsh sparrows.

### **Focus Area for Karner Blue Butterfly in the Concord Pine Barrens**

The Concord Pine Barrens support the only remnant population of the federally endangered Karner blue butterfly in New England. However, the existing 29-acre conservation easement managed by the refuge and lands under a 50-year management agreement with the city of Concord do not provide sufficient habitat to maintain a sustainable wild population (USFWS 2003, Fuller 2008). In consultation with NHRFG, the Service has identified significant habitat for the Karner blue butterfly on adjacent lands that are not currently protected (map 4.8). The powerline corridor that runs through this focus area serves as a primary dispersal corridor for the butterfly. The Air National Guard also owns significant land that has suitable habitat for the butterflies. PSNH and the Air National Guard are two important partners in this focus area. Some of the lands under consideration in this focus area would also provide habitat for New England cottontail.

Map 4.5. New England Cottontail Rollinsford and Dover Focus Areas



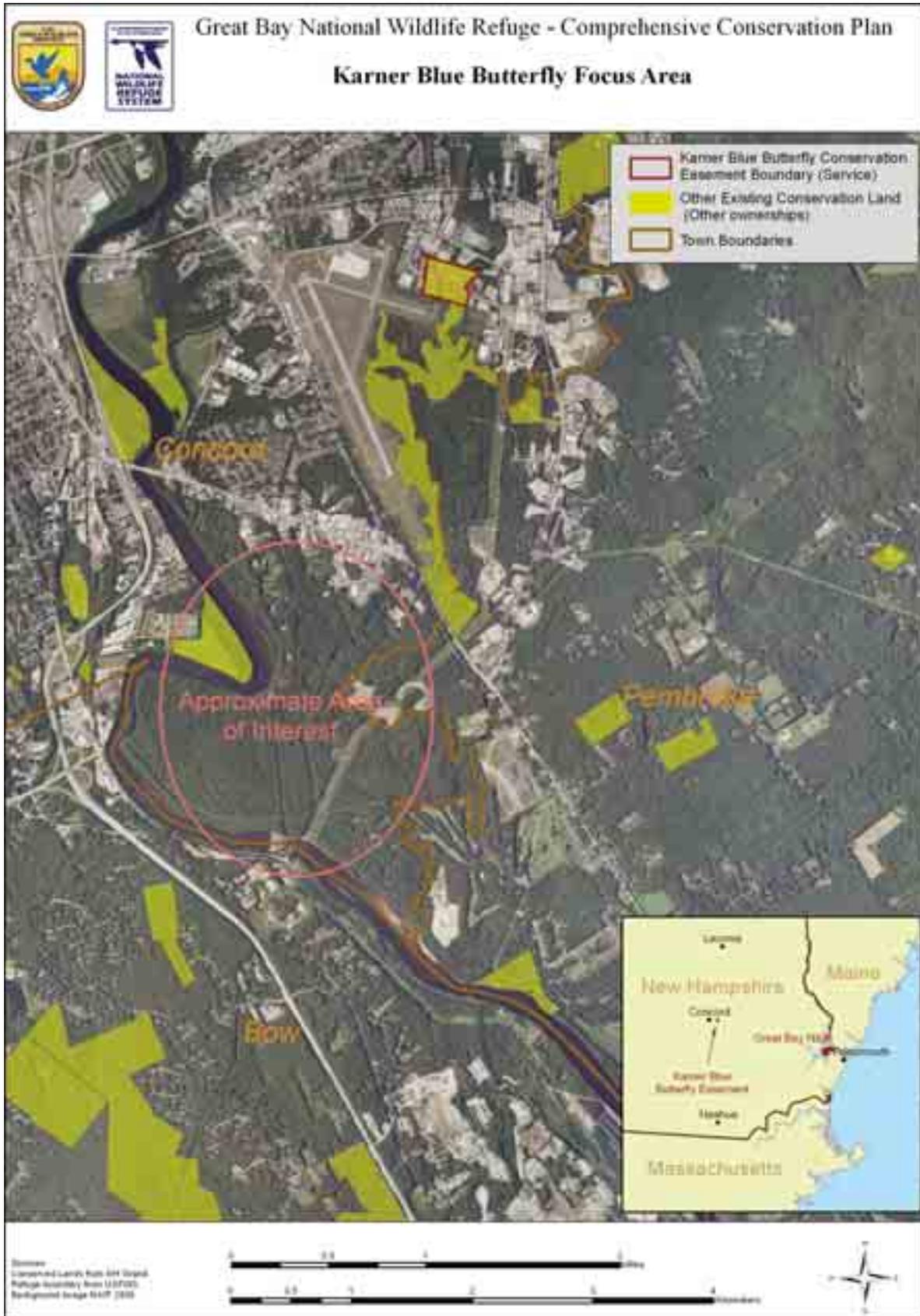
Map 4.6. East Great Bay Focus Area



Map 4.7. Hampton-Seabrook-Salisbury Marsh Focus Area



Map 4.8. Karner Blue Butterfly Focus Area



## Goals, Objectives, and Strategies

### GOAL 1.

**Perpetuate the biological integrity, diversity, and environmental health of estuarine and freshwater habitats on Great Bay Refuge to protect water quality and sustain native plant communities and wildlife, including species of conservation concern.**

#### Objective 1.1 Salt Marsh

Annually, maintain the quality and natural function of the 36 acres of salt marsh that supports a mix of native high and low marsh plant species including smooth cordgrass, salt meadow cordgrass, spikegrass, and black grass, with less than 1 percent overall cover of invasive plants, to provide habitat for breeding salt marsh sparrow, wintering American black ducks, foraging wading birds, fish, shellfish, and rare plants.

#### Discussion and Rationale

Several areas of salt marsh occur along the refuge shoreline, with the most extensive located near Woodman Point and Stubbs Pond. The low salt marsh is dominated by smooth cordgrass, while the high salt marsh is dominated by salt meadow cordgrass, spikegrass, and black grass. A healthy population of seaside mallow, a State-listed threatened plant, is found in the salt marsh near Woodman Point (NHB 2010). The salt marsh is relatively free of invasive plants, with the exception of patches of *Phragmites* adjacent to Stubbs Pond.

Up to 80 percent of the marshes that once occurred in New England have been lost to human development. The remaining salt marshes are being rapidly degraded by fragmentation and development (Bertness et al. 2002). Most of the salt marshes in New England, including those found around Great Bay were parallel ditched for mosquito control and to facilitate salt marsh haying. Salt marshes in the Great Bay Estuary occur as expansive meadow marshes and narrow fringing marshes. These marshes provide cover and forage habitats for fish, invertebrates, and birds, stabilize shorelines and protect against storm damage, and filter nutrients (Mills 2009). Protecting the remaining salt marshes is important to sustain habitat benefits, ecosystem services, and wetland functions.

In 1992, prior to refuge establishment, the town of Newington hired a contractor to spray the pesticide Bti on marshes to control the extensive mosquito breeding occurring in areas of the marsh heavily impacted by humans. Beginning in 1996, in an effort to eliminate chemical application on the marshes and restore fish and wildlife habitat, the refuge initiated four OMWM projects. In total, 5.1 acres were implemented at Stubbs Pond, 11.25 acres at Herods Cove, 9.9 acres at Woodman Point, and 3.4 acres at Welch Cove. Project objectives included eliminating invasive plants (*Phragmites* and cattails) restoring native salt marsh vegetation such as wigeon grass, and creating suitable habitat for the mummichog minnow. The mummichog is a native predator of mosquito larvae; a healthy population eliminates or minimizes the need to spray Bti for mosquito control (University of Delaware, 2008).

Various open marsh and water management techniques were used. Ditch plugs were constructed to block man-made drainage ditches and create open water habitat. Pannes (beginning at a depth of 2 inches and gradually sloping to 24 inches) were excavated to increase open water habitat and to facilitate wading bird access. Sumps (2-foot-deep depressions) were excavated within pannes to ensure minnow survival during drought conditions. In some areas, shallow connector ditches were also excavated to allow minnow access between pannes. We have not created any additional OMWM projects since then, as we have completed all the opportunities for OWMN on the refuge.

As presented in chapter 1, the Service's policy on maintaining biological integrity, diversity, and environmental health guides our conservation and protection of the broad spectrum of fish, wildlife, and habitat resources found on refuges (<http://www.fws.gov/policy/601fw3.html>, accessed May 2011). A major principle underlying this policy is to maintain and restore the diversity, structure, composition, and functioning of the refuge's fish, wildlife, and plant species, communities, and ecosystems, as well as biotic and abiotic processes that shape them. We plan to develop an index of salt marsh integrity for the refuge's salt marshes to gather baseline data, and measure our success in sustaining and improving their biological integrity, diversity, and environmental health over time.

Coastal salt marshes provide breeding habitat for black ducks. Specifically, coastal marshes, estuaries, and sheltered coves are especially important foraging habitat and shelter for black ducks in the winter (Dettmers 2006). On average, about 75 percent of New Hampshire's coastal wintering waterfowl gather on Great Bay, including nearly all of the State's Canada geese, greater scaup, and lesser scaup populations, as well as several thousand black ducks (Vogel 1995). The black duck is a globally vulnerable watch list species and is considered one of the highest priority species of concern according to the Atlantic Coast and Eastern Habitat Joint Ventures and among the state and provincial agencies where it occurs.

Virginia rail, red-winged blackbird, sora, salt marsh sparrow, and Nelson's sparrow nest and forage in salt marshes around Great Bay (Mills 2009). The salt marsh sparrow is a species of concern in New Hampshire and of highest conservation concern in BCR 30. The NHB Report (2009) documents an observation in 1997 of eight salt marsh sparrows in the salt marsh off the refuge; two were feeding young in the salt marsh at Woodman's Point. Flooding, particularly during new moon tides, is the primary cause of nest failure for the salt marsh sparrow, which is synchronized to nest immediately after a new moon tide. Vegetation structure and composition are less important in predicting nest success. Females wedge or suspend a nest in medium-high cordgrass just above the substrate or water near the mean high-tide line (Greenlaw and Rising 1994). Another potential threat to this species is elevated mercury levels, which were detected in salt marsh sparrows at other coastal national wildlife refuges (Lane 2008). Walsh et al. (in press) found the population at Chapman Landing, on the west side of Great Bay, was the most genetically differentiated from all populations sampled from Maine to Long Island.

According to the NHDES–Coastal Program (2005a), New Hampshire's salt marshes also provide habitat for other aquatic species, including a wide variety of fish and shellfish (e.g., American eel, mummichog, Atlantic silverside, nine-spine stickleback, shore shrimp, and sand shrimp). Several mammals also use salt marsh habitat including deer, muskrat, river otter, and red fox (NHDES 2005b).

### Strategies

*Continue to:*

- Control any existing and new invasive plant species in the salt marsh using the most effective technique, which could include cutting, hand pulling, biological controls, and herbicide application (e.g., cut and drop or spot treatment).
- Participate in the CWIPP's ongoing identification, monitoring, and eradication efforts for invasive plants in seacoast marshes.
- Prohibit public access to salt marsh habitat on refuge.

*Within 3 years of CCP approval:*

- Develop an index of salt marsh integrity to:
  - \* Determine the current baseline integrity condition.
  - \* Determine what areas of integrity are low and need attention.
  - \* Prioritize management actions to ensure that the index does not fall below the baseline level. The index's parameters may include vegetation richness and diversity, elevation, sediment accretion, salinity, extent of tidal fluctuation, and water quality measures.
- Evaluate all salt marshes that received OMWM to determine integrity of the marshes, with special emphasis on hydrology, climate change impacts, and invasive plants. Assess the effects of the OMWM treatments to determine if they were successful in meeting objectives.
- Collaborate with partners to assess the salt marsh sparrow population around the bay and determine the relative importance of the refuge population to the Great Bay ecosystem and to the larger regional population. Also, partner with UNH to determine how the refuge salt marsh sparrow population fits in the metapopulation structure in New England and throughout the species' range.
- Work with GBNERR to identify and address sources of mercury entering Great Bay, to the extent possible.
- Collaborate with GBNERR on their efforts to establish vertical benchmarks in various low-elevation habitat types within the GBNERR boundary. Promote placing one or more on the refuge. Regular surveying of these benchmarks, coupled with enhanced data from tide gauges, will enable accurate tracking of local sea level rise and anticipate its effects on habitats within the Great Bay ecosystem.
- Provide information to refuge visitors about the environmental sensitivity and importance of salt marsh to the health of the Great Bay Estuary.
- Implement an "early detection rapid response" program that will prevent new invasive species from becoming established within the freshwater tidal marsh by locating newly established invasive species and immediately addressing those populations through the appropriate control measure. This program 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.
- Partner with BRI or other organizations to test if mercury levels are high in the refuge's salt marsh sparrow population, as one indicator of ecological health.
- With volunteers and partners, conduct fall waterfowl migration surveys, and mid-winter waterfowl surveys to the extent access is possible, of black ducks and other waterfowl to assess the importance of the refuge to regional migrating populations.

**Monitoring Components**

- Annually monitor the salt marsh habitat for presence of invasive plant species.
- Establish and implement monitoring protocol to track changes in salt marsh biological integrity against its baseline index.

- Work with GBRPP, GBNERR, and other partners to use SLAMM or other modeling results to develop a monitoring program that will evaluate conditions in the region's salt marshes over the next 15 years with respect to climate change and sea level rise.
- Work with partners to develop and implement a monitoring plan to identify breeding activities, abundance, and densities of salt marsh sparrows in Great Bay, inclusive of the refuge.
- Work with NHFG to monitor migrating and wintering waterfowl.
- Establish and implement monitoring program to assess health and distribution of rare plant populations.

### **Objective 1.2 Intertidal and Shallow Estuarine Waters**

Work with partners to protect and restore the health and function of the intertidal habitats in Great Bay Estuary, including enhancing water quality to benefit fish, shellfish, breeding and wintering bald eagles and waterfowl, and other estuarine life, such as oysters, soft-shell clams, and horseshoe crabs. Emphasize the restoration and maintenance of 2 acres of oyster beds around Nannie Island and Woodman Point, as well as the eelgrass beds.

Refuge-specific support of regional objectives will include:

- Contribute to the PREP CCMP's goal of 50,000 bushel of adult oysters (greater than 3.2 inches in size) by 2020 by supporting 25,000 bushels of adult oysters in the Nannie Island area in the same time period.
- Contribute to the PREP CCMP's goal of restoring eelgrass cover to 2,900 acres and restoring connectivity of eelgrass beds throughout the Great Bay Estuary by 2020, by restoring the extent of eelgrass bed in Herod Cove and western shoreline of the refuge and increase eelgrass percent cover to a minimum of 60 percent for both beds.
- Contribute to protecting the water quality of the bay to provide migrating and watering habitat for waterfowl and breeding and wintering habitat for bald eagles. Support partner efforts to provide areas for waterfowl and bald eagles where they can nest, forage, and roost without human disturbance.

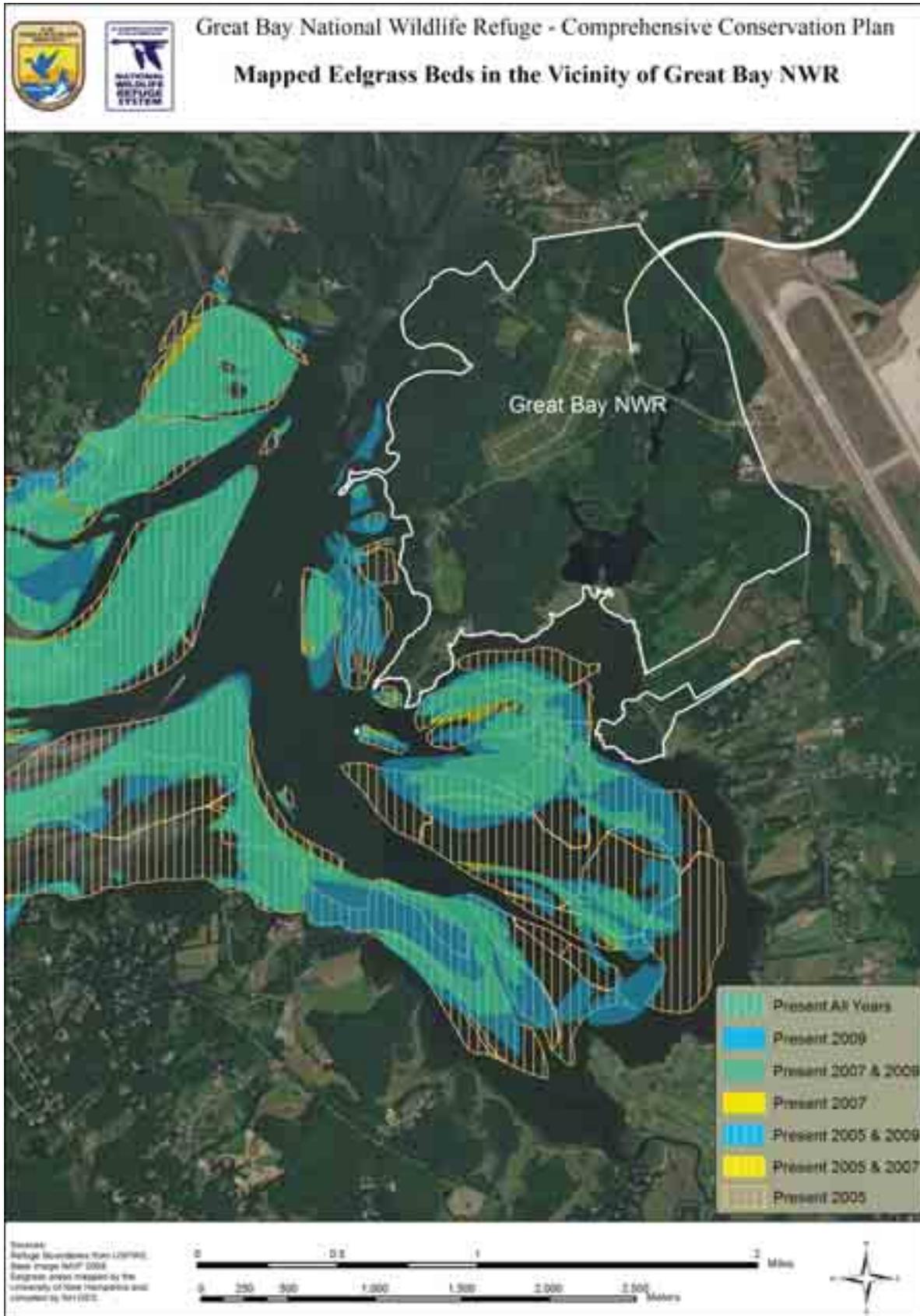
#### **Discussion and Rationale**

Both eelgrass beds (map 4.9) and oyster beds (map 4.10) are regarded as keystone and indicator species for Great Bay Estuary. A keystone species is a species that plays a critical role in maintaining the structure and diversity of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass. Indicator species are plants and animals that, by their presence, abundance, lack of abundance, or chemical composition, demonstrate the quality of the environment.

Oysters, as long-lived filter feeders, are able to filter nutrients and pollutants to help maintain water quality and clarity in estuaries. Oysters accumulate in dense groups called beds or "reefs." These reef habitats provide homes or cover for other fish and crustaceans. Close to shore, oyster reefs serve as natural breakwaters, easing the impact of waves and boat wakes on shorelines.

Historical records document extensive oyster beds in most of Great Bay's tributaries and many channels within the bay. Hundreds of years of pollution, siltation, and harvest led to sharp declines in oysters throughout the bay (Mills 2009). More recent threats include two parasitic protozoa, *Haplosporidium*

Map 4.9. Mapped Eelgrass Beds in the Vicinity of Great Bay National Wildlife Refuge





*nelson* (MSX) and *Perkinsus marinus* (Dermo). A major decline of oysters in Great Bay beginning in the early 1990s is thought to be caused by these protozoa. The population fell from 125,000 bushels in 1993 to 6,174 bushels in 2000; the population has since recovered to 10,044 bushels (PREP 2009). Oysters filter about 20 gallons of water per day, which has major implications for the health of the Great Bay Estuary. In 1970, the oyster population could filter the estuary's water in 4 days. Today, with the reduced population, it takes 100 days or more (Mills 2009).

PREP established a management goal of 50,000 bushels of adult oysters or 10 million adult oysters by 2020 (PREP 2010). The largest oyster bed in Great Bay is located near Nannie Island, supporting almost 100,000 bushels of adult oysters in 1993 (map 4.10) (PREP 2009). This reef declined in area by 33 percent between 1997 and 2000, while a much smaller bed at Adams Point expanded by over 200 percent during the same period. In 2007, UNH constructed 12 mini-reefs (from recycled oyster shells), seeded with 1.2 million oyster spats, in a 1.75 acre area just north of Nannie Island. The Nannie Island restoration area experienced increased oyster densities from 2007 to 2009 due in large part to the exceptional 2006 natural recruitment observed throughout Great Bay (PREP 2009).

Eelgrass is an essential habitat in Great Bay Estuary and the basis of an estuarine food chain, providing food for migrating and wintering waterfowl and habitat for juvenile fish and invertebrates (map 4.9). In winter, eelgrass is dormant with much of its energy reserves tied up in the underground root or rhizome. This carbohydrate-rich food source is relished by wintering geese and ducks (Smith 2004). Eelgrass beds are particularly important to juvenile rainbow smelt, Atlantic silversides, nine-spined sticklebacks, alewife, and blueback herring. Larger fish and wading birds are attracted to the smaller fish that hide within the eelgrass beds. The long narrow leaves of eelgrass slow water flow and filter suspended sediments from the water column (Short et al. 1992a).

In 1989, there was a dramatic decline in eelgrass beds to only 300 acres. This decline was linked to an outbreak of a slime mold (*Labryrinthula zosterae*), commonly called "wasting disease." Although the eelgrass beds originally recovered from the outbreak (back up to 2,000 acres in 1996), the eelgrass beds are again in a slow and steady decline. Between 1990 and 2008, the eelgrass cover in Great Bay declined by 37 percent and eelgrass biomass by 64 percent. By 2008, eelgrass was gone from Little Bay, the Winnicut River, and almost entirely from the Piscataqua River (PREP 2010). Eelgrass beds remain offshore from the refuge, although greatly diminished from 1996 levels. The loss of eelgrass beds has major implications for the health of the Great Bay Estuary, affecting water quality and habitat suitability for eelgrass-dependent species. Nutrient loading and increased turbidity from suspended sediments are considered two of the limiting factors to restoring eelgrass to the bay (PREP 2009).

Soft-shell clams are another important food source for wintering waterfowl, particularly diving ducks (map 4.10). A large clam flat is located in Herods Cove. Clam populations in Great Bay have fluctuated due to harvest pressures, invasive predators (such as the nonnative green crab) and diseases (such as "neoplasia").

Another interesting invertebrate found in Great Bay is the horseshoe crab, which is not a true crab. Horseshoe crabs spawn in late spring and early summer on the shores of Great Bay. In some places along the East Coast, horseshoe crab eggs are a valuable food source for nesting terns and wading birds and migrating shorebirds. Their distribution and ecological role in the Great Bay Estuary is unclear.

The bay is one of the primary bald eagle wintering areas in New Hampshire, contributing roughly 20 percent of the total eagles counted in the State during the mid-winter bald eagle survey (Martin 2011 personal communication). Eagles use large trees on the refuge, particularly dead or alive white and red pine as daytime perches, roost sites, and for nesting. As of 2010, there were 14 total nesting pairs of bald eagles in the State (NH Audubon 2010). In 2011, a pair of bald eagles nested on the refuge adjacent to the bay, and successfully fledged one chick. This is the first time in decades that bald eagles have nested on the refuge. The bay also supports the largest concentration of wintering waterfowl in the State, with thousands of waterfowl using the bay at any one time. To provide undisturbed habitat for waterfowl and eagles, the refuge restricts public access to the shoreline.

### Strategies

*Continue to:*

- Organize annual shoreline cleanup on the refuge with the help of volunteers.
- Restrict public access to the shoreline to provide buffer and undisturbed roosting, foraging, and breeding habitat for waterfowl and bald eagles.

*Within 3 years of CCP approval:*

- Begin working with NHFG and other Great Bay partners to restore oyster beds near Nannie Island and Woodman Point. This includes assessing the current status of the oyster reef and restoring the reef through existing or experimental methods such as augmenting the reef with spent clam shells or other material and seeding with oyster “spat” (young oysters).
- Begin working with NHFG, UNH, and other Great Bay partners to restore eelgrass bed west of Woodman Point and at Herods Cove. This includes assessing the current extent and percent cover of eelgrass beds and restoring beds by transplanting eelgrass.
- Begin working with NHFG, NHDES, and Great Bay partners to reduce nutrient and sediment loading into Great Bay, which affects water quality and in turn affects oysters, eelgrass, and other aquatic life, with particular emphasis on oyster and eelgrass beds in Herods Cove.
- Work with NHFG to protect the clam flats in Herods Cove from overharvest through cooperative enforcement of State regulations on shellfish harvesting.
- Study the importance of the refuge shoreline as spawning and nursery habitat for horseshoe crabs; partner on assessing the health of horseshoe crab population in the estuary.
- Assess the need for additional protection for nesting bald eagles from human disturbance. If necessary, work with NHFG and other partners to provide additional buffer from recreational bay user.

### Monitoring Components

- Work with partners to monitor the health and distribution of the oyster beds near Nannie Island and Woodman Point.
- Assess the Herod Cove clam flat to determine area of clam bed, density, and populations.
- Work with partners to monitor the health and distribution of eelgrass beds near the refuge.

- Work with partners to monitor the presence of nonnative invasive aquatic organisms, such as the green crab, to minimize impacts on native shellfish.
- Conduct annual horseshoe crab surveys at spawning sites on Great Bay, consistent with approved State or regional protocols. Shoreline protocols are currently being developed by the University of Rhode Island and the State of New Hampshire.
- Work with GBNERR and PREP to monitor water quality within the Great Bay Estuary as indicator of ecological health.

**Objective 1.3 Freshwater Impoundments and Peverly Brook System**

Manage the 62-acre Peverly Brook system on the refuge to improve water quality, establish a more natural flow regime, improve migratory and resident fish habitat, and maintain habitat for waterfowl, marshbirds, and other aquatic life.



Matt Poole/USFWS

Wetlands on the refuge

**Objective 1.3a Stubbs Pond**

Annually manage the existing 44-acre Stubbs Pond to maintain a diversity of native emergent marsh vegetation (e.g., cattails, arrowhead, wild rice, and softstem bulrush) with 30 to 50 percent open water and less than 5 percent invasive plant species (e.g., purple loosestrife and *Phragmites*) to benefit migrating waterfowl such as black duck, nesting marsh birds such as marsh wren and Virginia rail, raptors such as bald eagles and osprey, and migratory fish, including American eel, alewife, and blueback herring. Specific habitat targets include:

- Annually support migratory waterfowl through a mix of water depths, flooded vegetation (cattail, wild rice, and softstem bulrush) at peak fall migration (late October).
- Annually maintain a high water level in Stubbs Pond during the summer months to maintain 50 to 70 percent native emergent vegetation (cattail, wild rice, and softstem bulrush) and provide breeding habitat for marsh and wading birds.
- Annually provide migratory fish (alewife and blueback herring) access to spawning habitat in Stubbs Pond by maintaining a minimum of 1.0 feet of running water through the fish ladder structure from late April to mid-July, or until water level is insufficient for fish passage.

**Objective 1.3b Upper Peverly Pond**

Annually maintain the existing 11-acre Upper Peverly Pond to provide wildlife observation opportunities, and to benefit migrating waterfowl, including wood duck, ring-necked duck, and green-winged teal, and to provide nursery habitat for American eel. Establish evaluation criteria, and regularly evaluate the environmental conditions of this pond to determine the desirability and feasibility of its future removal.

**Objective 1.3c Lower Peverly Pond**

Within 5 years of CCP approval, remove the failing dam and other associated infrastructure at Lower Peverly Pond, and restore the existing 7-acre pond to 1,100 feet of native riparian habitat, reconnecting a portion of a fragmented river

system, reestablishing natural streamflow, and enhancing habitat for migratory native fish.

### Discussion and Rationale

The 1.52-mile Peverly Brook begins a few thousand feet north of the refuge boundary. The 907-acre watershed is the largest watershed in the town of Newington and was once a drinking water source for the city of Portsmouth. The city diked Peverly Brook around 1900 to serve as a water supply, creating Upper and Lower Peverly Ponds. The Air Force acquired the lands encompassing Peverly Brook in 1952 and managed the three freshwater impoundments for mosquito control and recreation. We describe the history of the impoundments under Air Force ownership in chapter 3 in the section on “Freshwater Impoundments.”

According to the Service’s New England Ecological Services Field office (NEFO), contaminants have not migrated any lower down the watershed and the contaminant levels in Lower Peverly and Stubbs Ponds meet clean-up goals (Drew Major, NEFO 2011 personal communication). However, prior to any dam removals we will conduct additional sediment and water quality testing to ensure safe levels.

Since refuge establishment, the three impoundments in the Peverly Brook drainage have been managed primarily to benefit spring and fall migrating waterfowl and marsh nesting birds. We will expand our management to include enhancing water quality, improving habitat for migratory and resident fish, and maintaining habitat for waterfowl, marsh birds, and other aquatic life. Specific strategies will be detailed in the HMP, such as water level management (e.g., timing, season, and desired water level) and invasive species treatments.

In chapter 3, in our discussion on freshwater impoundments, we provide a summary of the 2006 SEED report which identified concerns with the three impoundment infrastructures, but also included recommendations for improvement. Our summary in chapter 3 also includes what work we have been undertaking to date to address those concerns and implement recommendations.

*Stubbs Pond:* As part of this CCP process, we reviewed the benefits and consequences of maintaining Stubbs Pond as a freshwater impoundment versus breaching the dike and restoring it to a saltwater system. According to NHFG, Stubbs Pond is unique within the Great Bay Estuary system, given its large size (44 acres of freshwater wetland) and established population of wild rice. The State-listed plant large bur-reed is found in Stubbs Pond. There are no other places in coastal New Hampshire that draw in the amount and diversity of waterfowl documented at Stubbs Pond, especially mallards and black ducks during spring and fall migration (Ed Robinson, Waterfowl Biologist, NHFG 2011 personal communication). A recent study commissioned by the Service reported that Stubbs Pond is unlikely to be affected by sea level rise as a result of climate change over the 15-year life of the CCP (Clough and Larson 2009), but a more detailed analysis is needed.

Water level manipulation is used in Stubbs Pond to manage the ratio of vegetation to open water and to control undesirable vegetation including invasive plants. The objective is to control the monoculture of cattail vegetation and increase vegetation diversity, opening up areas to increase the ratio of open water to emergent vegetation while controlling invasive purple loosestrife and *Phragmites*. Water level management has fluctuated from year to year, in part because of the difficulties in managing Stubbs Pond. A new water control structure was installed in 1996. Since then, refuge staff have used various techniques to control excessive cattail growth and to strive for a 50:50 balance of aquatic vegetation and open water. Techniques included mowing, manipulating water levels

(drawdowns and flooding), using herbicides to control cattails, and releasing *Galerucella* beetles to control purple loosestrife.

After several years of using these techniques, refuge staff concluded that spring drawdown of Stubbs Pond allows cattail and purple loosestrife to increase, while inhibiting other more desirable species, such as large bur-reed, soft stem bulrush, wild rice, wild celery, and arrowhead. Our experience indicates that Stubbs Pond should be kept relatively high during the spring and summer to discourage cattail growth. A drawdown in early fall benefits migratory birds. If weather permits, it may be possible to mow, spray, or burn cattail stands in the fall before refilling the pond in the winter to early spring.

A fish passage structure was installed in 1995 in Stubbs Pond but was not operated until the spring of 2003. The fish passage is now opened in late April to allow alewife and blueback herring to migrate into Stubbs Pond. Our volunteers have documented blueback herring migrating through the fish ladder during May.

Five years (1999 to 2003) of marsh bird surveys were conducted on the refuge. Virginia rail, least bittern, sora, common gallinule, pied-billed grebe, king rail, and marsh wren were recorded in Stubbs Pond. The amount of emergent wetland habitat has declined significantly throughout North America along with apparent declines of marsh-dependent birds. Changes in water levels, ratios of mud flats to open water areas, invertebrate communities, and amount of emergent plant cover in marsh habitats could affect habitat quality for marsh birds. Given the variability of rainfall, annual vegetation changes, and the varying needs of priority species, we will continue to use adaptive management and annually modify water levels as needed to create appropriate seasonal habitat conditions for the full suite of species, including waterfowl, marsh birds, and migratory fish.

In order to establish a baseline and improve our water level management in Stubbs Pond, we plan to map the bathymetry (the underwater elevations) of Stubbs Pond, relative to the dike, spillway, fish ladder, water control structure, brook, and salt marsh. This information will help us determine how to manipulate the pond's water levels to meet our objectives for migratory birds, fish passage, and other resource values. It will also help us establish a baseline from which to measure changes that might occur due to climate change, such as sea level rise or other processes that might result in subsidence or deposition in areas.

We will also work with partners to evaluate the effectiveness of the fish ladder and determine if there are practicable opportunities to enhance the movement of fish migrating through. Examples of improvements that have been recommended, but need further analysis, include the following:

- Create an attraction jet to guide fish to the ladder.
- Install a nature-like bypass to provide additional passage for American eel, alewife, and blueback herring.
- Install additional sections of the “steppass” ladder.
- Determine if a new design or retrofit could allow fish to pass at a greater range of tides.

The existing fish ladder was designed to only pass fish at high tide because at lower tides fish cannot cross the tidal mudflats to reach the ladder. It would be very difficult and costly to provide fish passage at a wider range of tide levels (Brownell 2011 personal communication).

*Upper Peverly Pond:* The 11-acre Upper Peverly Pond is used as a foraging and resting site during migration by a small number of waterfowl and marsh and wading birds (great blue heron, wood duck, bufflehead, ring-necked duck, and green-winged teal). It provides nursery habitat for American eel during its elver stage. American eel is a declining species that spends most of its life in fresh or brackish water, then travels downstream and far offshore to the Sargasso Sea where it spawns.

A new water control structure was installed on Upper Peverly Pond in 1999 to control water levels to benefit waterfowl. The pond was drawn down several times during spring for moist soil management with positive vegetative and waterfowl population response to this management. The vegetation in and around Upper Peverly Pond seems to be more stable than in Stubbs Pond. In 2004, the invasive brittle water nymph was discovered in Upper Peverly Pond. Brittle water nymph is an annual invasive plant with no easy control methods. Upper Peverly Pond is maintained primarily as open water habitat, with minimal water level management.

We plan to maintain the dam on Upper Peverly Pond for several reasons. There are still contaminated sediments remain in Upper Peverly Pond and trapped behind the dike. We are concerned that removal of the dam in the near future would release these sediments downstream with unknown environmental impacts and would likely diminish habitat for American eel as well as waterfowl. However, we will establish evaluation criteria, and regularly evaluate the environmental conditions of this pond to determine the feasibility of its future removal.

*Lower Peverly Pond:* The 7-acre Lower Peverly Pond has an antiquated spillway that is deteriorating and has no water control capabilities. Also, beaver activity in the area is significantly affecting the integrity of the dam and accelerating the likelihood of total failure. The current risk that the dam might fail is high. We plan to remove the dam at Lower Peverly Pond because of the expense to upgrade it to current safety standards, compared to the minimal value to Federal trust resources. The use of this pond by waterfowl, wading birds, and other species of concern is low. A limited number of waterfowl, including a few wood, black, and ring-necked ducks, and bufflehead, are seen during the spring and fall migration. We predict that we could recover and restore to near natural conditions approximately 1,100 feet of stream if the dam were removed.

Although removal of the Lower Peverly Dam might diminish some habitat for American eel, the presence of active beaver in the system will likely function similar to the existing dam, and might allow for improved eel passage (Douglas Smithwood, Fishery Biologist, USFWS 2009 personal communication). Furthermore, removal of the failing Lower Peverly Pond Dam is consistent with a proposal presented in a letter to the Service from the NHDES in 2007. That letter clearly stated that reconstruction of the dam would not be beneficial to aquatic life in Peverly Brook or Stubbs Pond. Rather, breaching the dam would remove the threat of dam failure and eliminate continued downstream erosion from the Lower Peverly spillway. The letter further noted that dam removal would improve the water quality in Peverly Brook and provide additional stream habitat for spawning blueback herring and other fish species. In addition, dam removal would be consistent with the Coastal Zone Management Act (Christian Williams, NH Coastal Program 2007 personal communication).

Contaminant levels associated with the former Air Force Base have decreased enough that they are close to or meet clean-up targets. The Upper Peverly Pond Dam has acted as a sediment trap, preventing some contaminants from moving downstream. The removal of the Lower Peverly Pond Dam should not exacerbate any existing contaminant issues below Lower Peverly (Drew

Major, Contaminants Specialist, NEFO, personal communication with Graham Taylor, Dec 12, 2009; see appendix I). We will conduct pre- and post-dam removal sampling to establish a baseline and measure any impacts to water and contaminants resulting from dam removal. Brittle water nymph was found in Lower Peverly Pond in 2004. We will also evaluate control methods prior to removal of the Lower Peverly Pond Dam.

We do not have a detailed plan for the dam removal at present. We will work with NHFG, NEFO, NHDES, and the Service's Central New England Fisheries Resource Office to coordinate the design. We will also consult with the SHPO to determine if Lower Peverly Dam is eligible for the National Register and to minimize any potential impacts of its removal on cultural resources. We expect the work will occur in late summer during low flow and drier conditions. Our concept will be to remove the concrete spillway using excavators and then use some of the earthen material to reconstruct and contour the uplands to begin restoration of a forested riparian area. Some recontouring of the stream channel will also likely be necessary to recreate the original stream channel and bed, or to approximate it the best we can. In our estimation, approximately 150 feet of stream reach will be included in the project area. We hope to coordinate with the Coastal America program to implement the project.

### Strategies

#### *Continue to:*

- Work with partners at the headwaters of the Peverly Brook system to improve water quality and ensure water quantity.
- Prioritize and control invasive plants (e.g., *Phragmites*, purple loosestrife, brittle water nymph) within the Peverly Brook system using mechanical (e.g., mowing), biological, chemical, prescribed fire, and ecological methods. Chemical controls are used as a last option if the other techniques are not effective.
- Use adaptive management in Stubbs Pond and Upper Peverly Pond to maintain an optimal mix of open water and aquatic vegetation (approximately 50 percent of each) to benefit breeding and staging waterfowl, marsh and wading birds, fish, and rare plants. Specific water level manipulations will be prescribed in the AHWP, based on existing conditions at the time.
- Annually maintain dikes, dams, spillways to ensure integrity of structure and address any items identified in the periodic SEED assessments (last done in 2006). Annually maintain and inspect water control structures and emergency valves (See "Freshwater Impoundments" section in chapter 3 for details on current and proposed maintenance of the dams).
- In partnership with NHFG, control mute swans, a nonnative species that negatively impacts local plants and waterfowl.

#### *Within 3 years of CCP approval:*

- Work with NHFG and the Service's Central New England Fisheries Program to evaluate effectiveness of the fish ladder and determine if there are practicable opportunities to enhance the movement of fish migrating through the ladder from late April to mid-July given the constraints of tidal flow and with consideration for maintaining quality, open water habitat for migratory birds. If this evaluation recommends that the fish ladder be updated or repaired, we will implement those recommendations within 3 years of the review, or as soon as funding allows.

- Work with Service's NEFO to monitor contamination and identify remediation options for Upper Peverly Pond. Develop evaluation criteria and regularly evaluate the environmental conditions of this pond to determine the feasibility of its future removal.
- Work with partners to detect and remove "hot spots" of DDT contamination in Upper Peverly Pond, if determined feasible, and contingent upon funding and staffing.
- Seek technical and financial assistance from partners with project design and implementation to remove the Lower Peverly dike and restore that section of the Peverly drainage. Consult with the SHPO to determine if Lower Peverly Dam is eligible for the National Register and to minimize any potential impacts of its removal on cultural resources. Work with NHFG, NHDES, NEFO, and the Service's Central New England Fisheries Program to plan and design the removal of impoundment structure and restoration of brook, including stream channel and adjacent riparian area. Begin all requirements to obtain permits for the work.
- Prevent infestation of invasive species during and after the dam removal at Lower Peverly. Use early detection rapid response techniques.
- Complete bathymetry study of Stubbs and Upper Peverly Ponds to help refine impoundment management on those ponds.
- Relocate, or construct an additional, osprey platform at Stubbs Pond in order to encourage nesting away from the dike and to minimize the disturbance to nesting birds caused by management activities.

*Within 5 years of CCP approval:*

- Assuming funding is secured, remove Lower Peverly Pond Dam and restore the existing 7-acre pond to stream and adjacent riparian habitat. Prior to dam removal:
  - \* Evaluate the extent of brittle water nymph in the impoundments and determine control methods.
  - \* Assess Lower Peverly Pond for water and sediment contamination. If levels do not pose a concern for refuge resources, begin required permitting process for dam removal.
  - \* Arrange assistance with Coastal America program to help during construction and restoration phase.
  - \* Within 15 years of CCP approval:
    - Develop a protocol for ongoing evaluation of Stubbs Pond to develop criteria and thresholds, or triggers, that would lead to a shift in management and/or restoration to a tidally influenced system based on regional landscape context, contribution to Federal trust resource conservation, potential management implications, and commitments, and long-term solutions to contaminant issues.

**Monitoring Components**

- Monitor water levels in Stubbs Pond and Upper Peverly Pond, 1 to 2 times per week, year-round as feasible (i.e., if open water).

*Beaver activity on the refuge*



Matt Poole/USFWS

- Check fish ladder several times a week from late April to mid-July and weekly from September to November for structural condition and fish use. Discuss the possibility of using automated monitoring with staff from the Service's Fisheries Program.
- Conduct a Water Resource Inventory and Assessment following the National Service standards to determine current water conditions (quality and quantity) and needed future monitoring.
- Weekly monitor osprey and bald eagle nest during nesting season.
- Conduct sediment and water quality monitoring in the Peverly Brook system from Lower Peverly to Stubbs Ponds to establish pre-dam removal baseline. One year after the removal of the Lower Peverly Dam, conduct post-dam removal monitoring impacts in Stubbs Pond.
- Annually monitor the migratory fish populations and movement in the Peverly Brook system.
- Monitor sediments and water quality in the Peverly Brook system for contaminants every 3 to 5 years.
- Develop a monitoring protocol to assess current habitat condition of Lower Peverly Pond and adjacent habitats, and monitor vegetation community change after dam removal.
- Develop a protocol for ongoing evaluation of Upper Peverly Brook to determine if pond should be dredged, maintained as is, or breached. Establish thresholds or triggers that will lead to a shift in management based on regional landscape context, contribution to Federal trust resource conservation, potential management implications and commitments, changes in visitor services, long-term solutions to contaminant issues.
- Map and monitor invasive plants in the Peverly Brook system, and update every 5 years.

- Work with the New England Wildflower Society and other partners to establish and implement a protocol for routine monitoring of rare plant populations documented by NHB in Stubbs Pond including large bur-reed and stout bulrush.
- Work with the Pease Airport Authority to establish regular monitoring of potential runoff from the airport into the Peverly Brook watershed, particularly potential runoff from the new de-icing pads.
- Collect baseline information on freshwater mussels in the impoundments and potential impacts from water level drawdowns and restoration.

## GOAL 2.

### **Perpetuate the biological integrity, diversity, and environmental health of upland and forested wetland habitats on Great Bay Refuge to sustain native plant communities and wildlife, including species of conservation concern.**

#### **Objective 2.1 Appalachian Oak-Hickory Forests**

Maintain the biological integrity, diversity, and environmental health of the refuge's 700 acres of mature Appalachian oak-hickory forests to provide habitat for breeding and migrating birds of conservation concern including scarlet tanager, Baltimore oriole, wood thrush, and breeding and migrating forest bats. Ensure less than 10 percent of total vegetation cover is invasive plant species (e.g., common buckthorn, common barberry, glossy buckthorn, and winged euonymus).

#### **Discussion and Rationale**

In appendix B (part 1.3), we detail the process we used to determine what elements comprise the biological integrity, diversity, and environmental health for each of the refuge's plant communities. We reviewed historical conditions, site capability, the current regional landscape conditions, and the biological diversity on the refuge. We also considered natural processes and limiting factors which could potentially affect each plant community.

Many of the forests on Great Bay Refuge have a recent agricultural history and are dominated by successional white pine or hardwoods. Although pine, hardwoods, and mixed stands are clearly evident, the current overstory dominant tree species are not necessarily the best indicator of what natural community types occurred on the refuge. White pine stands are common and are generally a stronger indication of past land use history than they are of the long-term potential of a site. NHB used the total composition of plant species, in combination with soil attributes, to indicate community type (Sperduto 2000).

Dry Appalachian oak forests are characterized by southern (or "Appalachian") species that reach the northern extent of their ranges in southeastern New Hampshire and southern Maine. The typical dominant trees in this forest type include a mix of oaks, such as red, black, and white oaks, and the somewhat less abundant shagbark hickory. The shrub layer is dominated by flowering dogwood, mountain laurel, and American hazelnut. Pennsylvania sedge may form extensive "lawns," contributing to a park-like setting. This community supports a high diversity of herbaceous plants, including numerous State rare species, such as sweet goldenrod, birdfoot violet, hairy bedstraw, reflexed sedge, slender knotweed, fern-leaved false-foxglove, Maryland tick-trefoil, and prostrate tick-trefoil.

The mesic Appalachian oak-hickory forest on the refuge is documented as an exemplary natural community, according to NHB. This community type includes a mix of Appalachian hardwoods, as described above, and "transitional" hardwoods, such as beech, birches, and maples. Hemlock and white pine occur in

variable amounts in both forest types. The mesic oak-hickory forests tend to have a more diverse forest canopy compared to the dry oak forest. The mesic forest occurs in two variants, both of which occur on the refuge. The dry-mesic variant occurs on well-drained fine sandy loam soils where beech, paper birch, and some dry-site herbs are more frequent. The mesic variant is more common on silt loam soils with more moisture, where white ash and black cherry might be more prevalent (Sperduto and Nichols 2004).

Oak forests were not dominant in the Northeast pre-human settlement. Burning by Native Americans may have increased oak dominance in certain forests. European settlement further increased oak dominance through logging, land clearing and the introduction of chestnut blight (Abrams 1992). Oak and hickory are early to mid-successional species that depend on fire or disturbance for regeneration. Abrams (1992) suggested a fire frequency of 50 to 100 years in pre-settlement oak forests to sustain oak species. Some of these forests may transition to other overstory species in time due to lack of adequate red oak regeneration, and from increases in beech on drier sites and sugar maple and beech on more mesic sites. Repeated fire will tend to knock back fire-sensitive species like beech and sugar maple. As such, any natural, semi-natural, and/or controlled fire regimes may be necessary for the long-term maintenance of oak and hickory on some sites (Sperduto and Nichols 2004). However, projected changes to natural processes under climate change predictions (northward shift of ecosystems and increased likelihood of natural fires) may maintain this habitat.

Appalachian oak forests are important to many wildlife species given the abundance of nut-bearing oaks and hickories. These rich foods are eaten by wild turkey, white-tailed deer, ruffed grouse, squirrels, and other small mammals, blue jays, rose-breasted grosbeak, and wood duck among other birds. The mature deciduous trees in these forests offer nesting sites for scarlet tanager, Baltimore oriole, and wood thrush, which are three species of conservation concern in this region. All three prefer deciduous or mixed mature forests. The oriole occurs in more open or semi-open wooded areas, while the wood thrush is found more commonly in mature forests with a denser understory of shrubs and sub-canopy trees. The scarlet tanager occurs across a broader range of mature forest understory conditions.

Bat surveys on the refuge from 2009 to 2011 detected several species of bats using the refuge both during migration and breeding period. Migrating species including northern myotis, eastern small-footed bat, little brown bat, big brown bat, and eastern red bat. Confirmed breeding species include northern myotis (most abundant), red bat, eastern small-footed bat, and big brown bat. Bats use forested areas for roosting and wetland areas for feeding. The loose bark of hickory species and other tree species in stages of decay provide breeding and migratory habitat for bats. The northern myotis and the big brown bat roost under tree bark and the red bat roosts in dead leaves in trees. Small-footed bats are found in rocky outcrops. Very little is known about the range, habitat, reproduction, and population size of bats in New England. In addition, recent dramatic declines in bats due to the white-nose syndrome raise the importance of Great Bay Refuge as potential habitat for breeding and migrating bats (see Shrub section for bat hibernacula and refugia at Great Bay). The Service is currently conducting a 90-day review for the listing of the northern myotis and eastern small-footed bat. To date, none of the bats caught at Great Bay has shown any signs of white-nose syndrome or wing damage. Much of New Hampshire's Appalachian oak forest is lost to development and large intact stands are rare. The remaining oak-hickory forests have fewer large trees, less diverse understory vegetation, and little coarse woody material on the forest floor.

In the summer and fall of 2006, the Forest Service, Forest Health Protection Group, Durham Office, conducted a forest health assessment on the refuge. Their full report is included as appendix H. In general, the forest stands on the refuge are healthy. However, many stands inventoried were overstocked, large diameter stands. This forest condition is common in stands that have had no active management. In their assessment, the distribution of size classes is not balanced on the refuge and mature size classes are overrepresented. They report that there is a potential for overstocked stands to be less vigorous, more susceptible to pests, lacking adequate regeneration in the understory, and which may lead to the loss of moderate to intolerant shade species in future stands. Their report includes management recommendations. As indicated below under our strategies, we will continue to work with the Forest Service and other forest ecologists to develop specific treatments for managing the refuge's forests.

The 41-acre increase in the Appalachian oak-hickory forest habitat is based on our proposal to allow small (less than 3 acres each) isolated patches of grassland and shrubland habitat, that are otherwise surrounded by trees and not providing quality grassland or shrubland habitat, to naturally revert to mature forest. This is expected to take at least 50 years. Over the next 15 years, however, we anticipate that those grassland patches will only transition to a shrubland-type and existing shrubland will only transition to a sapling-pole stand. Allowing these isolated patches to revert to forest over the long term will reduce edge effect from forest fragmentation, increase habitat for forest interior dwelling species of conservation concern, and reduce the amount of management-intensive habitat on the refuge.

### Strategies

*Continue to:*

- Assess use of refuge's habitats by Indiana bats, eastern small-footed bats, northern myotis, red bats, and other tree bat species using acoustic monitoring and mist nets, and monitor refuge's population for white-nosed syndrome; focus assessment on large diameter trees which may be important summer roosting habitat.
- Complete a vegetation map for Fabyan Point and Thomas property and update the natural community map for the rest of the refuge.

*Within 5 years of CCP approval:*

- Allow an additional 41 acres of grassland and shrubland habitat to naturally transition to forest (705 total acres) by discontinuing mowing.
- Work with forest ecologists to determine appropriate management techniques to sustain species diversity, forest structure, and ecological integrity of the oak-hickory forest community, and develop best management practices (e.g., prescribed fire, silvicultural practices, or passive management) to sustain a healthy oak-pine forest.
- Evaluate and develop management strategies for red pine, which occurs in 44 patches on 25 acres on the refuge. These pines are approximately 170 years old. According to Spurduto (2010 personal communication) red pine start to die out between 170 to 200 years old and may need fire to regenerate, although no evidence of fire is apparent on these sites and they appear to be regenerating naturally.
- Survey for and locate potential roosting sites for bats species known to breed on the refuge (northern myotis, red bat, big brown bat, and eastern small-footed bat) using acoustic monitoring and radio tracking.

- Manage 25 acres of plantations (white pine, red pine, white fir, and white spruce) to ensure succession to oak-hickory forests and control any disease outbreaks.
- Complete inventory and mapping of invasive plants for the refuge.

#### **Monitoring Components**

- Revisit the exemplary Appalachian oak-hickory forests identified by NHB in 1990 to assess their condition. Consult with NHB on this reevaluation. Evaluate the rest of the oak-hickory forest with these sites as reference.
- Monitor the red pine plantation by Woodman Point for successful regeneration, and manage (using prescribed fire) if necessary.
- Develop a long-term monitoring program to track the vegetative and wildlife response to climate change. Project topics may include phenology of plants and birds, species composition, hydroperiods of forested wetlands, and fire regimes.
- Survey forests and adjacent habitats for Indiana bats and other bats species. Use mist-netting and acoustic surveys during breeding, roosting, and migration periods to determine the presence and abundance of bat species. Also, search large diameter trees for bat activity, particularly in summer.
- Continue to partner with the Forest Service Research Station in Durham, New Hampshire, to conduct forest health surveys on a regular basis.
- Annually, monitor the long-term effectiveness of invasive plant treatments.

#### **Objective 2.2 Forested and Scrub-Shrub Wetlands**

Maintain the biological integrity, diversity, and environmental health of 158 acres of forested and scrub-shrub wetlands within the larger matrix of oak-hickory forests and Peverly Brook drainage, to sustain high water quality and native vegetation such as speckled alder, spicebush, silky dogwood, and winterberry, to benefit foraging woodcock, breeding willow flycatcher, other birds of conservation concern, and native plant communities. Ensure less than 10 percent of total vegetative cover of invasive plant species. Also manage wet forests and shrublands that contain functioning vernal pools to benefit vernal pool obligate species of conservation concern, such as wood frog.

#### **Discussion and Rationale**

We detail how we determined what elements comprise the biological integrity, diversity, and environmental health for each of the refuge's plant communities in appendix B (part 1.3). In summary, we reviewed historical conditions, site capability, the current regional landscape conditions, and the biological diversity on the refuge. We also considered natural processes and limiting factors which could potentially affect each plant community.

Approximately 13.5 percent of the Great Bay Refuge is forested or scrub-shrub wetland. As noted in chapter 3, approximately 81 percent of those wetlands are forested and 19 percent is scrub-shrublands. Vernal pools are an important habitat feature that is imbedded in these wetlands types.

In 2000, NHB mapped the following rare natural plant communities on the refuge. They identified four forested wetland community types:

1. Black gum–red maple–basin swamp
2. Seasonally saturated red maple swamp
3. Red maple–elm–ladyfern silt forest
4. Red maple–sensitive fern–tussock sedge basin/seepage

These forested wetlands are scattered throughout the refuge's forest and occur in a range of sizes from 0.27 acres to a 65-acre red maple swamp that is hydrologically connected to Stubbs Pond.

NHB mapped a mosaic of scrub-shrub habitats, including approximately 12 acres of "speckled alder basin/seepage shrub thicket." The moist, silty soils associated with this wet shrub community are particularly suited to alder thickets and hence potential foraging habitat for American woodcock. Moist shrublands are also habitat for several species of concern including willow flycatcher and blue-winged warbler, as well as many other migrating songbirds. Maintaining shrubland habitats in native shrub condition and controlling invasive shrubs requires active management.

Vernal pools are a critical component of these wetlands habitats because they support a wide diversity of species and are essential breeding habitat for some species of amphibians and invertebrates. Black gum basin swamps and other seepages can also function as vernal pools. Wood frogs, spotted and blue-spotted salamanders, and fairy shrimp all depend on vernal pools. Several rare species including Blanding's and spotted turtles also use vernal pools as "stepping stones" as they move from one wetland to another.

A former refuge manager created a 1-acre wetland in 1995 by installing a wooden water control structure to impound several drainage ditches in the former Weapons Storage Area. This wetland holds water during the spring and early summer and goes dry during late summer. Cattails dominate this wetland and a few marshbirds were noted here, such as sora and Virginia rails, and some frogs. We plan to remove the water control structure and plug the ditches to create a wet shrub-meadow to benefit New England cottontail and several bird species of concern, as mentioned above. There is another 1-acre impounded wetland east of Stubbs Pond and adjacent to the large red maple swamp complex. This open water impoundment was likely created with the collapse of a culvert under the access road to Stubbs Pond.

The amount of forested and scrub-shrub wetlands will increase approximately 9 acres from current levels due to the removal of the Lower Peverly Dam and restoration of a portion of Peverly Brook.

### Strategies

*Continue to:*

- Complete the inventory and mapping of invasive plant species. Prioritize invasive species to be controlled and implement control using biological, ecological or cultural, mechanical, prescribed fire, or chemical, as needed.

*Within 5 years of CCP approval:*

- Maintain water control structure off Ferry Way Trail to prevent flooding by beaver.
- Inventory, map, and assess the quality of forested and scrub-shrub wetlands, including vernal pool habitat, rare plants, and rare natural communities. Identify actions that will sustain or enhance these areas, including treating invasive plants, as warranted.
- Remove the water control structure from the 1-acre impoundment in the former Weapons Storage Area and plug the ditches to create wet shrub meadow habitat.
- If the access road to Stubbs Pond is rehabilitated, install a culvert where the current impoundment is to restore hydrological flow on both sides of the road.

### Monitoring Components

- Initiate a cover board project to inventory and monitor use of various habitats by salamanders and snakes. This project will measure presence, abundance, and habitat use by these species.
- Evaluate the existing amphibian and reptile monitoring data, including the deformed frog surveys, to determine other future monitoring needs.
- Continue participation in the U.S. Geological Survey's Amphibian Research and Monitoring Initiative (ARMI) to monitor long-term population trends of vernal pool associated amphibians and for water quality.
- Establish a monitoring program to measure vegetation and hydrology before and after removal of the water control structure in former Weapons Storage Area and near Stubbs Pond.
- Establish a monitoring program to evaluate the long-term effectiveness of invasive plant control.

### Objective 2.3 Upland Shrubland

Annually manage at least 54 acres of upland shrub habitat in three areas (former Weapons Storage Area, along McIntyre Road, and in the old orchard) to support native shrubs and young trees (e.g., highbush blueberry, black huckleberry, dogwoods, arrowwood, bayberry, meadowsweet, raspberry, sensitive fern, sumac, and elderberry) and less than 25 percent cover of invasive plants, to provide nesting and foraging habitat for migratory birds of conservation concern including prairie warbler, blue-winged warbler, eastern towhee, American woodcock, and New England cottontail and other thicket-dependent species.

- Within 5 years of CCP approval, evaluate the feasibility of establishing a captive breeding and/or "hardening" pre-release site for New England cottontail on at least 37 acres of shrubland in the former Weapons Storage Area. If determined feasible, manage these shrublands to provide preferred cottontail habitat which consists of dense native shrubs and vine tangles with a density of 20,000 woody stems per acre that are at least 20 inches tall and less than 3 inches in diameter. Work with partners to release captive bred young to suitable sites to reestablish or augment populations.
- Within 5 years of CCP approval, experiment with modifying two to four bunkers, which lie within shrubland habitat, to provide bat hibernacula and refugia. Work with the Service's NEFO and partners to explore those opportunities.

### Discussion and Rationale

The refuge currently has approximately 26 acres of early successional shrub habitat that is reverting from prior management as grassland or shrubland. We plan to manage an additional 28 acres of shrubland habitat to benefit migratory birds and other shrubland-dependent species of conservation concern. This additional acreage is primarily a result of active shrub management that will occur in the former Weapons Storage Area, which is currently grassland. Invasive species often quickly invade areas that are disturbed on the refuge, particularly grassland and shrubland areas. Autumn olive is particularly difficult to control as it quickly invades open land habitat. The shrub habitat provides nesting and foraging habitat for birds of conservation concern including prairie warbler, blue-winged warbler, eastern towhee, and American woodcock, and habitat for other thicket-dependent species. However, invasive plants also provide dense cover from predators needed by many of these species, particularly New England cottontail. When managing shrublands for birds and New England

cottontail, we will balance managing for a native composition of shrubs while providing sufficient cover and food resources. This is particularly true for New England cottontail habitat in the former Weapons Storage Area, where some areas will initially be allowed to be revegetated by invasives while we restore a more native, higher nutritional shrub cover in other areas.

Shrublands and brushy old fields are critical wildlife habitats that are essential for the survival of many wildlife species. Of the 40 bird species associated with shrubland habitats in eastern North America, 22 are undergoing significant population declines. Forest interior birds also use shrub habitats extensively during the migratory and post breeding period (Rodewald and Brittingham 2004, Vitz and Rodewald 2006, and Chandler 2007). Important habitat characteristics for both shrubland-dependent nesting birds and migrating birds include:

- High dense cover, which provides protection from ground and aerial predators.
- Native fruit-bearing plants; which provide diverse high quality prey base (Vitz and Rodewald 2004).

Additionally, 139 species of reptiles, amphibians, birds, and mammals either prefer (17 species) or use (122 species) shrub and old-field habitats. Shrubland habitats in the Northeast also contain higher proportions of State-listed butterflies and moths than other natural community types. Of 3,500 species of butterflies and moths in the Northeast, 58 are dependent upon shrublands, which provide sunny open areas in combination with desired host plants, such as scrub oak and blueberry. Fifty-six of these are considered rare (Tefft 2006).

Great Bay Refuge supports breeding habitat for several species of shrubland birds, including eastern towhee, prairie warbler, blue-winged warbler, and willow flycatcher. Shrub habitats on the refuge range from alder thickets (described under objective 2.2) to dry, old field conditions. In addition to its value to breeding birds, shrubland habitat is important because many other birds rely on it at various other times of the year. Many shrub species bear fruit in the fall, which helps boost the fat reserves for migrating and overwintering birds. Chandler et al. (2007) found that forest nesting birds preferred shrub habitat during the post-fledgling period, presumably due to its higher insect and fruit abundance. The loss and degradation of naturally maintained shrublands has been extensive throughout the region (Dettmers 2003). In Eastern North America over the last 60 years, open habitats (e.g., grasslands, savannah, barrens, and shrublands) have declined by 98 percent, with shrubland communities comprising 24 percent of this decline (Tefft 2006). Residential development, conversion to other land uses, and natural succession has contributed to the decline of shrub habitats. In southeastern New Hampshire, many shrub communities are now dominated by invasive plants.

The New England cottontail is a candidate species for listing under the Federal Endangered Species Act, and has declined significantly throughout its range. Litvaitis and Tash (2006) estimated the species only occupied 14 percent of its historical range as of 2004, with the population in New Hampshire and Maine persisting in highly developed, fragmented areas. Kovach and Fenderson (2010) found four major genetically distinct subpopulations:

- Maine/New Hampshire
- Cape Cod
- Connecticut/Rhode Island
- Connecticut/New York

All subpopulations face reduced fitness due to habitat fragmentation, with the Maine/New Hampshire and Cape Cod population at the greatest risk of extirpation. A fine-scale genetic study in southern Maine found a drastic reduction in patch occupancy and range contraction from 1997 to 2007, and a 50 percent reduction in effective population size of some remnant populations in the same time period (Kovach and Fenderson 2010).

Strong partnerships are developing in the cottontail rabbit's remaining ranges to manage and restore shrub habitat. However, major barriers to dispersal and rapid loss of genetic diversity and extirpation of local patches indicate that reintroduction and augmentation within each genetically distinct population is a necessary tool for the survival of this species. There is an ongoing effort at the Roger William Zoo in Rhode Island to captively breed and rear New England cottontail. To date, seven rabbits have been taken into captivity from Connecticut. Due to the necessity to maintain genetic separation among the four distinct populations, the zoo does not have the capacity to supply rabbits throughout its range.

We have been in discussion with partners regarding the potential for managing a captive rearing facility in the bunker area of the former Weapons Storage Area. This would increase the amount of shrub habitat that currently occurs on the refuge by approximately 30 acres. The former Weapons Storage Area is currently fenced, which would facilitate cottontail management. A captive rearing program on the refuge would be similar to that implemented for the riparian brush rabbit in the San Joaquin Valley of California, where founder rabbits are rotated through the facility at 6 to 12 month intervals, and then placed in the wild. We will also consider using the area for "hardening," a process in which captively breed rabbits are slowly acclimated to natural conditions prior to being released into the wild.

The refuge does not currently have sufficient shrub habitat to support a viable population of New England cottontail, even over the short term. However, we are exploring the option of working with partners to coordinate the protection of a significant population off-refuge in the Dover, New Hampshire, area.

The majority of bat species are facing unprecedented threats to their population due to white-nose syndrome. The disease was first detected in a cave in New York in 2007. Since then, it has spread to 13 U.S. states and 2 Canadian provinces, from ranging from Newfoundland, West Virginia to Indiana. In 2011, it was also detected in three additional states (Oklahoma, Delaware, and Missouri), however no deaths associated with white-nosed syndrome has been detected in those states to date.

Researchers suspect that a cold-loving fungus (*Geomyces destructans*) is cause of the disease. The fungus appears to disrupt normal patterns of hibernation, causing bats to arouse too frequently from torpor and starve to death. Staggering mortality rates (greater 90 percent in some caves) have pushed even some of the most common species to risk of extinction. Frick et al. (2010) predicted that little brown bats could be extinct in 20 to 60 years. The Service is currently reviewing the northern myotis and eastern small-footed bat for Federal listing (75 FR 38095).

In response to this threat, the refuge is collaborating with numerous partners, including the Service's NEFO, NHFG, and other states and refuges, to conduct a pilot study to adaptively modify two to four bunkers on the refuge to provide suitable hibernacula for bats. The pilot study involves monitoring temperature and relative humidity in the bunkers while we increase insulation and humidity in the bunkers using a wide range of techniques. Bats use military bunkers at

other sites in New England, including those at Odion State Park in Rye, New Hampshire. By modifying additional abandoned military bunkers to suitable hibernacula, we can:

- Provide alternative refugia/hibernacula to surviving bats or non-affected bats.
- Minimize spread of disease by disinfecting hibernacula after bats leave.
- Use bunkers as experimental chambers to eradicate white-nose syndrome or lessen its impact on infected bats.

Bat species that might use these bunkers include big brown bats, little brown bats, northern myotis, and eastern small-footed bat. All species of these are known to occur on Great Bay Refuge during the breeding and migratory season. Northern myotis are the most common species on the refuge.

Another benefit of shrub management is to conceal the existing bunkers. These bunkers are an eyesore in an otherwise natural landscape and cannot be reasonably removed without extensive disturbance and expense.

There are two other shrubland units on the refuge. The first is the 14-acre unit by MacIntyre Road that has sandy soils and supports primarily shrub species. This site could potentially support the State-listed endangered northern blazing star and the State-listed threatened hairy hudsonia. Both plants occur on abutting airport lands. Although these species do not currently occur on the refuge, this is a potential site for reintroduction. The blazing star occurs in sandplain grasslands and other dry, open habitats and may require prescribed fire. The hairy hudsonia also requires sandy areas. The other shrub unit is an old 3-acre orchard directly west of the MacIntyre Road unit. It will continue to be managed as an open orchard for wildlife observation.

Under this plan, as noted above, the overall shrubland habitat acreage on the refuge will increase by at least 28 acres due to active management in the former Weapons Storage Area on areas which are currently in grassland. However, it is also important to note that a few smaller shrubland habitat patches will transition to forest. These patches, each less than 3 acres, are either embedded in, or immediately adjacent to, large forest patches. Because they fragment the existing forest, and/or create additional edge habitat when contiguous forest habitat is a priority on the refuge; they do not provide valuable wildlife viewing opportunities; and, they are not efficient to manage from an administrative perspective, we plan to allow them to transition to forest. Management activities will be minimal in those shrublands, and likely only need to occur to manage invasive plants or pests.

Under Objective 2.1, "Appalachian Oak-Hickory Forests," our long-term plan is to allow small, disjunct patches of grassland and shrubland across the refuge to naturally transition to forest to minimize forest fragmentation and reduce edge effects. However, over the first 5 years of CCP implementation, we will evaluate wildlife use and response in those fields as the vegetation changes. If we find that regionally important shrubland-dependent species of conservation concern are using these areas we will consider actively managing them as shrublands, rather than allowing them to continue to transition to forest.

We may allow an additional 37 acres of grasslands in the former Weapons Storage Area to revert to shrubland if:

- Upland sandpipers do not breed in this field within 3 to 5 years.

- No other grassland species of conservation concern will benefit from those grasslands.

We will also continue to manage some of the former Weapons Storage Area as grassland for wildlife-observation opportunities and administrative purposes (see objective 2.4).

The shrub management areas are depicted on map 4.1.

### Strategies

*Continue to:*

- Complete the inventory and mapping of invasive plant species. Treat invasive plant populations using early detection rapid response methods. Prioritize invasive species to be controlled and implement control using biological, ecological, mechanical, or chemical methods, as needed.
- Maintain the existing shrub habitats using mechanical tools, such as a brush hog or mower.

*Within 5 years of CCP approval:*

- Use adaptive management to modify two to four bunkers to achieve ideal hibernation conditions for cave-dwelling bats (constant temperature above freezing and relative humidity of 80 to 100 percent from late August to May). Potential strategies include the following:
  - \* Close and insulate the door of the bunkers.
  - \* Scrape soil on top of bunkers and adding rigid insulation.
  - \* Plug drainage ditches and add water (small pools or water pumps) to increase moisture in bunkers.
  - \* Install bricks and cinder block walls for added thermal regulation and hibernating surfaces.
- Determine what ecological integrity components should be monitored as part of the managed shrub community and develop a management plan that will sustain the 54 acres on an approximately 15-year rotation.
- Establish partnership with scientists at Boston University to identify and conduct various research projects involving bats and bat ecology.
- Develop a restoration and monitoring plan for the bunker areas at the south end of the former Weapons Storage Area and the areas abutting this site (outside the fenced former Weapons Storage Area) as a shrub community totaling approximately 37 acres or more, using a “brontosaurus” or other mechanical tools, and native plantings as needed. Incorporate monitoring protocols and adaptive management techniques gained from the Regional Shrub Adaptive Management Project led by the Parker River Refuge biologist.
- Collaborate with NHHF and UNH to determine feasibility of starting a New England cottontail captive propagation on the refuge for reintroduction to other areas in the region.
  - \* If found feasible, maintain the existing Weapons Storage Area fence around the proposed native shrub management area to provide safe habitat (free of mammalian predators) for New England cottontails. Shift rest of fence to create enclosure at north end of shrub management area.

- If right conditions achieved for hibernating bats, work with partners to develop a plan to attract bats and manage and/or experiment with different ways to address white-nose syndrome.
- Develop a shrub restoration partnership to propagate native species and work with local contractors to select and transfer dominant shrubs from development sites.
- Determine the distribution and management needs of northern blazing star and hairy hudsonia, and evaluate potential habitat for reintroduction of northern blazing star. If potential habitat is located and reintroductions are possible, develop survey and monitoring protocol for reintroduced populations.
- Evaluate upland sandpiper use in the managed grassland portion of the former Weapons Storage Area. If upland sandpipers do not nest here within 3 years of creating suitable habitat, let the majority of grassland (30 to 35 acres) revert to shrub habitat.
- Evaluate wildlife use and response in the 41 acres of grassland and shrubland we are allowing to naturally transition to forest (see objective 2.1). If these areas are providing regionally important habitat to shrubland-dependent species of conservation concern, evaluate whether the resources are available to actively manage these areas as shrubland, and adjust management accordingly, rather than allowing them to continue to transition to forest.

#### **Monitoring Components**

- Establish a monitoring program to evaluate the long-term effectiveness of invasive plant control treatments.
- Monitor the density and plant composition in the shrub habitat blocks every 5 years to assess management needs.
- Monitor breeding and migratory bird use of shrub habitat after successful establishment and every 5 years as part of breeding bird point surveys. Data collected will include presence/absence and abundance.
- Monitor for other shrub-dependent species, such as black racer and smooth green snake, using the cover board technique or other established protocols.
- Monitor modified bunkers to obtain suitable conditions for hibernating bats (temperature and relative humidity on an hourly to daily basis). If ideal conditions are established, work with partners to continue to monitor conditions and develop an additional strategy for monitoring strategy bat use in the bunkers. Within 2 years of achieving ideal conditions, work with partners to establish a plan for ongoing research on hibernating bats in bunkers.

#### **Objective 2.4 Grassland**

Annually manage the Thomas Field (39 acres) to maintain a mix of grass and herbaceous vegetation at mixed heights ranging from 8 to 24 inches during the summer, with minimal thatch build-up, less than 15 percent of total vegetation of woody species and greater than 5 percent bare ground, to provide nesting habitat for upland sandpiper and other grassland species of conservation concern.

Annually manage the former Weapons Storage Area (38 acres) similar to the Thomas Field. If upland sandpipers do not breed in this field within 3 to 5 years, and no other grassland species of conservation concern would benefit from those grasslands, determine whether to allow the Weapons Storage Area Field to revert to shrubland. Include in that determination whether to maintain a small

portion of grassland in the northwest corner for wildlife observation and cultural interpretation.

Manage the Woodman Point Field (15 acres) to maintain a mix of grassland herbaceous species as nesting habitat for bobolinks, singing habitat for woodcock, and migration habitat for Lepidoptera and other species of conservation concern. Manage the Ferry Way Trail grassland unit (6 acres) primarily to provide habitat diversity for wildlife viewing along the trail and also to support singing habitat for woodcock and migration habitat for Lepidoptera and other species of conservation concern.

### **Discussion and Rationale**

In 2005, refuge staff were managing 21 treatment areas as grasslands for nesting birds and other wildlife, primarily in the former Weapons Storage Area, at Woodman Point, along the refuge road, along Ferry Way Trail, and adjacent to the Thomas Farm. Many of these grassland areas have a component of little bluestem, as well as nonnative grasses. The largest grassland, approximately 70 acres, is in the former Weapons Storage Area. This grassland complex is managed using prescribed fire and mowing to control autumn olive and other woody plants. The 30-acre Thomas field and 24-acre Woodman Point Field complex are mowed and hydro-axed. The remaining grassy areas range from 2 to 4 acres in size and are mowed every 1 to 2 years to benefit woodcock. Since 2008, seven of these treatment areas have been allowed to revert to shrub or forest habitats.

Northeastern grasslands have provided habitat for grassland birds and other wildlife for hundreds of years. Historically, most of northern New England was forested with grasslands generally restricted to scattered small openings along river floodplains, wetlands, and beaver meadows. However in southern New England early settlers described more extensive openings including coastal sandplain grasslands, heathlands, and openings maintained by Native Americans. By the 1800s, grasslands were widespread throughout the region and grassland birds such as grasshopper, savannah, and vesper sparrows, upland sandpipers, eastern meadowlarks, and bobolinks were thought to be prevalent. By the late 1800s grasslands were declining as farms were abandoned, existing farms changed their use of the land, and fire was used less. More recent human development has consumed many remaining open fields. Remnant patches of grasses remain throughout the Northeast along railroad grades, rivers, roadsides, cemeteries, pastures, old fields, and reverting farmlands (Capel 2006).

Grassland bird species recorded during surveys on the refuge from 2001 to 2003 included eastern meadowlark, bobolink, upland sandpiper, field sparrow, red-winged blackbird, American kestrel, and vesper sparrow. Brown thrasher and eastern towhee, two shrubland species, were also recorded. In 2003 and 2004, at least one pair of upland sandpipers was observed using the former Weapons Storage Area and the Thomas field during the nesting season. The Thomas Field pair was observed nesting for the second year in a row.

In the NHWAP (NHFG 2005), “extensive grasslands” are defined as areas greater than 25 acres dominated by grasses, forbs, and sedges with little shrub or tree cover. Large grasslands are particularly important, since many grassland birds require large areas for nesting. The State-listed endangered upland sandpiper, for example, typically requires over 150 acres of grassland that supports a mix of short (greater than 8 inches) grasses for foraging and taller (up to 24 inches) grasses for nesting. They also need taller structures—fence posts, signs, tall mullein—as singing perches. Many of the remaining large

grasslands in New Hampshire are restricted to hayfields, cropland, airports, capped landfills, and military installations, places that do not have wildlife habitat as a primary objective and in some cases may be in conflict with wildlife management (NHFG 2005). The airfield at the Tradeport, adjacent to the refuge, has supported a population of 8 to 12 nesting pairs of upland sandpipers on its 500 to 600 acres of grasslands since 1989. As this is the State's only extant breeding population, the Tradeport and NHFG seek help in managing a second population of upland sandpipers on refuge land. The species has been sighted at several other locations in New Hampshire including Dover, Manchester, and southern Coos County (P. Hunt and D. De Luca, New Hampshire Audubon 2011 personal communication with refuge manager).

Given the regional decline of grassland habitats, the refuge can play an important role in maintaining several large blocks of this habitat. Here, the Service has the capacity to annually manage these habitats to benefit species of conservation concern. The refuge has two sites that lend themselves to managing large blocks of grassland habitat: the north end of the former Weapons Storage Area and the Thomas Field at the south end of the refuge. Although both sites are smaller than the 150-acre minimal patch size, upland sandpipers have nested in both fields in the past, and are known to prefer grassland adjacent to airports (USGS 2006).

Two additional sites will also continue to be managed as grassland. The Ferry Way Trail grassland unit is 6 acres and will be managed to provide a popular and high-quality wildlife viewing opportunity for the public. The 15-acre Woodman Field includes a diverse mix of grasses and flowering herbaceous species.

Another potential area to consider for future grassland management is a 15 to 20 acre field on the northern boundary of the refuge, north of the Ferry Way Trail. A small little bluestem field has persisted there since prior to 2000 (mapped by NHB) without any management. Additionally, the soils adjacent to this small grassland, including the 15-acre pine plantation, are very sandy and suitable for grassland management. Although these grasslands are not suitable for upland sandpipers, they may benefit other wildlife species, such as bobolink, northern leopard frog, smooth green snake, butterflies, moths, spiders, bees, and other insects (NHFG 2005).

Under this plan, grassland acres will be reduced from 169 acres to 98 acres. Of that 71 acre reduction, 28 acres of grassland will be actively managed as shrubland in the former Weapons Storage Area, thus continuing to provide early successional habitat. The remaining 43 acres will be allowed to revert to forest for to reduce forest fragmentation and edge effects. In summary, we will propose to allow fields to revert to forest if they meet at least one of the following criteria:

- They fragment the existing forest.
- Create additional edge habitat when contiguous forest habitat is a priority on the refuge.
- They do not provide valuable wildlife viewing opportunities.
- They are not efficient to manage from an administrative perspective.

Management activities will be minimal in the area allowed to revert to forest, and likely only need to occur to manage invasive plants or pests.

The grassland management areas are depicted on map 4.1.

### Strategies

*Within 2 years of CCP approval:*

- Complete the inventory and mapping of invasive plant species. Prioritize invasive species to be controlled and implement control using biological, ecological, mechanical, or chemical methods, as needed.
- In conjunction with revising the HMP, develop best management prescriptions (e.g., mowing, burning, frequency, seeding, haying, disking, etc.) for maintaining grass-dominated fields of variable sizes as indicated below.
- Enhance the habitat quality of the two larger grassland habitats (39-acre Thomas field and 38-acre former Weapons Storage Area field) for upland sandpipers through annual mowing, burning, and/or other management tools after grassland bird breeding season (August 1). Consider management options that will also benefit pollinators.
- Similarly, manage the Woodman Field (15 acres) as nesting habitat for bobolink, singing grounds for American woodcock, and as migration habitat for Lepidoptera.
- Evaluate site capacity (including soil and hydrology) of all non-administrative grassland units to determine ideal plant species composition and structure, use of management tools such as fire and mowing; and restore to shrub or forest if site is not suitable for grassland management. Evaluate site capacity of shrub unit by MacIntyre Road and the pine plantation by the refuge's northern boundary to be managed as grassland habitat for pollinators, bobolinks, and singing ground for American woodcock.
- Mow the 6 acres of fields along the Ferry Way Trail for early successional species such as pollinators, raptors, and landbirds as well as a wildlife viewing site for visitors.
- Allow eight patches of shrub and grassland openings in the forest to revert to forest to reduce forest fragmentation.
- Except as discussed elsewhere under historic resources, remove any remaining structures. Within the former Weapons Storage Area this will include all above ground structures and possibly some of the bunkers.
- Partner with New Hampshire Audubon and NHHFG to develop methods for enhancing habitat for upland sandpipers on the refuge.

*Within 5 years of CCP approval:*

- Remove remaining Weapons Storage Area fencing and remaining military structures in the grassland management area. Remove hedgerows and small woodlots at the Thomas Field to enlarge the grassland area.

### Monitoring Components

- Continue to monitor breeding birds in the refuge's grassland habitats, according to regional protocol, to determine population trends, density, and use by grassland obligate species (e.g., upland sandpiper).
- Develop monitoring protocol and establish parameters to determine success for restoration of grassland habitat (for upland sandpipers) and for restoration of grasslands to shrub or forested habitat.

**GOAL 3.****Foster and maintain conservation, research, and management partnerships to promote protection and stewardship of the ecological resources of the Great Bay Estuary.****Objective 3.1 Great Bay Resource Conservation, Research, and Management Partnerships**

Maintain and expand current key partnerships to promote land conservation, stewardship, research, and management of resources of concern within the Great Bay Estuary. These partnerships include the Great Bay Resource Protection Partnership, Piscataqua Region Estuaries Program, Coastal Watershed Invasive Plant Partnership, Pease Development Authority Wildlife/Bird Strike Hazard Committee, and the New England Cottontail Working Group, among others.

**Discussion and Rationale**

GBRPP is a coalition of public and private conservation groups that formed in 1994 to help protect the remaining important habitats within and around Great Bay. GBRPP takes a comprehensive, landscape-scale approach to conservation and habitat protection by developing and implementing conservation strategies through a combination of scientific field studies and ongoing communication with local, regional, State, and national conservation representatives. Parker River Refuge's refuge manager attends the quarterly meetings of GBRPP. Since 1996, the partnership has protected over 5,000 acres of habitat around Great Bay.

In 1992, a MOA was signed between the Service, Federal Aviation Administration, U.S. Department of Agriculture–Animal and Plant Health Inspection Service), and Pease Development Authority. The MOA calls for coordination and quarterly meetings among the parties to review and discuss past and future wildlife management practices by the Service on the refuge and Pease Development Authority at the airport; the effects of such management practices on airport operations and on Service trust resources; and airport facility aircraft operations and their potential effects on the refuge (MOA 1992). This group is referred to as the Wildlife/Bird Air Strike Hazard Committee. Current issues include managing upland sandpipers that nest on the airport, impacts of large birds, such as wild turkeys, on the runway, and addressing potential impacts to the refuge from new de-icing pads and other sources of runoff.

As previously mentioned, Great Bay Refuge is a “sustaining partner” of CWIPP, a partnership among 11 agencies and organizations concerned with the effects of invasive plants within New Hampshire's coastal watershed. The goal through this cooperative effort is to achieve better management of invasive plants while improving working relationships between the signatories and the public.

We will also expand our partnerships to include the New England Cottontail Working Group, as well as partnerships with local land trusts and other private land management cooperatives in the region that have a goal to conserve lands of high resource value to Federal trust species.

**Strategies**

*Continue to:*

- Be an active member of GBRPP and serve on the Principal Partnership and Stewardship committees.
- Participate on the Pease Development Authority Wildlife/Bird Airstrike Hazard Committee.
- Serve on the PREP Management Committee.
- Participate in oil spill response training and coordination. One important reason to stay current on these skills is as a precaution in the unlikely event that an accident occurs with the shipping traffic up the Piscataqua River.

- Partner with the town of Newington, NHFG, and regional Service personnel on law enforcement on and around the refuge.
- Attend CWIPP meetings and actively participate in coordinated invasive control and outreach efforts.

*Within 2 years of CCP approval:*

- Facilitate research on the refuge, with focus on research that supports management goals and objectives, such as groundwater studies, hydrology, land use change impacts, habitat management, and habitat restoration. Identify refuge research needs and establish links with partners who can assist the refuge in researching these management questions; specifically, partner with the GBNERR and the National Estuarine Research Reserve's Science Collaborative.
- Work with the New England Cottontail Working Group to implement habitat improvements and opportunities for cottontail recovery. Evaluate the feasibility to propagate and restore New England cottontails to the refuge, specifically within the former Weapons Storage Area.
- Support research by partners in the Great Bay Estuary on conservation and management of eelgrass and oyster restoration, Great Bay water quality, and other topics that are linked to the refuge's goals and objectives.
- Work with Service's Ecological Services Private Lands Program to identify and evaluate projects that will support or enhance refuge goals and objectives on other ownerships in the area and provide other resource assistance when possible.

*Within 5 years of CCP approval:*

- Enhance and strengthen collaboration with UNH's Jackson Lab in research and restoration of the Great Bay Ecosystem, particularly with restoration of eelgrass and oyster beds, salt marsh research, and monitoring water quality in the bay.
- Work with partners around Great Bay to create habitat management demonstration areas on the refuge and partner lands, including demonstration of invasive species control, grassland and shrubland management, dam removals, and oyster bed restoration. Facilitate technical workshops pertaining to the demonstration areas.
- Become a signatory to the CWIPP agreement.

*Within 10 years of CCP approval:*

- Establish partnership with Pease and Great Bay Country Clubs to develop management plans for their lands that contributes to the goals and objectives of the refuge and local conservation partnerships.

**Monitoring Component**

- The Air Force will continue its long-term groundwater well monitoring on the refuge to monitor water quality impacts from previous military uses. Obtain and interpret the results of this monitoring relative to refuge management. Adapt management practices accordingly.
- Develop a long-term monitoring plan to help identify and remediate (as feasible and necessary) potential offsite source of pollution that could negatively impact the refuge.

### Objective 3.2 Landscape-scale Conservation Partnerships

Over the next 15 years, expand partnerships to address the refuge's role in landscape-scale conservation issues including climate change, regional population trends, research priorities, land use changes, and water quality.

#### Discussion and Rationale

GBNERR is also a member of GBRPP and the boundary of the reserve encompasses Great Bay Refuge. The Research Reserve System recently established a science collaborative, to fund cooperative, science-based projects that address coastal management issues. The priority research areas include impacts of land use change, habitat change and restoration, estuarine contamination, and stormwater and nonpoint source pollution management. GBNERR is specifically interested in water quality, land use change, biological communities, and climate change. The Service is interested in collaborating with the reserve and other researchers on many of these issues.

In 1999, the Service launched the nationwide Land Management Research and Demonstration (LMRD) Areas "...to facilitate development, testing, teaching, publishing, and demonstration of state-of-the-art management techniques that support the critical habitat management information needs for fish, wildlife, and plant conservation within the System and other lands" (USFWS 1999). Two LMRD areas were established in our region: the Northern Forest LMRD and the Coastal Salt Marsh LMRD. Partnerships are a key element of demonstration areas. The Great Bay Refuge will partner with other participating national wildlife refuges, State and Federal agencies, universities, and others to further research on and off the refuge to advance our understanding of wildlife habitat concerns in the northern forest and coastal salt marshes.

The greatest effects of climate change will be on regional air and water temperatures, precipitation patterns, storm intensity, and sea levels. These effects are predicted to influence natural disturbances by resulting in an increase of freeze-free periods, decreased snow cover, increased storm intensities and frequencies, increased likelihood and frequency of droughts, damaging ozone, and an increase in the spread of invasive species and disease (NHFG 2005). The resulting effects on wildlife and habitats are expected to be variable and species-specific, with a predicted general trend of ranges shifting northward. The uncertainty about the future effects of climate change requires managers to use adaptive management to maintain healthy ecosystems in light of that unpredictability (Inkley et al. 2004). Tidal marshes are among the most susceptible ecosystems to climate change, especially rapid sea level rise. The refuge expects to partner at all levels—around Great Bay, within New Hampshire, regionally and nationally—to address this immense conservation challenge.

#### Strategies

*Within 5 years of CCP approval:*

- Conduct a research needs assessment for the refuge. Emphasize research projects that evaluate our assumptions, objectives, strategies, and techniques on species, habitat, and ecosystem management.
- Develop information exchange for research. Seek research partnerships to foster collaborations across the region.
- Collect information that contributes to regional information needs such as winter banding of waterfowl to help define populations.
- Identify the role of the refuge in contributing to the Service's 5-Year Action Plan on climate change and support similar initiatives in NHWAP and NHCP.

- Participate in and support the priorities of the North Atlantic LCC.
- Collaborate with GBNERR on monitoring sea level rise as part of national effort. Assess feasibility of having refuge install a sediment elevation table (SET) in the refuge salt marsh.
- Work with PREP to support the EPA climate ready estuary project; Work with GBNERR and Great Bay Stewards to develop and outreach impacts of human land use and climate change on the bay's resources, and facilitate implementation of mitigation measures by the bay's residents and visitors.
- Establish a partnership with UNH and the Jackson Lab to work with the refuge in addressing research needs.

#### **Monitoring Components**

- Continue to participate in regional ecological studies, such as malformed frog surveys, land bird monitoring, frog call surveys, analyses of mercury in fish, and invasive plant distribution surveys and control methods.
- Collaborate with the Service's Regional Inventory and Monitoring Program and our Great Bay partners to monitor long-term trends associated with climate change and effectiveness of mitigation measures.

#### **Objective 3.3 Education and Outreach Partnerships**

Within 5 years of CCP approval, support and coordinate with area environmental education facilities such as the Great Bay Discovery Center and the Seacoast Science Center, as well as area schools, to advance wildlife conservation and refuge goals.

#### **Discussion and Rationale**

Similar to many refuge programs, partnerships are key to the success of our environmental education and outreach programs. Specifically, refuge staff have partnered with the Youth Conservation Corps (YCC), Student Temporary Employment Program (STEP), Student Career Experience Program (SCEP), and the Phillips-Exeter Sustainable Program to complete projects on the refuge. The students gain valuable experience and the refuge completes much needed management activities.

By collaborating with and supporting area environmental centers, including local schools, the refuge can affect a wide range of environmental education opportunities. The Great Bay Discovery Center, on the shores of Great Bay in Greenland, serves as the conservation-education headquarters for GBNERR. Their facility offers interpretive displays, meeting space for workshops, outdoor interpretive trails, and reaches people of all ages with stewardship messages. Likewise, the Seacoast Science Center has many similar features. By working together on stewardship messages, and sharing resources where feasible, we can multiply our individual efforts into a more effective collective effort to promote environmental stewardship in coastal New Hampshire.

#### **Strategies**

*Continue to:*

- Partner with YCC program.
- Use the STEP and SCEP programs to mentor students and achieve refuge goals and objectives.
- Help CWIPP develop fact sheets on priority invasive species.

- Collaborate with Phillips-Exeter Academy students to complete refuge projects.

*Within 2 years of CCP approval:*

- Add a Web site link to GBNERR and other relevant links (such as Save Great Bay on Coastal Program Web site) on the Great Bay Refuge Web site.
- Work with the GBRPP to create regional recreational access information and maps that highlight locations around the bay where recreational activities can occur, especially those not available on the refuge such as kayak/canoe launch points.
- Collaborate with the Great Bay Discovery Center and GBRPP on educational and interpretive programs, materials, and maps; share outreach messages.
- With partners develop stewardship outreach material and program to reduce pollution and fertilizer runoff from residential and commercial facilities.
- Collaborate with local schools, GBNERR, and Gulf of Maine Institute (GOMI), to establish a coastal environmental stewardship and advocacy team with high school students in New Hampshire (see Newburyport, Massachusetts, high school team as example and other GOMI-sponsored team).
- Seek a volunteer willing to coordinate the volunteer program to improve organization, recruit new volunteers, and help prioritize and implement work.
- Create an orientation program for all volunteers and expand volunteer corps.
- Work with the Pease Development Authority and Great Bay Stewards to establish a Friends of Great Bay Refuge group.
- Partner with the New Hampshire Office of Tourism, New Hampshire Department of Transportation, Pease Development Authority, and others to provide information on the refuge, including signs, maps, and directions to the refuge.

#### **GOAL 4.**

**Promote enjoyment and awareness of the Great Bay Refuge and Great Bay Estuary by providing high-quality, compatible, wildlife-dependent public uses on refuge lands and on partner lands and waters around the refuge.**

##### **Objective 4.1 Wildlife Observation and Photography**

Provide enhanced high quality wildlife observation and photography opportunities by improving the refuge's two existing trails and pursuing new self-guided opportunities on Fabyan Point.

##### **Discussion and Rationale**

The Refuge Improvement Act of 1997 identified wildlife observation and photography as two priority public uses for national wildlife refuges, along with environmental education, interpretation, hunting, and fishing. In 2006, the Service's regional visitor services team identified wildlife observation and photography as areas of emphasis for Great Bay Refuge.

As an unstaffed refuge, we have had limited ability to conduct a vibrant visitor services program. Despite these limitations, the refuge is popular, especially for birders and walkers. The refuge is open from dawn to dusk, with vehicle access controlled by a timed gate along Arboretum Drive. The trails are for foot traffic only. The Peverly Pond Trail is wheelchair accessible. Bicycles and motor vehicles are limited to the entrance road and parking lot. Pets are only allowed in the

USFWS



Great blue heron

vehicle-accessible areas and only on leash. All other areas beyond the parking lot and the two trails are closed to the public.

The existing trails lead to several different habitat types including freshwater wetlands, fields, oak-hickory forests, and the shores of the Great Bay Estuary. They are accessed from the visitor parking lot at the end of Arboretum Drive, adjacent to the refuge office building (map 4.2). The 2-mile Ferry Way Trail begins across from the parking lot and starts out as an asphalt path next to a chain link fence (the former Weapons Storage Area). A leisurely walk on this trail takes about 2 hours. The 0.5-mile Peverly Pond Trail begins to the east of the parking lot.

Three Service staff conducted a visitor services review of the refuge in fall 2009. The review is part of the CCP planning process and provides recommendations to improve the quality of the visitor services at the refuge. Given the lack of staff and closure of the refuge office in recent years, many people are unaware of the visitor services opportunities available on the refuge. The recommendations included modest improvements to the existing trails and interpretive materials and structures to enhance the existing wildlife viewing and photography experience at the refuge, as well as attract more visitors. This in turn offers an opportunity to reach more people with key stewardship messages.

### Strategies

*Continue to:*

- Pursue funding to construct a boardwalk along the entire Peverly Pond Trail to meet accessibility standards.
- Maintain the view from the Ferry Way Trail observation deck by pruning shrubs and brush that grow in over time.

*Within 3 years of CCP approval:*

- Reroute the Peverly Pond Trail and modify Ferry Way Trail to improve wildlife viewing opportunities.
- Add benches and an interpretive sign to the wildlife observation blind.
- Highlight wildlife observation and photography opportunities on the Great Bay Refuge Web site.
- Improve trail sign location, including installing “No Dogs” and “No Bicycles” signs at trailheads.
- Construct an elevated observation platform overlooking the former Weapons Storage Area with interpretive panel, once the former Weapons Storage Area fencing and structures are removed.
- Remove roads around buildings in the former Weapons Storage Area once buildings are demolished.
- Develop a bird or watchable wildlife checklist for the refuge.
- Create a hotspot for the refuge on eBird and encourage visitors to post their sightings. Include a link to eBird on the refuge’s Web site.
- Conduct a refuge photo contest during June through August. Check with local businesses for potential prize donations.

- Work with area biking enthusiasts to develop a bike access onto McIntyre Road at juncture with the refuge entrance road underpass.
- Develop a more effective method for gathering visitor services data (e.g., number of daily visitors, visitor uses, and experiences at refuge).

*Within 10 years of CCP approval:*

- At Fabyan Point, pursue acquisition of public access right-of-way and upgrade road conditions to allow safe passage of public vehicles.

■ *Within 15 years of CCP approval:*

- If the public access right-of-way at Fabyan Point is acquired, we will use a staged approach to upgrading and constructing facilities there. If feasible, there are no safety concerns, and there are no anticipated negative impacts to wildlife, we will:

- ✱ First, make minor improvements to the road, create several parking places, and build an interpretive kiosk.

- ✱ Second, construct a trail and viewing platform.

- ✱ Finally, construct a car top-only boat launch.

#### **Objective 4.2 Environmental Education and Interpretation**

Within 5 years of CCP approval, 90 percent of refuge visitors contacted will be able to identify the refuge's purpose, name at least one habitat and associated wildlife species of conservation concern, or know the regional importance of the refuge through their experiences at the refuge or with one of our partners around Great Bay.

#### **Discussion and Rationale**

Great Bay Refuge is close to a highly populated area. Yet, due to the lack of staff, closed office, and history as a former military base, many members of the local community do not realize that the refuge is open to the public. Yet, the refuge has many unique natural resources and a diverse cultural history to share with visitors. The absence of dedicated visitor services staff for the refuge has resulted in few public interpretive programs or environmental education on or off the refuge. The refuge currently relies on volunteers to lead walks or other interpretive programs, which depends solely on their interest and availability. We continue to receive more requests for these types of programs than we can currently fill. Right now, our major interpretive materials consist of a general station brochure and one kiosk that provide information on the refuge, wildlife, and refuge management.

The refuge Web site also lacks information or links for teachers or students. Census estimates for 2008 indicate that 139,546 persons under 18 years old live in the three counties closest to the refuge: Rockingham and Strafford Counties in New Hampshire and York County in Maine. There is a tremendous opportunity for the refuge to help with environmental education in the area and to increase the appreciation and stewardship of the refuge through greater interpretation.

#### **Strategies**

*Continue to:*

- Provide limited environmental education and interpretation programs upon request.
- Use volunteers, if available and interested, to conduct occasional guided walks along existing trails.

*Within 2 years of CCP approval:*

- Update exhibits and information panels and refuge Web site; improve visitor orientation.
- Set up a wildlife observation log book and a visitor register at the main kiosk.
- Reroute the Peverly Pond Trail and modify Ferry Way Trail to improve wildlife viewing opportunities. Once the former Weapons Storage Area fence is removed, shift the Ferry Way Trail as appropriate.
- Initiate guided interpretive walks that can be led by partners and volunteers.
- Investigate opportunities to engage more youth programs on the refuge and on partner lands.
- Investigate opportunities to expand relationship with faculty and student programs at Phillips-Exeter to expand research projects.

*Within 5 years of CCP approval:*

- Develop three to five key environmental education messages, and activities associated with each message, about the refuge flora, fauna, habitats, and ecosystems that can be used in environmental education programs with local school teachers, college faculty, and youth group leaders.
- Develop key interpretive themes and the major messages to convey about the refuge, its role in regional conservation, and how citizens can become better stewards of the environment. Use these themes and messages to update the interpretive panels at main kiosk at parking lot.
- Collaborate with GBNERR to create shared stewardship messages and interpretive materials.
- Develop curriculum-based, multi-sensory, interdisciplinary, and learner-based environmental education activities that can be lead by volunteers. Partner with others such as UNH Cooperative Extension Coverts Project, UNH Marine Docents, Seacoast Science Center, Great Bay Discovery Center, and others.
- Develop interpretive materials to highlight the prehistoric and historic land use history of the Great Bay area and the rich cultural history of refuge lands, including the history of Pease Air Force Base and its relationship to the Cold War.
- Replace the current paved parking lot with a permeable surface. Consult with the UNH Stormwater Management Center to determine appropriate design and materials, and develop interpretive materials related to design.

**Objective 4.3 Hunting**

Continue to provide a quality hunt program to manage wildlife populations, protect habitat, and provide a priority, wildlife-dependent recreational opportunity.

**Discussion and Rationale**

Prior to Service ownership, deer and waterfowl hunting were permitted by the Air Force, but it was limited to military personnel, retirees, and their dependents, and was only allowed in certain areas. From 1967 to 1989, the Air Force used hunting as a management tool, due to the need to minimize aircraft strikes on the runway. It was estimated that 8 to 10 deer were taken annually from throughout the former Pease Air Force Base. The Air Force also permitted waterfowl hunting only on Stubbs Pond and only for Air Force personnel,

dependents, and retirees. The former base was closed to hunting from 1989 to 1993 in advance of the land transfer to the Service (USFWS 1995).

When the refuge was first proposed, the Service received public comments that a public deer hunting should continue, while others suggested that it be used only as a biological management tool. In response to these comments, a Hunt Plan was completed for the refuge in 1993 (USFWS 1993). In 1995, the Service completed an EA to evaluate establishing and conducting an annual, public white-tailed deer hunting program and waterfowl hunting program on the refuge. The decision from this EA was to open the refuge to controlled hunting of white-tailed deer in accordance with all Federal, State, and local regulations (USFWS 1995).

The first white-tailed deer hunt on the refuge occurred in the fall of 1996 and has been held every year since then. The hunt is a 2-day, Saturday and Sunday hunt, by fee permit only. A maximum of 20 permits per day are drawn from a pool of applicants each year. From 1996 to 2007 the number of hunters has ranged from 13 to 22. The number of deer harvested during a given hunt has ranged from 8 to 22 deer, with a mix of does and bucks taken. The refuge is closed to all other public uses during the 2-day deer hunt.

The refuge shoreline is open to waterfowl hunting under state seasons and regulations, with access by boat only. Land access for waterfowl hunting is not allowed on the refuge. Only occasionally are a few waterfowl hunters observed using the area.

Both Pease Airport Authority and NHFG support offering a wild turkey hunt on the refuge. First, offering a wild turkey hunt will provide a priority, wildlife-dependent recreational opportunity to refuge visitors. According to NHFG, there is an adequate population of wild turkeys at the refuge to support a hunt (Bridges 2011 personal communication). Second, Pease Airport Authority believes a hunt would help reduce the airport's turkey population. Currently, turkeys are the greatest hazard to airport operations (i.e. bird-air strike hazard). Although we do not have a specific proposal, we will evaluate whether to offer either a spring or fall turkey hunt, or both. During the State's spring turkey season, hunters are only allowed to harvest males (gobblers). However, hunters are allowed to harvest females during the fall season, which will likely better control the turkey population. We will also consider developing a youth turkey hunting program, in cooperation with NHFG and other partners, to extent practicable and there is interest.

### Strategies

*Continue to:*

- Provide a 2-day lottery deer hunt, with a maximum of 20 fee permits issued. Work with NHFG to handle the permit applications.
- Provide a waterfowl hunt according to 50CFR (Part 32, Subpart B, § 32.48), including limiting access to the refuge shoreline by boat only launched from areas outside the refuge.
- Maintain closure on recreational trapping on the refuge.

*Within 3 years of CCP approval:*

- Evaluate the opportunity to expand the hunt program to include a fall bow season for deer and a turkey season. Develop a youth turkey hunting program, in cooperation with NHFG and other partners, to the extent practicable and there is interest. Pursue all administrative procedures necessary to pursue the expanded hunt opportunities, including NEPA and public involvement, as warranted.

- Work with NHFG to evaluate closing the shoreline of the refuge, including Herods Cove, to waterfowl hunting to protect estuarine habitats and associated species.

#### **Objective 4.4 Fishing**

Provide maps and other information about off-refuge fishing opportunities to refuge visitors and continue to assess the potential to open the refuge to fishing in the future by annually monitoring the level of contaminants in refuge sediments and fish, and assessing the potential health risks from consuming refuge fish.

##### **Discussion and Rationale**

Upper Peverly, Lower Peverly, and Stubbs Ponds were historically stocked and fished by the Air Force as we detailed in chapter 3 under “Freshwater Impoundments.” The two Peverly Ponds were stocked with largemouth bass, rainbow trout, and brook trout. Upper Peverly Pond was also stocked with crayfish. Stubbs Pond was stocked with largemouth bass, crayfish, and alewife.

Despite this fishing history, recreational fishing is not currently allowed on the refuge due to concerns with contaminant levels in the sediments and fish and potential risks to human health. Mercury is present in the fish in Upper Peverly Pond. Before any public fishing is allowed, additional fish studies should be done. We will continue to promote other off-refuge fishing opportunities around the Great Bay Estuary.

##### **Strategies**

*Continue to:*

- Keep refuge closed to fishing, but promote fishing opportunities available at established fishing sites around Great Bay.
- Prohibit boats from landing on refuge shoreline.
- Conduct outreach and enforcement to ensure that fishing and boat landings do not occur.

*Within 1 year of CCP approval:*

- Develop a fact sheet on why fishing is not allowed on the refuge and that identifies off-refuge sites where individuals can fish.
- Train volunteers to answer questions about fishing.

*Within 5 years of CCP approval:*

- In conjunction with water quality studies in the Peverly Brook system, establish a schedule to conduct periodic sampling of fish to determine whether they continue to pose a risk to human health if consumed. Establish conditions under which, over time, the refuge might consider opening up to recreational fishing.

#### **GOAL 5.**

**Contribute to the recovery of the federally endangered Karner blue butterfly and other rare Lepidoptera through the conservation, protection, and restoration of the pine barrens habitat.**

#### **Objective 5.1 Habitat Management**

Working with NHFG and other partners, protect, manage, and restore historic pine barren communities in the Concord area, including the refuge’s 29-acre conservation easement, to benefit the federally endangered Karner blue butterfly, other rare Lepidoptera, and shrubland bird species.

##### **Discussion and Rationale**

Great Bay Refuge also includes a 29-acre conservation easement in the pine barrens of Concord, New Hampshire, in Merrimack County (map 4.4). The

property is managed primarily for the federally endangered Karner blue butterfly. The conservation easement is approximately 45 miles west of Great Bay Refuge. The parcel abuts the Concord Airport and is within a fragmented, but important complex of remnant pine barrens habitat that supports rare moths and butterflies. The conservation easement land is a mix of open pitch pine-scrub oak, pine-hardwood, and other scrubland.

Karner blue butterflies inhabit pine barrens, an early successional community composed of 4 distinct vegetative layers: herbaceous, heath, scrub, and canopy. Within the scrub and canopy layer, shade-providing pitch pine and scrub oak dominate. The lower layer includes grasses, vascular plants, and heath. Throughout these layers little bluestem and big bluestem are the principle grass species. New Jersey tea, spreading dogbane, lowbush blueberry, and huckleberry, as well as State threatened wild lupine, blunt-leaved milkweed, and golden heather comprise the majority of the herbaceous and heath layer and provide a critical source of nectar (USFWS 2003).

Currently, Karner blue butterflies are restricted to fragmented pine barren remnants, highway and powerline rights-of-way, airports, military camps, and gaps in forest stands that support their required host plant, wild lupine (USFWS 2003). Karner blue butterflies, as well as other members of the family Lycaenidae, are highly susceptible to environmental changes and population declines. The limiting factors for Karner blue butterflies have been compounded by a severe loss of habitat. Nearly 90 percent of historic pine barren communities along the Merrimack River have been lost (Helmbolt and Amaral 1994). This makes the 29-acre Karner blue butterfly conservation easement especially important to the survival of this species in the Concord Pine Barrens. Habitat restoration and management on the Karner blue butterfly conservation easement began in 1996 and has included removal of overstory vegetation using a hydroax, brontosaurus, pruning, and prescribed fire to create openings and grassy patches to allow wild lupine, the host plant of larval Karner blue butterflies, to thrive. The U.S. Department of Agriculture–Wildlife Services assisted with woodchuck removal and fencing to prevent browsing of lupine. Over time, most of the 29 acres has been managed.

In 2004, a spearhead was found on the conservation easement, which changed the pace and process for active management. We have been cooperating with the SHPO to conduct surveys in areas they request. The SHPO has also reviewed the 5-year Lupine Restoration Plan and indicated several areas where they recommend testing occur. An old farm site dating to 1800s is also on the conservation easement. NHFG is developing methods for planting native lupine seed that would avoid conflict with cultural resources.

Concord school kids have helped grow and plant lupine. “Kids for Karners” is a program started by National Wildlife Federation and NHFG around 2000. In the past 9 years, over 1,700 lupine plants have been grown by local school children and planted on the Service’s conservation easement. The project includes a teachers training in the winter, classroom plantings in the spring and a field trip to the conservation easement at the end of the school year to plant lupine and tour the Concord Pine Barrens.

In addition to habitat management on the 29-acre conservation easement, NHFG also currently manages 320 acres within conservation management zone of 450 acres on city of Concord lands. Although, these 320 acres and the Service’s conservation easement provide important habitat for the Karner blue butterfly, additional habitat is needed to help recover the Karner blue butterfly. Historically, natural disturbances and Native American settlement patterns maintained open habitat for Karner blue butterflies in the Northeast. The Karner blue and its required host plant, wild lupine, have persisted in some

developed areas, such as airports, utility rights-of-way, and road edges because moderate human disturbances mimic beneficial natural disturbances. However, urbanization and fragmentation by roads and development in parts of the butterfly's range may have already degraded populations beyond what is needed to maintain viable populations (USFWS 2003, Fuller 2008). The butterfly can disperse across roads but may be hampered by traffic and wind. Also, small, isolated habitat patches do not seem to retain these butterflies (Fuller 2008). Preventing further fragmentation of existing habitats and connecting corridors is an important management priority.

Although intense development and habitat fragmentation continues in the region around the Concord Pine Barrens, the remaining undeveloped lands from the airport south to the Merrimack River are still mostly pine barrens habitat. Historically, the Concord area has always been an important patch of habitat for the Karner blue butterfly population along the Merrimack River corridor. Major development in the corridor has degraded or eliminated habitat; the exclusion of fire has also degraded pine barrens, which is fire-dependent.

NHFG has identified potentially restorable areas between the powerline, which extends through the refuge's conservation easement, and the Merrimack River. This was identified as the best location to focus effort on Karner blue butterfly recovery. Karner blue butterflies have been observed traveling up to 1 mile along the powerline corridor. The Army National Guard is in the process of acquiring the remaining potentially good undeveloped Karner blue habitat south of the current management area. They plan to construct a classroom-training facility in the front section of the property, with a lighter footprint in the back of the property. NHFG intends to work with the Guard on maintaining as much Karner blue butterfly habitat as possible.

### Strategies

*Continue to:*

- Compile current cultural resource inventories and, in cooperation with SHPO, identify additional survey work needed to protect cultural resources in conjunction with site plan implementation.
- Support NHFG with habitat management actions, including prescribed burning, when and where resources allow.
- Post and maintain conservation easement boundary and protect habitat from adverse impacts.
- Identify funding sources or mechanisms to maintain sufficient funding for habitat management.

*Within 3 years of CCP approval:*

- In partnership with NHFG, the Service's Ecological Services, city of Concord, landowners, and other partners, evaluate role of the refuge in acquiring additional lands—in fee simple or conservation easement—from interested landowners within the focus area, to expand protection and management for the federally endangered Karner blue butterfly (see the discussion on "Land Protection Focus Areas" under "General Refuge Management"). If determined that refuge has a role, then proceed with necessary administrative process. The Service will only acquire lands from willing sellers, either in fee simple or as conservation easements.
- Work with Service's Ecological Services Concord, New Hampshire, office to review the ESA Section 7 consultation for Karner blue butterflies completed for the CCP to ensure that it continues to cover management activities on the conservation easement and adjacent airport, including incidental take.

- Update HMP to include habitat management for the Karner blue butterfly conservation easement. Include information such as which vegetation manipulations should occur, when they should occur, and/or under what conditions. Potential treatment methods including prescribed fire, hydroaxing, brushhogging, herbicides, manual pulling, planting, or seeding of native lupine.
- Facilitate NHFG's efforts to seed native lupines and avoid conflict with cultural resources; schedule archaeological surveys as soon as practicable in high priority lupine seeding sites.
- Support NHFG and the Service's Ecological Services office efforts to protect and manage additional acreages to meet revised population and goals identified in latest population viability model.

#### **Monitoring Components**

- Prioritize monitoring needs in conjunction with site plan implementation.

### **Objective 5.2 Species Management**

In collaboration with New Hampshire Fish and Game and the Karner Blue Butterfly Recovery Team, restore and sustain a viable Karner blue butterfly population for the entire Concord Pine Barrens recovery unit through captive rearing and release. The population goal for the conservation easement is a viable sub-population that produces at least 750 wild-born individuals in any one brood on the Service's conservation easement lands, sustained for at least 4 out of 5 consecutive years.

#### **Discussion and Rationale**

In 1992, the Karner blue butterfly was listed as federally endangered. The population at the Concord Pine Barrens is the only population in New England. The distribution of Karner blue butterflies is largely dependent on the availability of wild lupine, their larval food source, and preferred native nectar sources (Schultz and Dlugosch 1999). These plants occur in pine barrens communities, which occur primarily on glacially deposited sand, shale, and serpentine soil types in parts of eastern North America (NHFG 2006). In New Hampshire, this community type once spanned the Merrimack River valley from Canterbury to Nashua, occupying Windsor sandy loams and Hinckley cobbly sandy loams (VanLoven 1994). Today, only the Concord Pine Barrens supports a population of Karner blue butterflies. The Concord population represents the easternmost extent of this species' distribution and is separated from the nearest population in New York by over 140 miles (225 kilometers) (Helmbolt and Amaral 1994). This butterfly formerly occurred in a band extending across 12 states from Minnesota to Maine and in the province of Ontario, Canada.

Without enough suitable habitats to support a viable population, the Karner blue butterfly was extirpated from New England in 2000 (Amaral 2000), and was subsequently reintroduced. The PSNH lands off Pembroke Road, north of the conservation easement, was the site of the last remaining wild population. In 2000, TNC found only 6 eggs, none of which hatched. NHFG began a captive rearing program in 2000 to restore a viable population. The Karner blue butterfly captive rearing and reintroduction program is funded by the State and paid for with State Moose Plate Grants and Section 6 grants. The first adults from a population in New York were released in 2001. The first eggs and larvae were released in 2003. The program has focused primarily on the rearing and release of adult butterflies. Mark-recapture has been actively implemented since 2004 to track survival and breeding in the wild. The first mark-recapture surveys during the 2004 summer flight resulted in the observation of 22 "wild-born" unmarked Karner blue butterflies on the conservation easement (out of 31 total including surrounding conservation lands on the airport). From 2001 to 2008, butterflies were only released on the conservation easement. The first release of butterflies on non-easement land occurred in 2009 due to a significant increase in

captive reared adult numbers. In 2010, two releases of adult butterflies occurred (over 2,500 individuals in the Concord Pine Barrens).

Karner blue butterflies live only 4 days as adults. Each year, the population can produce two broods, with each brood being a separate generation. The highest population numbers from either brood in a particular year is used for recovery goal population estimates. The Karner Blue Butterfly Recovery Plan has a goal of one viable population in the Concord Pine Barrens recovery unit, consisting of 3,000 wild-born individuals. A viable population is further defined as a minimum 3,000 individuals (in either brood) that is sustained for at least 4 out of 5 consecutive years. Any year that does not meet 3,000 individuals, has to have a minimal population of at least 1,500 individuals, and the final year has to reach at least 3,000 individuals. Recent population viability analyses indicate that 3,000 individuals are not sufficient to sustain a viable population (Fuller 2008), and the recovery goal may be updated in the future.

In 2008, the conservation easement produced 56 wild individuals. In 2010, the entire Concord Pine Barrens produced 313 wild individuals and a total of 3,749 captive-reared individuals were released (1,300 individuals in the first brood; 2,449 individuals in the second brood).

### Strategies

*Continue to:*

- Support the Karner blue butterfly captive rearing and translocation program conducted by NHFG, through the partnership outlined in objective 5.4.
- Implement recovery plan actions when and where possible.

*Within 2 years of CCP approval:*

- Evaluate effectiveness of captive-rearing program and develop milestones for reaching recovery goals.
- Support NHFG and the Service's Ecological Service's efforts to update recovery population goals based on latest population viability model.
- Determine if conservation easement lands are being managed sufficiently and effectively to contribute to Karner blue butterfly management and recovery.

### Monitoring Components

- Support NHFG monitoring program for the Karner blue butterfly on the conservation easement to document recovery as per the Federal Recovery Plan.

### Objective 5.3 Outreach and Education

Within 3 years of CCP approval, install new and expanded interpretive signs and trail on the Karner blue butterfly conservation easement, establish a program of guided walks, create additional Web-based information, and work with partners to improve enforcement on easement lands.

### Discussion and Rationale

The Karner blue butterfly conservation easement is within walking distance of many businesses and residential homes. An unpaved right-of-way runs through the center of the conservation easement, which is gated at each end. A kiosk at the west entrance explains about the ecology of the Karner blue butterfly, but needs updating.

As we described in chapter 3, the conservation easement has a 0.4-mile hiking trail for visitors; however, there is no interpretive signage along the trail to make

the public more aware of the pine barrens ecosystem and associated management issues, and to protect the sensitive areas within the conservation easement. Under this plan, we will develop a 0.1-mile addition to the trail and provide quality self-guided interpretive panels along the entire length.

In addition, more information on the Karner blue, pine barrens, and the conservation easement is needed on the Service's Web site, with links to NHFG and other partners. Law enforcement is a concern given the sensitivity of the resource, proximity to a human population, and lack of any regular onsite staff.

### Strategies

*Continue to:*

- Partner with the “Kids for Karners” program in the Concord schools, coordinated by NHFG and National Wildlife Federation.
- Support existing partnership with the New England Zoo and Aquarium Association to engage volunteers in conservation of local species through activities such as native plant propagation, transplanting, trail construction, and outreach.

*Within 3 years of CCP approval:*

- Add approximately 0.1-mile to the existing 0.4 mile trail and establish self-guided interpretive panels along its length. Panels will explain butterfly ecology and management, to enhance the visitor's understanding and experience. The trail will be clearly designated as the approved footpath to reduce impact on sensitive resources off-trail.
  - Upgrade and maintain existing kiosk with interpretive information about butterfly recovery efforts, pine barrens ecology, and warnings about Lyme disease. Construct an additional kiosk on east end of property with similar information.
  - Provide volunteer-led group tours and interpretive talks onsite.
  - Work with NHFG to develop interpretive materials and information.
  - Improve Web site information and link to refuge and NHFG Web sites.
  - Develop brochure that describes pine barrens ecology, other dependent species and aspects of biological diversity, in addition to butterfly ecology.
  - Have Service law enforcement officers contact NHFG Conservation Officers and Service Special Agents to coordinate on visiting the site and enforcing against unauthorized uses.
- ### Monitoring Components
- Monitor and evaluate the number of violations and take appropriate action to discourage future infractions.



Matt Poole/USFWS

*Heron nest*

### Objective 5.4 Partnerships

Establish a formal partnership with New Hampshire Fish and Game to continue and enhance the existing collaboration on Karner blue butterfly species and habitat management and develop new partnerships with local businesses, land trusts, and other entities to enhance and expand Karner blue butterfly population and pine barrens habitat restoration.

### Discussion and Rationale

The Karner blue butterfly conservation easement was established in July 1992 through a cooperative agreement between the Service, the city of Concord, the CCDC, the U.S. Postal Service, and TNC. From 1992 to 1999, TNC carried out most of the management on the conservation easement, which included removal of unwanted vegetation by mechanical methods and with prescribed burns and planting of wild lupine. Since 2000, NHFG has conducted the onsite management which has continued with vegetation removal, plantings, moth and butterfly surveys, and a captive rearing program.

The refuge has administrative responsibility for the conservation easement. Given that Great Bay Refuge is unstaffed, these responsibilities lie with the refuge manager at Parker River Refuge. The Service has maintained an informal partnership with NHFG, as they implement onsite management and captive rearing of the Karner blue butterflies. A more formal agreement is needed to ensure that continued funding and support for habitat management, captive rearing, and law enforcement. The Service also seeks to expand other partnerships including with TNC and the New Hampshire Prescribed Fire Council in relation to the use of prescribed fire. Local land trusts and area businesses may be able to help the Service advance its goals of restoring healthy populations of Karner blue butterflies to the Concord Pine Barrens.

### Strategies

*Within 5 years of CCP approval:*

- Participate in New Hampshire Prescribed Fire Council to enhance safety and share resources while implementing prescribed burning on the conservation easement.
- Develop a memorandum of understanding (MOU) with NHFG regarding cooperation and funding for species and habitat management, monitoring, and law enforcement on the conservation easement.
- Develop stronger partnerships with local land conservation groups to assist with recovery of Karner blue butterflies and pine barrens habitat in the area.
- Engage at least 20 percent of the corporate business employees in adjacent industrial park in developing and implementing a volunteer/community service program.

*Refuge shoreline on Great Bay*



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