

## Chapter 3



USFWS

*Beach habitat on the refuge*

## Alternatives Considered, Including the Service-preferred Alternative

- **Actions Common to All Alternatives**
- **Actions Common to Alternatives B and C Only**
- **Alternatives or Actions Considered but Eliminated From Further Study**
- **Alternative A. Current Management (No Action Alternative)**
- **Alternative B. Enhanced Management of Habitat and Public Uses (Service-preferred Alternative)**
- **Alternative C. Natural Processes**

## Introduction

This chapter describes our process for formulating alternatives, the actions that are common to all the alternatives, the actions or alternatives we considered but did not fully develop, and the three alternatives we analyzed in detail. At the end of this chapter, table 3.2 compares how each alternative addresses key issues, supports major programs, and achieves refuge goals.

## Formulating Alternatives

### Relating Goals, Objectives, and Strategies

Refuge goals and objectives define each management alternative identified below. Refuge goals are intentionally broad, descriptive statements of the desired future condition of refuge resources. By design, refuge goals define the targets of our management actions in prescriptive rather than quantitative terms. They also articulate the principal elements of the refuge's purposes and vision statement, and provide a foundation for developing specific management objectives and strategies. All the alternatives share the same goals.

Objectives are essentially incremental steps toward achieving a goal and further defining management targets in measurable terms. Objectives vary among the alternatives and provide the basis for developing detailed strategies that are the means by which we achieve our objectives. We also identify monitoring elements that help us evaluate our progress toward meeting our objectives. "Writing Refuge Management Goals and Objectives: A Handbook" (USFWS 2004) recommends writing "SMART" objectives characterized by five attributes: specific, measurable, achievable, results-oriented, and time-fixed.

Where possible, we incorporated the principles of Strategic Habitat Conservation (SHC) in the development of our objectives and strategies. According to "Strategic Habitat Conservation: Final Report of the National Ecological Assessment Team" (USFWS 2006a): "This approach focuses on the ability of the landscape to sustain species as expressed in measurable objectives. Developing a strategy to attain a biological outcome, such as a population objective, requires documented and testable assumptions to determine whether the objective is met." Not only will this approach ensure refuges are contributing to the Refuge System and Service mission and goals in a strategic, standardized, and transparent way, but it also ensures that refuges contribute to local and regional conservation priorities and goals (USFWS 2008b).

Next we identified strategies, or the actions, tools, or techniques we may use to achieve each objective. The list of strategies in each objective represents the potential suite of actions we may implement. We will evaluate most of them further as to how, when, and where we should implement them when we write our refuge step-down plans. We will measure our successes by how well our strategies achieve our objectives and goals.

A rationale accompanies each objective to explain its context and importance. We will use the objectives in the alternative selected for the final CCP to write refuge step-down plans, which we describe later in this chapter.

### Developing Alternatives, including the "No Action" or "Current Management" Alternative

After we identified a wide range of possible management objectives and strategies that could achieve our goals, we began the process of designing management alternatives. Simply put, management alternatives are packages of complementary objectives and strategies designed to meet refuge purposes and the Refuge System mission and goals, while responding to the issues and opportunities that arose during the planning process.

We grouped the objectives that seemed to fit together in what we loosely called "alternative themes." For example, we considered such themes as "current management," "enhanced management of habitat and public uses," and

“natural processes management.” We formed those into three management alternatives after further evaluating how the objectives would interact, their compatibility with refuge purposes, and the reality of accomplishing them within a reasonable period.

Based on these themes, we describe in this chapter three alternatives that characterize different ways of managing the refuge over the next 15 years. As required by NEPA, we believe they represent a reasonable range of alternative proposals for achieving the refuge purpose, vision, and goals, and addressing the issues described in chapter 1. Unless otherwise noted, refuge staff would implement all actions.

Alternative A satisfies the NEPA requirement of a “no action” alternative, which we define as continuing the status quo, or current management. It describes our existing management priorities, activities, and available resources, and serves as a baseline for comparing and contrasting alternatives B and C. Many of the objectives in alternative A do not strictly follow the objective-setting guidance in the Service goals and objectives handbook, but rather describe ongoing management actions established prior to that guidance. Our descriptions of those activities devolve from a variety of formal and informal management decisions and planning documents, resulting in fewer and more subjective objectives in alternative A, as compared to alternatives B and C. However, informal applications of adaptive management have been an important component of wildlife and habitat management in alternative A. Alternative A represents the management we have been conducting on lands that we actively managed in 2012. Management of the Nauset/South Beach area is not well described under alternative A because it is such a recent refuge addition. However, our intent would be to manage it consistent with other refuge wilderness lands.

Alternative B, the Service-preferred alternative, more formally emphasizes adaptive management to reduce biological uncertainty, with particular attention to landscape context and scientific integrity. Priority resources of concern were reevaluated in light of new Federal trust resources (candidate species), recent landscape-level plans and priorities (including but not limited to BCR 30, NALCC Regional Prioritization, U.S. Shorebird Conservation Plan), and additional biological information gathered on Monomoy refuge and surrounding lands, including Nauset/South Beach. In addition, this alternative enhances our present visitor services with opportunities to reach more offsite visitors. Increased emphasis on wilderness stewardship would occur under this alternative.

Alternative C proposes less intensive management, with a theme of allowing natural succession of habitats to progress, to the extent that the refuge purposes and goals are not compromised. Generally, wildlife census and refuge monitoring efforts would be decreased, with less active management than alternative B. Most refuge visitor services would be onsite. Compared to alternative A, public use opportunities would be enhanced through virtual and social networking sites, albeit not to the extent proposed for alternative B. Our wilderness management under alternative C is similar to alternative B, except that motorized boat access would not be allowed.

## **Actions Common to All Alternatives**

All the alternatives share some of the following common actions or elements. These occur at varying degrees or levels as described in each alternative. Some of them are required by law or policy, or represent management decisions that have undergone NEPA analysis that includes public review, agency review, and approval. Others may be administrative actions that do not require public review, but that we want to highlight in this public document.

All the following actions are current practices or policies that would continue under all alternatives:

- Conducting resource management and public use activities consistent with wilderness principles.
- Conducting a Wilderness Review.
- Adaptive management.
- Strategic habitat conservation.
- Monitoring and abating wildlife and plant diseases.
- Biological and ecological research and investigations.
- Controlling pest plants and animals.
- Addressing the threats of accelerating sea level rise and climate change.
- Volunteer opportunities and partnerships.
- Refuge staffing and administration, including boundary issues.
- Distributing refuge revenue sharing payments.
- Completing step-down management plans.
- Protecting cultural resources.
- Alternative energy projects.
- Providing opportunities for quality, priority, wildlife-dependent public uses.
- Appropriateness and compatibility determinations.
- Special use permits.
- Mosquito management.
- Additional NEPA analysis.

**Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles**

The majority of Monomoy NWR lands lying above mean low water were designated as wilderness in 1970. All three alternatives manage the existing Monomoy Wilderness to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. In all alternatives, we will continue managing the existing Monomoy Wilderness and the Inward Point and Powder Hole (currently non-wilderness) exclusions to maintain their size, naturalness, and outstanding opportunities for solitude or primitive and unconfined recreation, to the extent that it will not prevent us from fulfilling and carrying out refuge establishing purposes and the Refuge System mission, in accordance with Service wilderness stewardship policy (610 FW). Wilderness designation also applies to the Nauset/South Beach lands and waters that are now part of the Monomoy NWR.

The U.S. Fish and Wildlife Service conserves fish, wildlife, and plant resources and their habitats (including water resources) within wilderness in a manner

consistent with the Wilderness Act purposes (610 FW Wilderness Stewardship Policy). The Service is responsible for ensuring that the Monomoy Wilderness: firstly, retains its primeval character and influence, without permanent improvements and without permanent habitation; and secondly, that the natural conditions of the wilderness are preserved so visitors will experience an area affected primarily by the forces of nature where the imprint of humans in their immediate surroundings is substantially unnoticeable, where they can find outstanding examples of ecological, geologic, scientific, educational, scenic, or historic features, and where they can seek and experience solitude or primitive and unconfined recreation.

Section 4(c) of the Wilderness Act provides the basis for the concepts of “minimum requirement” and “minimum tool” for agency administrative actions in wilderness (defined in the glossary). These concepts pertain to agency administrative actions in wilderness. When management activities are proposed in a wilderness area, they must be evaluated to determine the necessity of the proposed action to accomplish the purpose of the refuge, including Wilderness Act purposes. (610 FW 1.5M). If the proposed action is determined to be necessary, we evaluate alternatives to minimize the impact of the action on the area’s wilderness character. This process, known as a minimum requirement analysis (MRA), is mandatory under current Service wilderness policy (610 FW 1.18 to 1.21). The MRA is prepared in conjunction with NEPA compliance documentation.

We conduct and document an MRA for all proposed refuge management activities that involve a generally prohibited use. We will authorize an activity only if we demonstrate that it is necessary to meet the minimum requirement for administering the area as wilderness and necessary to accomplish the purposes of the refuge, including Wilderness Act purposes. Please refer to appendix E; part II includes the complete list of current MRAs for the Monomoy Wilderness.

## **Conducting a Wilderness Review**

The Refuge System planning policy requires that we conduct a wilderness review during the CCP process. There are three phases to the wilderness review process: inventory, study, and recommendation.

### **Wilderness Inventory Phase**

Lands and waters that meet the minimum criteria for wilderness are identified in the inventory phase. These areas are called wilderness study areas (WSAs).

The refuge property on Morris Island and two tracts on South Monomoy were excluded from the 1970 designation because they contained residences, permanent roads, summer cottages, and other facilities still being used or in private ownership. Those two wilderness designation exceptions on South Monomoy, totaling 595 acres, are Inward Point (432 acres) and Powder Hole (163 acres). Although not included in the wilderness designation because they contained summer cottages, historic light station structures, and other facilities then in use or private ownership, Congress expected that they would be designated as wilderness in the future once the cabins and other structures in these two areas were removed. Additionally, Congress directed the Secretary of the Interior to manage the entire area consistent with the concept of wilderness (House of Representatives, Report No. 91-1441). Appendix E summarizes the inventory phase of our wilderness review for Monomoy NWR. That draft wilderness inventory (appendix E) determined that none of the current non-wilderness portions of South Monomoy excluded from wilderness designation in 1970 yet meet the eligibility criteria for further detailed study as WSAs as defined by the Wilderness Act during the 15-year plan period. We may also conduct a wilderness review prior to the next planning cycle, should significant

new information become available, ecological, or other conditions change, or we identify a need to do so.

The two exclusion areas, Inward Point and Powder Hole, are bounded on three sides by wilderness and open water and not demarked. They are managed consistent with the adjacent wilderness area.

### Wilderness Study and Recommendation Phases

Since the wilderness inventory (appendix E) determined no current non-wilderness portions of Monomoy NWR possess wilderness character sufficient for wilderness study area designation, the wilderness study and recommendation phases of the Wilderness Review process will not be undertaken during the 15-year plan period. The refuge will undergo another wilderness review in 15 years as part of the next planning cycle, at which time WSA designation and the wilderness study and recommendation phases will be reconsidered for the Inward Point and Powder Hole areas. We may also conduct a wilderness review prior to the next planning cycle, should significant new information become available, ecological, or other conditions change, or we identify a need to do so.



Bill Thompson/USFWS

*American black duck duckling*

In the study phase, a range of management alternatives are evaluated to determine if a WSA is suitable for wilderness designation or management under an alternate set of goals and objectives that do not include wilderness designation. The recommendation phase consists of forwarding or reporting the suitable recommendations from the Director through the Secretary and the President to Congress in a wilderness study report. The wilderness study report is prepared after the

record of decision for the final CCP has been signed. Areas recommended for designation are managed to maintain wilderness character in accordance with management goals, objectives, and strategies outlined in the final CCP until Congress makes a decision or the CCP is amended to modify or remove the wilderness proposal.

### Adaptive Management

All the alternatives will employ an adaptive management approach for improving resource management based on what is learned from management outcomes. In 2007, Secretary of the Interior Kempthorne issued Secretarial Order No. 3270 to provide guidance on policy and procedures for implementing adaptive management in departmental agencies. In response to that order, an intradepartmental working group developed a technical 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 in a structured framework, and evaluating its effectiveness (Williams et al. 2009). You may view the guidebook at <http://www.doi.gov/initiatives/AdaptiveManagement/documents.html> (accessed August 2011).

The guidebook provides the following operational 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, increase 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 learning. At the refuge level, monitoring management actions and outcomes, and key resources, will be very important to implementing an adaptive management process. Our threatened and endangered species, migratory birds, wildlife habitat management, and wilderness stewardship activities are examples of refuge programs or activities in which an adaptive management approach may already be implemented or will be in the near future.

The final CCP covers a 15-year period. Periodic review of the CCP will be required to ensure established goals and objectives are being met and that the CCP is being implemented as scheduled, provided adequate resources are available to conduct the strategies outlined in the CCP. To assist this review process, a monitoring and evaluation program would be implemented, focusing on issues involving public use activities and wildlife habitat and population management, including the rates of coastal (shoreline) change that determine the type, amount, and arrangement of wildlife habitats and populations.

Monitoring visitor use could involve the formal collection and compilation of visitation figures and activity levels. We keep informal and incomplete visitor use records at this time. Research and monitoring programs need to be established to assess the impacts of visitor activities on wildlife and wildlife habitat and conflicts between refuge users, and to identify compatible levels of such use. We would modify these activities if we determine that incompatible levels of visitor use were occurring.

Collection of baseline data on wildlife populations and habitats would be implemented where necessary. These data would update the often limited, existing records of wildlife species using the refuges, their habitat requirements, and seasonal use patterns. This data would also be used in evaluating the effects of visitor use and habitat management programs on wildlife populations. Refuge habitat management programs would be monitored for positive and negative impacts on wildlife habitat and populations and the ecological integrity of the ecosystem. The monitoring will be of assistance in determining if these management activities are helping to meet refuge goals and objectives. Information resulting from monitoring would allow staff to set more specific and better management objectives, more rigorously evaluate management objectives, and, ultimately, make better management decisions. This process of evaluation, implementation, and re-evaluation is known as adaptive resource management.

The refuge manager is responsible for changing management actions and strategies if they do not produce the desired conditions. Significant changes from what we present in our final CCP may warrant additional NEPA analysis and public comment.

### **Strategic Habitat Conservation**

Strategic Habitat Conservation (SHC), the conservation approach the Service is using to achieve its mission in the 21st century, is a framework that utilizes adaptive management to redefine broad-scale conservation. It departs from the general pursuit of conserving more habitat and species to a more planned approach based on scientific data, at a landscape level, and in cooperation with partners. Starting with explicit, measurable objectives that are based on

testable assumptions that can be evaluated, it is enacted through an iterative process of biological planning, conservation design, conservation delivery, assumption-driven research, and outcome-based monitoring. The goal is to set specific population objectives for selected species of fish, wildlife, and plants, which become our conservation targets. We refer to this select group of species as representative or surrogate species because they represent other species or aspects of the environment. Such identified species are used for comprehensive conservation planning that supports multiple species and habitats within a defined landscape or geographic area. The surrogate species that have been identified for the North Atlantic Landscape Conservation Cooperative (LCC), in which Monomoy refuge is located, include the American oystercatcher, common tern, horseshoe crab, piping plover, saltmarsh sparrow, and semipalmated sandpiper. The red knot is also a surrogate species in the North Atlantic LCC.

Through the SHC approach, we will coordinate and link actions that various programs within the Service, other Federal agencies, and our State, nonprofit and private conservation partners take at individual sites, so the combined effort of all our work will enable the realization of biological outcomes at the larger landscape, regional, or continental scale. Inherent in the process is a continual evaluation of biological outcomes and approaches, with the intent to adapt the overall conservation strategy to respond to changing circumstances and new information.

**Monitoring and Abating  
Wildlife and Plant Diseases**

The Service has not yet published its manual chapter on disease prevention and control. In the meantime, we derive guidance on this topic from the Refuge Manual and specific directives from the Director of the Service or the Secretary of the Interior. The Refuge Manual (7 R.M 17.3) lists three objectives for the prevention and control of disease:

- (1) Manage wildlife populations and habitats to minimize the likelihood of the contraction and contagion of disease.
- (2) Provide for the early detection and identification of disease mortality when it occurs.
- (3) Minimize the losses of wildlife from outbreaks of disease.

The Service published these objectives in 1982. Since then, in addition to diseases that cause serious mortality among wildlife, diseases transmitted through wildlife to humans, such as Lyme disease, eastern equine encephalitis (EEE) or West Nile virus (WNV), have received considerable attention. Our focus, however, remains on diseases that can affect migratory birds on the refuge. A serious wildlife disease that receives considerable attention worldwide is avian influenza (AI); of particular concern is the highly pathogenic Eurasian form (H5N1). Terns were sampled for H5N1 in 2008, 2009, and 2010 and shorebirds were sampled in 2009 and 2010 with no cases of AI being identified. We have an Avian Influenza Surveillance and Contingency Plan in place should AI be detected in the future.

Two diseases that have impacted common terns on the refuge are salmonellosis and paralytic shellfish poisoning (PSP) (Nisbet 1983). Salmonella bacteria are often present at low levels in seabirds, and outbreaks often affect large colonies of nesting terns and gulls. Because the colony on South Monomoy has grown larger and nesting birds are being recruited from several neighboring colonies, the potential for disease transmission has increased and incidences of salmonellosis have been confirmed on the refuge most years since 2004. Paralytic shellfish poisoning, caused by red tide, impacted common terns on the refuge in 2005, resulting in adult deaths and low productivity due to soft eggshells. Several dead individuals tested positive for marine algal toxins associated with the poisoning



*Monomoy National  
Wildlife Refuge shore*



that was likely caused by a red tide event that impacted much of the New England coast. Red tide has not directly impacted the refuge since 2005.

Die-offs of common eider have been reported on many Cape Cod beaches, primarily in Wellfleet; these events have been increasing since 1998, leading to an international multi-agency effort to understand the cause of the die-offs and develop wildlife management strategies to better conserve this species (WHOI 2008). In 2010, tissue samples collected by the U. S. Department of Agriculture's APHIS-Wildlife Services were submitted to the National Wildlife Health Center and the Southeastern Cooperative Wildlife Disease Study. These samples contained a novel virus in the Orthomyxovirus family. The common eider is the only species known to be affected by this newly discovered virus, dubbed the Wellfleet Bay virus after the location where most deaths have occurred. Though the virus has not been identified in samples taken from the refuge, surveillance continues of possible eider die-offs on the refuge and the surrounding waters.

Continual surveillance for incidences of avian influenza, salmonellosis, PSP, and other avian diseases will continue. In addition to the diseases of wildlife, we will be attentive to the diseases and pests that affect the health of the ecosystems that the refuge supports, and respond in varying degrees based upon the alternative chosen. Under all alternatives, we would continue to opportunistically monitor for and report seabird mortality events on refuge beaches. We would also record and report instances of stranding as a wildlife disease because that might be the underlying reason for the stranding. It is likely that other monitoring efforts would be minimal, and the occurrence of any wildlife or habitat disease element would be responded to only if it posed an immediate or serious threat to indigenous wildlife and habitat. The Service would respond at a level commensurate with staffing and funding.

These are the general strategies for preventing or controlling disease:

- (1) Continue to conduct disease surveillance in conjunction with other fieldwork.
- (2) Cooperate with State agencies, particularly MassWildlife, and Tufts University by providing access for sampling and following protocols in the event of an outbreak.

- (3) Inform volunteers and others who work in the field about the dangers of Lyme disease and measures to avoid contracting it.
- (4) Monitor habitats for indicators of the increased occurrence of pests or disease. For example, note changes in flowering or fruiting phenology that do not appear to be linked to global climate change, physical damage, decay, weakening, or sudden death, particularly of major host species; also note changes in wildlife use of habitats, such as the absence of breeding birds that used to appear regularly.
- (5) Follow the protocols in national, State, and refuge disease prevention and control plans.

### **Biological and Ecological Research and Investigations**

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

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

In 2006, the Service Manual provided supplemental guidance on the appropriateness of research on refuges: “We actively encourage cooperative natural and cultural research activities that address our management needs. We also encourage research related to the management of priority general public uses. Such research activities are generally appropriate. However, we must review all research activities to decide if they are appropriate or not as defined in section 1.11. Research that directly benefits refuge management has priority over other research” (603 FW 1.10 D (4)).

All research conducted on the refuge must be consistent with the approved finding of appropriateness and compatibility determination for research. Research projects also must contribute to a need identified by the refuge or the Service. As we note in chapter 2, we have allowed many research projects that meet these criteria. We expect additional opportunities to arise under any of the alternatives we propose in this draft CCP/EIS. In determining the appropriateness and compatibility of future research proposals, we will follow the guidance in the manuals and employ the following general strategies:

- Seek qualified researchers and funding to help answer refuge-specific management questions.
- Participate in appropriate multi-refuge studies conducted in partnership with other groups.
- Coordinate with partners to initiate or conduct research on priority issues identified at local and regional scales.
- Facilitate appropriate and compatible research by providing temporary housing and equipment, if available, for persons conducting fieldwork.

All researchers will be required to submit detailed research proposals following the guidelines established by Service policy and refuge staff. Special use permits, and when necessary an MRA, would be issued to identify the schedules for progress reports, the criteria for determining when a project should cease, and the requirements for publication or other interim and final reports. All publications will acknowledge the Service and the role of Service staff as key partners in funding or operations.

### **Controlling Pest Plants and Animals**

Invasive plants and pest animals can sometimes interfere with management objectives. The Refuge Manual (7 RM 14.4A) defines a pest as “Any terrestrial or aquatic plant or animal which interferes, or threatens to interfere, at an unacceptable level, with the attainment of refuge objectives or which poses a threat to human health.” This definition also includes nonnative invasive species.

#### **Integrated Pest Management**

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

The refuge’s Integrated Pest Management (IPM) program will be written and on file at the refuge complex headquarters when complete. The IPM is a step-down plan from the CCP and supplements both the CCP and HMP with documentation on how to manage invasive or pest species. Along with a more detailed discussion of IPM techniques, this documentation describes the selective use of pesticides for pest management on the refuge, where necessary. Pesticide use, with appropriate and practical best management practices for habitat management, would be approved for use on the refuge when there likely would be only minor, temporary, and localized effects to species and environmental quality based upon not exceeding threshold values in the chemical profiles. We adhere to all administrative requirements for completing pesticide use plans. Our control program would address the most critical problems first and can be adjusted to reflect regional Service priorities, the availability of new information, or a new resource.

#### **Managing Invasive Species**

The establishment and spread of invasive species, particularly invasive plants, is a significant problem across the country, but to a much lesser degree on the refuge. For the purposes of this discussion, we use the definition of invasive species found in the Service Manual (620 FW 1.4E): “Invasive species are alien species whose introduction does or is likely to cause economic or environmental harm, or harm to human health. Alien species, or nonindigenous species, are species that are not native to a particular ecosystem. We are prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere.” This discussion focuses solely on invasive plant species.

Rugosa rose and *Phragmites* are the two main invasive plant species that have been identified on North and South Monomoy islands (see chapter 2); however, no comprehensive vegetation survey has been conducted due to lack of staff time and availability of funds. There are several additional species of invasives that are known to exist on the Morris Island portion of the refuge, including Asian bittersweet, autumn olive, and Japanese honeysuckle; these are not currently being managed. Our management of invasive plants would vary in degree with the alternative chosen. Invasive species may outcompete native plants and reduce available food and habitat required by native avian and mammalian species.

Invasive plants, in general, threaten the biological integrity, diversity, and environmental health of all national wildlife refuge habitats. In many cases, invasives have a competitive advantage over native plants and form dominant cover types, reducing the availability of native plants as food and cover for wildlife. Over the past several decades, government agencies, conservation organizations, and the public have become more acutely aware of the negative effects of invasive species. Several plans, strategies, and initiatives target the more effective management of invasive species, including “The National Strategy for Management of Invasive Species for the National Wildlife Refuge System” (USFWS 2003b), “Silent Invasion—A Call to Action,” by the National Wildlife Refuge Association (2002), and “Plant Invaders of Mid-Atlantic Natural Areas,” by the Service and the National Park Service (Swearingen et al. 2002).

Guidance on managing invasive species on refuges appears in the Service Manual (620 FW 1.7G). The following actions define our general strategies on the refuge:

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

See additional discussion on IPM below. The following actions define our specific strategies for the refuge:

- (1) Treat the most problematic species as funding and staffing permit, in accordance with the selected alternative.
- (2) Develop early-detection/early-response readiness regarding new invasions.
- (3) Remove the parent sources of highly invasive species (e.g., species that are high seed producers or vigorous rhizome producers).
- (4) Maintain accessibility to affected areas for control and monitoring, if possible.
- (5) Subject any treatments within the Monomoy Wilderness to a MRA.

### **Addressing the Threats of Accelerating Sea Level Rise and Climate Change**

Climate change is an issue of increasing public concern because of its potential effects on land, water, and biological resources. The issue was pushed to the forefront in 2007 when the International Panel on Climate Change (IPCC),

representing the world's leading climate scientists, concluded that it is "unequivocal" that the Earth's climate is warming, and that it is "very likely" (a greater than 90 percent certainty) that the heat-trapping emissions from the burning of fossil fuels and other human activities have caused "most of the observed increase in globally averaged temperatures since the mid-twentieth century" (IPCC 2007). The Northeast is already experiencing rising temperatures, with potentially dramatic warming expected later this century under some model predictions. According to the Northeast Climate Impacts Assessment Team, "continued warming, and more extensive climate-related changes to come could dramatically alter the region's economy, landscape, character, and quality of life (Frumhoff et al. 2007).

The Service is becoming more aware and knowledgeable about the impacts of climate change on national wildlife refuges. In response to the growing threat of climate change, the Service developed a strategic plan titled "Rising to the Urgent Challenge: Strategic Plan for Responding to Accelerating Climate Change," which establishes a basic framework within which the Service will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change. The plan details specific steps the Service will take during the next 5 years to implement the strategic plan (USFWS 2010b). The plan employs three key strategies to address climate change:

- Adaptation—minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats.
- Mitigation—reducing levels of greenhouse gases in the Earth's atmosphere.
- Engagement—joining forces with others to seek solutions to the challenges and threats to fish and wildlife conservation posed by climate change.

Under each alternative, the refuge would work to first understand how climate change might be affecting habitats and wildlife. For example, we completed a SLAMM analysis in 2009 that sought to predict potential impacts to the refuge under different sea level rise scenarios. In addition, we commissioned a report entitled, "A Geomorphological Analysis of the Monomoy Barrier System" by the Provincetown Center for Coastal Studies (Giese et al. 2010; appendix I). This latter report includes a summary of our present understanding of outer Cape Cod coastal processes, a chronology of Monomoy and vicinity coastal forms using aerial photographs to illustrate changes, a general overview of climate change and associated sea level rise with respect to the study area, discussion of the potential benefits and problems associated with dredging around Monomoy, and discussion of potential future research to benefit refuge management.

Results from both the SLAMM analysis and the Provincetown Center geomorphological study were subsequently incorporated by Service staff into a "Climate Change Vulnerability Assessment for Shorebird Habitat" for three refuges identified as Western Hemisphere Shorebird Reserve Network sites, including Monomoy National Wildlife Refuge. The information yielded from baseline surveys, assessments, and monitoring efforts would be used to develop specific adaptive and mitigation strategies to minimize the impacts of a changing climate on refuge resources. Under all alternatives, it will be important to coordinate with the State's climate change strategies as they are further refined. The establishment of the North Atlantic LCC will also facilitate the exchange of information and coordination among agencies in the region to implement climate change strategies.

## **Volunteer Opportunities and Partnerships**

As the Monomoy NWR contributes to the quality of life in Cape Cod, strong support in the community and the region also contributes to the refuge's success. Helping hands are needed for program development, data gathering, and other opportunities discussed in these alternatives. Only with this type of assistance can the refuge achieve its goals and objectives, support the missions of the National Wildlife Refuge System and the Service, and meet the needs of the community.

Volunteers participate in a wide variety of activities. These include wildlife and landscape photography, assisting with or conducting educational and interpretative programs, providing visitor information, conducting observations and surveys of wildlife species, conducting botanical surveys, conducting waterfowl surveys and research, litter and marine debris pickup, trail clearing and maintenance, sign rehabilitation, and other maintenance projects.

The volunteer program at the refuge is strong. In 2000, volunteers provided more than 2,615 hours of assistance. By 2010, this had increased to 4,175 hours of volunteer service. We are deeply indebted to all our volunteers for their dedication and services rendered for the betterment of our nation's natural resources.

In addition to the contributions of volunteers, our Friends of Monomoy NWR and our conservation partners play a significant role in the success of our resource management and public programs. All the alternatives would maintain the existing partnerships identified in chapter 2 and later in this chapter under goal 3, while also seeking new ones. These relationships are vital to our achievements in managing all aspects of the refuge—conserving land; managing habitats and protecting species, wilderness character, or cultural resources; conducting outreach and education; and providing wildlife-dependent recreation. We will pursue new partnerships in areas of mutual interest that benefit refuge goals and objectives and also provide additional opportunities for visitors.

## **Refuge Staffing and Administration, Including Boundary Issues**

Our proposals in this document do not constitute a commitment for staffing increases, funding for operations and maintenance, or future land acquisition. Congress determines our annual budgets, which our Washington headquarters and regional offices distribute to the field stations. Chapter 2 presents our levels of staffing and operating and maintenance funds for the refuge over the last 6 years. The funding amounts identified for Monomoy NWR were not sufficient to support refuge operations, so augmentation of the refuge budget came from the refuge complex budget. The activities shared among the alternatives we describe below pertain to staffing, administration, and operations. Implementing them supports all our refuge goals.

### **Permanent Staffing and Operational Budgets**

In all the alternatives, our objective is to fiscally sustain levels of annual staffing, fleet, facilities, equipment, and supplies that allow us to achieve refuge purposes, as interpreted by the goals, objectives, and strategies in this draft CCP/EIS. We achieved many of our most highly visible projects since the refuge was established through special project funds that typically have 1- to 2-year duration. Although those funds are still vital, their flexibility is limited because they cannot be used for any other priority project that may arise, and there is often no reliable source for sustaining recurring work over the longer term. Funding for land acquisition derives primarily from two sources: the Land and Water Conservation Fund and the Migratory Bird Conservation Fund. We generally direct the funds from those sources to specific acquisitions.

In 2007, our Regional Directorate completed the “Strategic Workforce Plan for the National Wildlife Refuge System in Region 5” (Phase 2; January 16, 2007) to

*Service employees at  
the refuge*



support a new base budget approach. Its goal is that a maximum of 75 percent of a refuge station's budget cover salaries and fixed costs, while the remaining 25 percent or more would be operating and maintenance funds. Our strategy is to improve the capability of each refuge manager to do the highest priority work, and to avoid having most of a refuge budget tied up in inflexible fixed costs. This strategy was successful for a few fiscal years; however, we now anticipate a level or declining budget environment, which will impact flexibility in managing financial resources and may have implications for the level of permanent staffing. A new round of workforce planning began in 2013 in response to the sequester and anticipated future budget reductions.

In all the alternatives, within the constraints or opportunities of our budget and in conformance with future workforce plans, we would seek to fill any currently approved but vacant positions that we believe are necessary to accomplish our highest priority projects. Alternatives B and C also propose additional staff to provide depth in our biological and visitor services programs. We identify our recommended priority order for new staffing in the RONS tables in appendix D. Appendix G identifies the staffing requests in each alternative.

### **Facilities Construction and Maintenance**

All the alternatives include the periodic maintenance and renovation of existing facilities to ensure the safety of and accessibility for staff and visitors. Our current facilities are described in chapter 2. They include refuge headquarters/visitor contact station, the dormitory and maintenance buildings, and the Monomoy Point Light Station. Visitor facilities to be maintained under all alternatives include these buildings as well as the headquarters parking lot, the Stage Island parking area, the ¼-mile Morris Island Trail, signs, stairs, overlooks, and moorings. Any new facilities recommended in the final CCP, once constructed, would be placed on the maintenance schedule. All maintenance and upgrades of facilities would incorporate ecologically beneficial and energy-efficient technologies, tools, materials, and practices.

The Rehabilitation Act of 1973, as amended, requires that programs and facilities be, to the highest degree feasible, readily accessible to and useable by all persons who have a disability. Opportunities to do so are limited on this refuge. We are not obligated to provide accessible facilities in the Monomoy Wilderness. We would do all that we can to accommodate persons with disabilities on the Morris Island portion of the refuge, and explore virtual visitation opportunities through the use of technology.

### **Refuge Operating Hours**

All the alternatives will open the refuge for visitation from half an hour before sunrise to half an hour after sunset, 7 days a week, to insure visitor safety and protect refuge resources, except for surf fishing, which is allowed 24 hours per

day on Morris Island. The refuge manager may issue special use permits to allow access outside those periods. For example, we may permit access for research personnel or anglers at different times, or organized groups to conduct nocturnal activities, such as wildlife observation and educational and interpretive programs.

### **Protecting Resources and Ensuring Visitor Safety**

Currently, the refuge does not have a law enforcement officer on staff; law enforcement staff from the refuge complex headquarters in Sudbury provide resource and visitor protection. When necessary, supplemental policing may be conducted by other Service law enforcement officers on detail, rangers from the Cape Cod National Seashore, Massachusetts Environmental Police, and police officers commissioned by the Town of Chatham.

### **Access or Right-of-Way (340 FW 3)**

The refuge will use and maintain its existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access its properties for refuge resource management, public use, and visitor access. At high tide, the refuge shoreline on Morris Island can be inaccessible for most visitors, limiting them to accessing refuge lands and trails via the Tisquantum Road right-of-way. Refuge staff will work diligently to ensure that adequate signs are in place so visitors can find the trailhead while minimizing disturbance to neighbors. Refuge staff will work with the Quitnesset homeowners association to improve the potentially confusing signs at the Quitnesset entrance, where the public roadway ends and becomes a public right-of-way (easement) over private roadways.

### **Protecting Morris Island Shorefront**

The refuge beach on Morris Island has experienced erosion, some natural and some exacerbated by an approximately 1,000 linear foot revetment constructed under a 1998 permit by adjoining landowners. The northern end of this revetment, known as the return, was constructed on refuge lands with our permission. The 1998 permit from the Chatham Conservation Commission required annual renourishment of the beach for five years. In 2005, the Service thought that beach renourishment would adversely impact intertidal resources, so we recommended no further beach renourishment. However, we now understand that the revetment can actually accelerate erosion and beach narrowing. We intend to work with the upland landowners and all applicable local, State and Federal agencies to determine available sources of sand, so that the beach is restored and adverse impacts of the construction are ameliorated and mitigated for. This will also benefit the upland landowners as it will preserve the integrity of their revetment. We will also encourage the conduct of a geomorphological study of the Morris Island beachfront to determine the long-term need for renourishment on a sustained basis. Furthermore, we will actively pursue the possible use of dredged material from Federal or local waterway projects to renourish the beach.

### **Boundary Issues/Overlapping Jurisdiction**

Under all alternatives, the Service will work to resolve the question of overlapping jurisdiction between the National Park Service's Cape Cod National Seashore and Monomoy NWR. As described in chapter 2, the gradual southward migration and ultimate connection of South Beach (the southerly portion of the Seashore's Nauset Beach) to South Monomoy Island in November 2006 resulted in the formation of a "land bridge" that has continued to grow over the past 6 years. It is highly unlikely that natural processes will break apart the connection at this point, although Nauset/South Beach breached a couple of miles north of the connection in February 2013, and could break at other locations as well. As the NPS's jurisdiction extends ¼ mile offshore, technically, part of the refuge has been overlain by the National Seashore boundary for a decade or more. While there are many similarities in mission between the National Park Service and the Service, there are some distinct differences, as well as in management direction and authority.



The geomorphological changes from gradual erosion and accretion of sand sediments along Nauset/South Beach-South Monomoy landforms have considerably changed the property ownership boundaries regardless of whether the 2013 breach is attributed to erosion or avulsion, and whether the equitable division doctrine or erosion is deemed to have drawn the new boundary line between the town's peninsula to the north or the southerly portion affixed to the refuge, as discussed in chapter 2. All alternatives use the same, new, eastern refuge boundary (map 1.1). All alternatives also recognize that this is an ambulatory (moving) property and administrative boundary (following mean low water) that will continue changing location through these same geomorphological processes throughout the 15-year plan period. In all alternatives, the western boundary of the refuge is the Declaration of Taking line (map 1.1).

**Distributing Refuge Revenue Sharing Payments**

As we describe in chapter 2, we pay the Town of Chatham annual refuge revenue sharing payments based on the acreage and the appraised value of refuge lands calculated by a formula determined by, and with funds appropriated by, Congress. All the alternatives will continue those payments in accordance with the law, commensurate with changes in the appraised market value of refuge lands, the extent of our property, or new appropriation levels dictated by Congress. For more information, refer to the Socioeconomic Environment section in chapter 2.

**Completing Step-down Management Plans**

Service planning policy identifies 25 step-down plans that may be applicable on any given refuge. We have identified below the plans most relevant to this planning process and have prioritized their completion, if they are not already developed. Several are ongoing as part of the refuge complex planning, but others will be completed depending upon the alternative chosen and its associated level of funding and staffing to complete them. Sections of the refuge habitat management plan that require public review are presented within this document and will be incorporated as an appendix in the final version of the CCP. We will also develop an annual habitat work plan and an inventory and monitoring plan as the highest priority step-down plans, regardless of the alternative selected for implementation. 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. Completion of these plans supports all CCP goals.

All the alternatives incorporate the following plans that are either up-to-date or in progress and will be completed within 1 year of the issuance of the CCP. An updated fire management plan for the complex is scheduled for completion in 2013. Please see appendix L for general fire program direction.

- Safety Plan, updated annually; last updated in 2010
- Continuity of Operations Plan (Complex), updated in 2012
- Emergency Action Plan, updated annually; last updated in 2013
- Hurricane Action Plan, updated annually; last updated in 2013
- Spill Prevention and Countermeasure Plan (Complex), completed in 2005; updated in 2012
- Avian Influenza Surveillance and Contingency Plan, completed in 2007
- Habitat Management Plan, appendix to the final CCP (see discussion below and discussion on NEPA requirements)

All the alternatives schedule the completion of these step-down management plans for the refuge after completion of the CCP. Step-down plans scheduled for completion include:

- Annual Habitat Work Plan, annually after CCP approval (see discussion below)

- Inventory and Monitoring Plan, within 2 years of CCP approval (see discussion below)
- Hunt Plan, within 2 years of CCP approval
- Fishing Plan, within 2 years of CCP approval
- Wilderness Stewardship Plan, within 3 years of CCP approval
- Integrated Pest Management Plan, within 4 years of CCP approval (see discussion below)
- Visitor Services Plan, within 5 years of CCP approval
- Avian Disease Contingency Plan, within 5 years of CCP approval
- Sign Plan, within 5 years of CCP approval
- Cultural Resources Management Plan, within 7 years of CCP approval

### **Habitat Management Plan**

A habitat management plan (HMP) is a dynamic working document that provides refuge managers with a decision-making process, guidance for the management of refuge habitat, and consistency for habitat management on refuge lands. Each plan incorporates the role of refuge habitat in international, national, regional, tribal, state, ecosystem, and refuge goals and objectives. The plan guides analysis of specific habitat management strategies to achieve habitat goals and objectives, and utilizes key data, scientific literature, expert opinion, and staff expertise. Specifically, the HMP defines management areas and treatment units, identifies the type or method of treatment, establishes the timing for management actions, and defines how we will measure success over the next 15 years. The HMP for the refuge is the first step toward achieving the objectives of goal 1, regardless of the alternative selected for implementation. The goals, objectives, and list of strategies in each objective identify how we intend to manage habitats on the refuge, based on current resource information, published research, and our own field experiences. In the HMP, we will update our methods, timing, and techniques as new, credible information becomes available. To facilitate our management, we will regularly maintain our GIS database, documenting any major changes to the refuge islands and wildlife habitats. As appropriate, we will incorporate the actions common to all alternatives into the HMP.

### **Annual Habitat Work Plan**

The annual habitat work plan (AHWP) is an essential component of an adaptive management approach. It details incremental (or annual) tasks in support of goals and objectives, and identifies habitat management strategies outlined in the CCP and HMP to be completed within the plan year. Typically, AHWPs evaluate progress toward achieving the habitat objective(s) from present management strategies and prescriptions by evaluating the response of the resources of concern as well as non-target resources to the habitat management strategies and prescriptions. The refuge uses this information to help select the management strategy or strategies with the most positive effect on refuge resources as a whole.

### **Inventory and Monitoring Plan**

The inventory and monitoring plan (IMP) for the refuge is a priority for completion upon CCP approval. Regardless of the alternative chosen, an IMP is vital for measuring our success in meeting objectives, though the levels will vary according to the alternative chosen. The IMP will outline the methodology to assess whether our original assumptions and proposed management actions support our habitat and species objectives and wilderness objectives. The IMP

may also be used to monitor the potential effects of global climate change on refuge habitats and wildlife populations. We will prioritize our inventory and monitoring needs in the IMP. The results of inventories and monitoring will provide us with more information on the status of our natural resources.

#### **Visitor Services Plan**

In accordance to Service policy (605 FW 1.14A), all refuge managers will develop a visitor services plan (VSP) that addresses all compatible wildlife-dependent recreational uses on a refuge. A VSP is critical to the future of the refuge's visitor services program. This plan will communicate the goals, objectives, and strategies for the visitor services program and will outline resource needs. The plan will also demonstrate how the visitor services program is integrated with the natural and cultural resource management program, and how it will support visitor understanding and appreciation of the natural and cultural resource management program.

The VSP will provide the reader with background information, including the refuge purpose, history of visitor services, goals, and a list of the present facilities and services. It will also discuss visitor services issues, concerns, and outreach topics and themes. The foundation of the plan will include the ten standards and four optional standards that are used to judge and plan visitor service program growth. Typically, a site will receive a visitor services review, which develops strategies and recommends specific actions that the refuge will strive to carry out to provide and improve visitor services. There are three types of strategies in a plan: those that the refuge presently does; those that are planned for the near future and can be achieved without major additional financial or personnel resources; and others that are long-range and can only be accomplished with increased staffing or funding.

#### **Wilderness Stewardship Plan**

The Monomoy Wilderness stewardship plan (WSP) will guide the preservation, stewardship, and use of the Monomoy Wilderness. It will provide detailed, specific, and measurable stewardship strategies and implementation schedules for meeting the broader wilderness goals and objectives identified in this CCP. The WSP process is guided by Service policy (610 FW 3) and must address the preservation or, as appropriate, the restoration of cultural and natural resource values and conditions, including the following WSP elements:

- (1) The WSP will clearly show the strategies and actions we will use and implement to preserve the wilderness resource, and show the linkage between those strategies and actions and the wilderness goals and objectives identified in the CCP.
- (2) The WSP will contain indicators, standards, conditions, or thresholds that define adverse impacts on wilderness character and values and that will trigger stewardship actions to reduce or prevent those impacts. The "Wilderness Character Monitoring Report: Monomoy Wilderness" (Sudol 2012) provides the basis for this WSP component. This document is located on the refuge's Web site.
- (3) The WSP will describe ongoing and needed monitoring and research, appropriate and compatible uses and associated determinations, and minimum requirement analyses for refuge management activities and commercial services within the Monomoy Wilderness.

Appendix E provides an outline/template (610 FW3 Exhibit 1) for completing the Monomoy WSP, which will be based upon the "four cornerstones" of wilderness stewardship as discussed in chapter 1.

**Protecting Cultural Resources**

Under the National Historic Preservation Act, the Service has a legal responsibility to preserve significant historic properties and to consider the effects its actions may have on archaeological and historic resources. Under all alternatives, the Service will comply with section 106 of the National Historic Preservation Act by considering potential adverse effects. Compliance may require any or all of the following: review of State Historic Preservation Office records, consultation with Native American Tribal Historic Preservation offices, literature survey, or field survey.

In addition, in compliance with section 110 of the National Historic Preservation Act, we will continue our program to maintain the historic lighthouse and associated structures at the Monomoy Point Light Station to at least the minimum national historic preservation standards of the Secretary of the Interior. While all alternatives include maintenance to meet minimum historic preservation standards, the alternatives differ in approach to further enhancements and public use of the Monomoy Point Light Station. The Service will comply with section 110 by protecting Native American and historical archaeological resources from ground-disturbing activities and artifact looting.

The Service will pursue prudent and feasible measures at Monomoy NWR to preserve archaeological resources from destruction by coastal erosion. If preservation of a significant resource is found not to be feasible, the Service will implement a mitigation plan prior to the loss of the resource.

**Alternative Energy Projects**

The Refuge System needs to quantify and reduce its overall carbon footprint. Refuge System operations and facilities generate heat-trapping gases and have other impacts on the environment and wildlife. The Service's stewardship of the Refuge System should provide cutting-edge leadership in reducing carbon emissions and implementing sustainable, green business practices.

As part of Federal mandates being implemented Servicewide, various energy efficiencies are incorporated into our facilities and operations at Monomoy NWR. For example, our fleet is being converted to alternative fuel vehicles and a solar-thermal domestic hot water system was recently installed in the refuge dormitory building. These and future efforts, common to all alternatives with some variations between them, would minimize the refuge's contribution of greenhouse gas emissions. We also are increasing the production of energy from photovoltaic cells/solar panels, and we explore options in this draft CCP for the use of alternative forms of energy on the refuge to generate electricity.

A satellite parking area with alternative fuel shuttle to and from the refuge Morris Island facilities aims to reduce fossil fuels required to transport people while concurrently improving public access to refuge facilities and lands under all alternatives.

Under all alternatives, we propose to seek funding and install a small-scale, onsite wind turbine at the Morris Island refuge headquarters to increase the proportion of electricity consumption derived from clean, renewable sources while reducing the proportion derived from fossil fuel combustion and associated greenhouse gas emissions. Installation of solar panels or photovoltaic array at the Monomoy Point Light Station (but no wind turbine) is proposed under alternatives A and B to restore electrical power for heat, sanitation, water distribution, hot water, and lights without connecting to the utility grid or fossil fuel combustion. Additional improvements would provide a remote base of operations for refuge staff and volunteers when conducting wildlife surveys, exclosing nests, posting signs, managing predators, conducting law enforcement, welcoming visitors and providing interpretation, and conducting other refuge stewardship and management activities essential to the purposes of Monomoy NWR. Currently, the refuge has been implementing alternative energy solutions in several ways, including solar panels that run a fan for the composting toilet in

the keeper's house. The biological program has also used solar panels to charge batteries for the roseate tern attraction project (charging the battery for the sound system) and for charging the battery to run electric fencing that has been installed on occasion as a non-lethal predator management technique to protect nesting piping plovers, American oystercatchers, and least terns. Solar chargers for cell phone batteries have also been explored as a green option for field camp.

Solar panels, wind turbine generator, and other energy conservation technologies proposed would provide public demonstrations of methods for reducing dependence on nonrenewable energy sources. It is the intent of the refuge to extend the useful life and reduce maintenance demands of existing Service structures at the refuge so they can continue serving as bases for Monomoy NWR natural resource stewardship activities conducted by seasonally resident refuge staff, volunteers, or visiting scientists, and as destinations for refuge visitors.

**Providing Opportunities for Quality, Priority, Wildlife-dependent Public Uses**

The National Wildlife Refuge System Improvement Act of 1997 designated six priority public uses on national wildlife refuges: hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Several criteria are provided to ensure quality, wildlife-dependent recreation on national wildlife refuges by the General Guidelines for Wildlife-Dependent Recreation, Service Manual, 605 FW 1 (USFWS 2011a). As established in the Service Manual, quality, wildlife-dependent recreation:

- (1) Promotes safety of participants, other visitors, and facilities.
- (2) Promotes compliance with applicable laws and regulations and responsible behavior.
- (3) Minimizes or eliminates conflict with fish and wildlife population or habitat goals or objectives in an approved plan.
- (4) Minimizes or eliminates conflicts with other compatible wildlife-dependent recreation.
- (5) Minimizes conflicts with neighboring landowners.
- (6) Promotes accessibility and availability to a broad spectrum of the American people.
- (7) Promotes resource stewardship and conservation.
- (8) Promotes public understanding and increases public appreciation of America's natural resources and our role in managing and conserving these resources.
- (9) Provides reliable/reasonable opportunities to experience wildlife.
- (10) Uses facilities that are accessible to people and blend into the natural setting.
- (11) Uses visitor satisfaction to help define and evaluate programs.

In recent years, the Service has recognized the importance of connecting children with nature. Scholars and health care professionals are suggesting a link between a disconnection with the natural world and some physical and mental problems in our nation's youth (Louv 2005). With local partners, we intend to promote connecting children and families with nature in all of our compatible recreational and educational programming.

**Appropriateness and Compatibility Determinations**

Chapter 1 describes the requirements for appropriateness and compatibility determinations. Under all alternatives, we will evaluate the compatibility of current and proposed public uses. Most Monomoy refuge compatibility

determinations needed to be updated to be consistent with Service policy, resulting in some public use activities that were previously found compatible to be found incompatible due to changes in refuge wildlife, habitat, policy, or other aspects of the use. Appendix D includes proposed appropriateness findings and compatibility determinations to support the activities in alternative B, the Service-preferred alternative. Our final CCP will include all approved findings of appropriateness and compatibility determinations for the alternative selected.

Certain changes in allowable, compatible uses for all six priority public uses are proposed in the alternatives being considered in this CCP. These potential changes in compatible uses are further described later in this chapter and in appendix D.

**Activities Allowed (Uses the Refuge is Officially Opened to)**

The refuge manager has previously determined that five of the six priority public uses are compatible, subject to stipulations as detailed in appendix D. The refuge has not previously officially opened for the sixth priority public use—hunting. Non-priority uses that the refuge manager proposes as compatible on Monomoy NWR and associated stipulations are also detailed in appendix D. Some activities are already approved through an existing compatibility determination. In addition, we are formally proposing to allow other activities considered to be appropriate and compatible with refuge goals and objectives. Allowed activities common to all three alternatives include wildlife observation, photography, environmental education, and interpretation, fin fishing, harvest of subterranean shellfish, such as softshell clams, quahogs, and razor clams, beachcombing, hiking and walking, research, sunbathing and swimming, and mosquito monitoring and management.

At this time, there is no compelling Service interest necessitating further regulation of fishing in open waters lying above the submerged lands within the Declaration of Taking. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and hand-harvest of scallops. These activities do not cause disturbance to the submerged lands and are already regulated by other Federal and State agencies (e.g., the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries).

The refuge would continue to implement area and seasonal closures to public use to protect wildlife. Generally, these closures have occurred between April 1 and September 30. However, closed areas and season length may vary year to year based on wildlife use and changes in habitat.

**Activities Not Allowed (Uses the Refuge is Officially Closed to)**

All areas included in the National Wildlife Refuge System are closed to public access until and unless we open the area for a use or uses in accordance with the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd-668ee) and the Refuge Recreation Act of 1962 (16 U.S.C. § 460k-460k-4).

Under all three alternatives, the refuge will remain closed to all forms of hunting except waterfowl hunting. The existing deer and small mammal populations are not large enough to sustain a hunt program or the administrative burden of managing such a program.

We have received requests for non-priority (non-wildlife-dependent) activities. According to Service policy, (603 FW 1), if the refuge manager determines a use is not appropriate,



*Pied billed grebe*

Bill Thompson/USFWS

it can be denied without determining its compatibility. In appendix D we propose the following uses as not appropriate on refuge lands: horseshoe crab harvesting, including within the submerged lands and waters within the Declaration of Taking boundary (refer to the 2002 Horseshoe Crab Harvesting Compatibility Determination); fisheries harvest using bottom disturbing gear and techniques on submerged lands; mussel harvesting; camping; fires; fireworks; bicycling; dog walking; beach use activities such as beach sports, kite flying, grilling, and use of shade tents; organized picnicking; boat mooring, kite boarding, and motorized personal watercraft (e.g., wave runner and jet skis) in refuge waters within the Declaration of Taking boundary; and over-sand vehicles (OSV). We will also phase out dinghy storage on both Morris and Stage Islands and parking in Stage Island Lot 7b under all three alternatives. Appendix D documents the refuge manager's justification for why these are deemed not appropriate. Most of the activities are sufficiently provided for on other nearby ownerships, so the lack of access on the refuge does not eliminate the opportunity.

### **Special Use Permits**

All the alternatives require the refuge manager 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 require special use permits. We will only approve permit requests that are compatible, with the preference being for activities that benefit the refuge or the Refuge System, are manageable by refuge staff, and are consistent with the Wilderness Act if the activity is proposed within designated wilderness.

All economic activities or uses on the refuge will adhere to 50 CFR, Subpart A, 29.1 and follow Service policy (603 FWS 2), which allows these activities if they contribute to the achievement of refuge purposes or the Refuge System mission. There are two types of economic uses that may occur on the refuge:

- (1) "Refuge management economic uses" that are conducted by the Service or an authorized person or entity to fulfill a refuge purpose or the Refuge System mission.
- (2) Other sorts of economic uses conducted by private parties (e.g., commercial guiding to facilitate wildlife-dependent recreation).

Before an economic activity or use is allowed, it must be found appropriate. If deemed appropriate, it must also be found compatible. The compatibility determination must justify how the use benefits refuge purposes or the Refuge System mission, including any stipulations to ensure compatibility. A special use permit may also be issued in conjunction with the compatibility determination and may include stipulations as well. A fee may also be collected for each special use permit.

Section 4(c) of the Wilderness Act prohibits commercial enterprise within designated wilderness, except that (Section 4(d)(6)) commercial services may be performed to the extent necessary for activities that are proper for realizing the recreational or other wilderness purposes of the area.

Appendix D includes a description of activities and uses we evaluated for the refuge and our determination of whether they were appropriate and compatible.

### **Mosquito Management**

Mosquito control through larvicide has been allowed for many years on Morris Island, but not on North Monomoy Island or South Monomoy. The Cape Cod Mosquito Control Project (CCMCP) has been treating the salt pannes on Morris Island since CCMCP establishment in 1930, and in recent years with Bti, a biological mosquito control method that kills mosquito larvae and also can kill non-target organisms such as midge (Chironomid) larvae. A special use permit to

control salt marsh mosquitoes has been issued annually since at least 1983 (2003 Compatibility Determination for Mosquito Control). Monitoring of mosquitoes is required so that larvicidal applications are only conducted when a threshold population size is reached. The two species that are controlled through larvicides are also bridge vectors for mosquito-borne diseases such as West Nile virus and eastern equine encephalitis (EEE). Recent monitoring (CO<sub>2</sub> light trap) by CCMCP of several mosquito species known as human disease vectors collected from the Morris Island area has not revealed any instances of mosquitoes infected with these human transmissible diseases, although EEE was detected in mosquitoes from nearby Brewster during 2012 mosquito monitoring.

We will continue to issue special use permits to the CCMCP for annual mosquito monitoring. We will also continue to allow mosquito control on Morris Island until a mosquito management plan for the refuge is developed that complies with Service policies.

### **Additional NEPA Analysis**

For all major Federal actions, NEPA requires site-specific analysis and disclosure of expected impacts, either in a categorical exclusion, environmental assessment (EA), or environmental impact statement (EIS). NEPA provides for categorically excluding other routine activities from that requirement. Generally, those include the administrative actions listed in chapter 4. The major actions proposed in the three alternatives and analyzed in this draft CCP/EIS are described in enough detail to comply with NEPA, and would not require additional environmental analysis. Although this list is not all-inclusive, the following projects fall into that category:

- Development of the habitat management plan, including its beach shoreline, dune grassland, and wetlands habitat management programs.
- Development of the inventory and monitoring plan.
- Expanding or reducing our priority public use programs, such as opening a portion of the refuge to waterfowl hunting.
- Small construction and improvement projects, such as remodeling and expanding the headquarters and visitor contact station, construction of universally accessible trail platforms, or installing ground-mounted solar panels (photovoltaic array) serving refuge facilities.
- Operations and maintenance of existing infrastructure and facilities.
- Law enforcement activities.
- Control of invasive plants.
- Conducting a predator management program.

Additional NEPA analysis would be required if we were to implement a significant public action or construction project not considered in detail in this document. The following is a list of actions under alternatives A, B, and C that would require further NEPA analysis:

- Opening the land-based portion of the refuge to deer hunting.
- Construction of a new building at refuge headquarters, or construction of an offsite visitor contact facility.
- Installation of a wind turbine at the Morris Island headquarters site.



## **Actions Common to Alternatives B and C Only**

Alternatives B and C have several actions or activities in common that are not included under alternative A. These are discussed below.

### **Proposed Land Acquisition**

The Service has a need for additional property to provide for staff, seasonal intern, and volunteer housing and a potential offsite visitor contact station. We cannot expect all of these uses to be met in one site, therefore, multiple sites may need to be acquired through donation, partnership, long-term lease, or fee acquisition. Funding for land acquisition could come from the Land and Water Conservation Fund and the Migratory Bird Conservation Fund under the Migratory Bird Conservation Act.

### **Visitor Services**

We are proposing under alternatives B and C to allow virtual geocaching and letterboxing (refer to glossary), as well as guiding for fishing, which would necessitate new compatibility determinations. Other new activities proposed include concessionaire services for access to the refuge, and waterfowl hunting. Alternative B would provide commercial ferry services and interpretive opportunities; alternative C would only allow non-motorized services such as kayaks.

Activities that are currently allowed under alternative A (some of which will be phased out in 1 year of CCP implementation) that would not be allowed under alternatives B and C include:

- Dog walking (including Morris Island)
- Beach use activities such as beach sports and grilling
- Use of shade tents except on Morris Island
- Dinghy storage on Stage Island and Morris Island
- Parking in Stage Island Lot 7b

### **Waterfowl Hunting**

Waterfowl hunting has regularly occurred within the Monomoy NWR Declaration of Taking since refuge establishment, but the refuge has never been officially opened for waterfowl hunting by regulation, individual permit, or public notice as required by law. Under CCP alternatives B and C, a portion of Monomoy NWR is being opened to waterfowl hunting in accordance with Federal, State, and local hunting regulations. The refuge proposes to open 40 percent of the open waters on the refuge to sea duck hunting as shown on map 3.1, in compliance with the Migratory Bird Conservation Act of 1929, which was the establishing authority for the refuge. A hunt plan will be drafted as part of an opening package that will include a public comment period.

### **New Visitor Contact Facility**

Alternatives B and C seek a location for an alternative visitor contact station in the Chatham or Harwich area. We will seek opportunities to work with partners on the siting and operation of a new off-site visitor facility. Prior to any action, we would perform a cost-benefit analysis to evaluate the cost of maintaining or renovating existing structures on Morris Island to meet the refuge's future needs, the cost of relocating all facilities to a preferred site, and the option of armoring to slow coastal bluff erosion at the existing site and possible impacts, to determine the most cost-efficient option the refuge could implement.

Our preference for an alternate visitor contact station in either downtown Chatham or Harwich is common to alternatives B and C; however, the size of the facility differs by alternative. Alternative B proposes a small facility downtown to serve as a site for providing information to potential refuge visitors and the general public, as well as a place to display temporary exhibits about the refuge and the Monomoy Wilderness. Under alternative B, there would also be a small

expansion of the current infrastructure at Morris Island (such as a second story on the office) to meet refuge needs. Alternative C proposes relocation of the visitor contact station to a more centrally located site that can also accommodate visitor parking, but no physical changes would be made to the refuge's current headquarters building. Both alternatives B and C include offsite shuttle parking and seek to provide additional offsite housing for seasonal staff.

Our Director, via Director's Order 144, and our regional leadership team have identified facility energy and resource conservation as a priority. As such, any new buildings or building upgrades will incorporate ecologically sound and environmentally beneficial technologies, tools, materials, and practices, including building design and construction, water and energy consumption, wastewater management, and solid and hazardous waste management.

**Alternatives or Actions Considered but Eliminated From Further Study**

Based on public scoping and internal agency discussions, the following alternatives or actions were considered, but eliminated from further study.

**Managing the Refuge Strictly Based on Wilderness Designation and No Active Management**

Some wilderness advocates support a completely natural wilderness with no active management.

This alternative was considered, but eliminated. We cannot manage the refuge exclusively for a wilderness purpose, as that would result in unacceptable impacts to the very migratory bird species the refuge was established for and the Service is required by law to conserve. The Service has an affirmative responsibility to protect federally listed threatened and endangered species, migratory birds, and marine mammals. There is insufficient information on the effect such an action would have on existing refuge resources.

Wilderness purposes are by law "within and supplemental to" refuge establishing purposes. Sections 4(a and b) of the Wilderness Act expressly state that wilderness is declared "to be within and supplemental to the purposes for which national forests and units of the national park and national wildlife refuge system are established and administered"... "each agency administering any area designated as wilderness ... shall so administer such area for such other purposes for which it may have been established as also to preserve its wilderness character."

**Close the Refuge to Clamming**

This alternative was considered but eliminated because clamming has been occurring off the Monomoy islands for over 150 years. It is a traditional use, one that the Service has always allowed, and it contributes to the purpose of the refuge. The wilderness proposal for the Monomoy Wilderness indicated that shellfishing occurred and would be allowed to continue. The harvest of clams using exclusively traditional hand tools does not negatively impact wilderness character, so in all alternatives this CCP allows softshell clam harvest using non-motorized hand tools to occur.

**Discontinue Predator Management Program**

This alternative was considered but eliminated due to the affirmative responsibility the Service has to protect federally listed threatened and endangered species and migratory birds. Appendix J provides detailed summaries of the importance of predator management to promote nesting tern species (including federally listed roseate terns) and piping plovers. The appendix also includes summaries of predator presence and impacts of predators on these nesting species at Monomoy NWR. Discontinuing the predator management

program would prevent us from meeting our productivity objectives for these and other high-priority bird species.

**Allow Horseshoe Crab Harvesting**

This alternative was considered but eliminated because Monomoy NWR hosts one of the largest spawning sites for horseshoe crabs in Massachusetts (USFWS 2002) and horseshoe crabs are an important component of the northeast coastal ecosystem. The rationale section in alternative A, objective A1.7, discusses the role of horseshoe crabs and their eggs as an integral part of the coastal food web, particularly the importance of eggs to migrating shorebirds on the Atlantic coast. Harvesting horseshoe crabs does not contribute to the purposes for which the refuge was established.

**Install a Wind Turbine at Monomoy Point Light Station**

This alternative was considered but eliminated from further consideration based upon information collected during avian and bat monitoring surveys at the potential turbine site. Preconstruction surveys were conducted during 2010 and 2011 to determine bird use of the area during migration and the nesting season. Surveys were performed in the fall of 2010 and between April 19 and September 30 in 2011. Bat recordings were also made during these time frames (refer to Terrestrial Mammals on page 2-67 for more information on bat monitoring).

In 2010, birds (41 percent) frequently passed through the cylinder of observation at or below 35 feet (level A) and would assumedly be unaffected by the rotors. Another 19 percent of the birds observed passed between 35 and 65 feet (level B), which is within the rotor sweep zone. Nine percent of the birds observed passed over the site above 65 feet (level C), and would also presumably not be affected by the rotors. Additionally, 32 percent of the total birds observed passed through the turbine site at multiple heights; this demarcation was used to describe flocks of birds present at different heights or a single bird that changed altitude within the site area or a combination of both (level D). The majority of birds (63 percent) in 2011 utilized the proposed site at multiple heights (level D). Of the remaining birds observed, 26 percent passed through level A, 10 percent passed through level B, and 1 percent passed through level C.

Surveys demonstrated documented use by piping plover and roseate tern, both federally listed species, among other species of conservation concern. We determined that the risk of turbine-strike injury or mortality to migratory birds, and in particular to plovers and terns, is too high through the 15-year plan period to warrant further consideration of installing a wind turbine at this site. Should turbine technology improvements reduce the risk and the turbine size required to produce the 12 to 15KW needed at the site, this alternative can be reconsidered during a future plan period.

*Shoreline at Monomoy*



Gary M. Stoliz/USFWS

**Alternative A. Current Management (No Action Alternative)**

This alternative reflects current management, including activities previously undertaken, or already planned or approved, and is the baseline for comparing the other two alternatives. In addition to the actions common to all, under the No Action alternative there would be little or no change in our current management programs at Monomoy NWR. We would initiate few, if any, new wildlife population, habitat, or ecosystem management activities, provide no new public recreation opportunities, and undertake no new land acquisition efforts. The refuge would continue its current operations and maintenance activities within its current staffing and funding levels. The current management is summarized under alternative A in table 3.2, which compares the three management alternatives for Monomoy NWR.

**Habitat and Population Management**

Currently, our habitat management program consists primarily of periodically setting back dune vegetation succession to maintain breeding habitat for various seabirds. In addition, some areas are treated to remove nonnative vegetation. We also implement a rigorous predator management program that includes both lethal and non-lethal techniques. We provide artificial nest boxes and chick shelters to provide additional cover, and set up predator exclosures to minimize predation of nesting shorebirds. Periodic habitat management and annual predator management would continue.

The Massachusetts' coastline is susceptible to the effects of climate change, particularly increases in sea level. However, as Giese et al. 2010 reported in "A Geomorphological Analysis of the Monomoy Barrier System," "at the current rate of sea level rise, sediment supply from Nauset Beach to Monomoy is not only capable of maintaining the barrier complex, but of supporting ongoing accretion along the southern portion of South Monomoy Island." In these long-term scenarios, management actions are not warranted immediately and would likely be better addressed in future CCPs. We would, however, continue to be cognizant of the indicators of climate change (e.g., sea level rise) on the refuge. We worked with the Manomet Center for Conservation Sciences to assess the shorebird habitat vulnerability of climate change on the refuge, which is one of three Western Hemispheric Shorebird Reserve Network sites on the Atlantic coast to be evaluated. Though we have not had an opportunity to act on these findings, it has been our intention to monitor impacts associated with climate change and to encourage or promote additional climate change research by local and regional partners. In addition, the refuge would continue to work to reduce non-climate environmental stressors, including scouting for invasive species when possible, opportunistically monitoring for disease and mortality, and reducing pollution by using hybrid vehicles when possible for transportation and instituting a seasonal refuge visitor shuttle with satellite vehicle parking.

**Inventories and Monitoring**

Inventory and monitoring activities are a major component of evaluating the success of refuge management. Refuge staff and volunteers conduct bird surveys and monitor productivity of priority bird species from March through October. We initiated bat surveys near the lighthouse in 2010, and continued long-term horseshoe crab surveys and tagging efforts. In addition, we conduct northeastern beach tiger beetle surveys to monitor the presence and abundance of adults and larvae. We would continue to collect shorebird and seabird data that contribute to State and regional knowledge about the breeding status of seabirds and shorebirds. We would also continue vegetation monitoring so refuge habitat maps can be periodically updated. We would also continue periodic assessments of wilderness character, initiated during 2012, within the Monomoy wilderness.

**Visitor Services**

Under this alternative, we would continue to offer opportunities for the following priority wildlife-dependent uses: wildlife observation and photography, environmental education, and interpretation. Although fishing is occurring, the refuge has never officially been opened to this use. Seasonal closures to public access would continue to protect wildlife. See maps 2.7 and 2.8 for approximate

closure areas and seasons. Commercial photography would be allowed by permit, and businesses that assist visitors in wildlife-dependent recreation, such as boat tours, would continue via special use permits.

### **Wilderness Management**

The Monomoy Wilderness would continue to be managed to accomplish refuge purposes and the Refuge System mission, concurrent with preserving wilderness character and natural values for future generations. Refuge management strategies and techniques are chosen that comply with wilderness stewardship principles and prevent degradation of wilderness character. Management of the Nauset/South Beach area is not well described under alternative A because it is such a recent refuge addition. However, our intent would be to manage it consistent with other refuge wilderness lands.

Uses that are “generally prohibited” in wilderness (use of motorized vehicles, motorized equipment, and mechanical transport) would still be allowed within the Monomoy Wilderness for emergency purposes as provided for in the Wilderness Act or when deemed the minimum necessary to meet requirements for the administration of the area as wilderness and to accomplish refuge purposes in accordance with Service policy (610 FW). The Monomoy Wilderness boundary would continue to be accessible by motorboat.

All refuge management activities and refuge uses that we believe are necessary to achieve resource management objectives but are considered to be “generally prohibited uses” would be evaluated through a minimum requirement analysis, a documented decision-making process, to determine if the activities are necessary and identify measures to mitigate impacts on wilderness character. We also use the minimum requirement analysis to identify the minimum impact methods necessary to accomplish activities safely and with a minimal amount of impairment to wilderness character.

In order to increase emphasis on and clarify measures for protecting wilderness character within the Monomoy Wilderness, we would complete a wilderness stewardship plan.

### **Refuge Administration**

Current staffing levels would not change under this alternative, assuming no significant decrease in the refuge’s budget. The refuge headquarters at Morris Island would continue its dual function as the visitor contact station. Refuge infrastructure would likely remain at current levels under this alternative. Upgrades to the lighthouse and associated facilities would be completed as funds are available, and routine maintenance would occur.

In the discussion that follows, we describe in detail the goals, objectives, and strategies that we would implement under alternative A.

### **REFUGE GOAL 1:**

**Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.**

#### **Objective A1.1 (Dune Grasslands—Roseate and Common Terns)**

Continue to protect from disturbance and degradation 30 acres of nesting habitat for common terns, and enhance and maintain 2 acres of prime nesting habitat for roseate terns within this area. Maintain a minimum productivity of 1.0 chick per nesting pair over a 5-year period for both tern species.

#### **Rationale**

We chose to address common and roseate tern protection and management as one combined objective. All roseate terns nesting in the Northeast do so in conjunction with large, productive common tern colonies (Nisbet 1981), therefore, most management actions are likely to equally benefit both species. If future recovery plan efforts require new, specific actions for roseate terns, we may revise the roseate tern portion of this objective.

The Northeastern population of roseate tern is a Federal and State-listed endangered species, and common terns are listed as a species of special concern in Massachusetts. Both roseate and common terns in the Gulf of Maine were decimated in the late 1800s by a combination of shooting and eggging for food and bait, and feather collection for the millinery trade (Drury 1973). Conservation legislation passed in the early 1900s provided protection from human persecution, but expanding gull populations (which also benefited from protection and from artificial food sources provided by dumps and fish offal) soon caused tern numbers to again decrease significantly (Drury 1973, Kress 1983). By 1977, the New England populations of nesting herring and great black-backed gulls had reached more than 40,000 and 80,000 pairs respectively (Erwin 1979a). During this same timeframe, tern populations throughout the entire Gulf of Maine had declined significantly, and by 1977 the number of islands supporting nesting terns had declined by half. In 1987, the northwest Atlantic population of roseate terns was listed federally as endangered because of significant breeding range contraction and declining numbers, including the total loss of breeding birds in Virginia, Maryland, and New Jersey (Nisbet 1980, USFWS 1989, USFWS 1998a). Roseate terns currently nest on offshore islands from New York to the Magdalen Islands in Quebec (Gochfeld et al. 1998, Environment Canada 2006). The population increased from about 3,350 peak period nesting pairs in 1988, to 4,450 nesting pairs in 2000, but has since declined dramatically to fewer than 3,100 nesting pairs in 2009, erasing 13 years of progress toward recovery. Breeding roseate terns are close to extirpation on the south shore of Long Island, New York, in Connecticut, and in the northern limits of their range in Canada.

On Monomoy NWR, similar increases in nesting gulls were matched with precipitous declines in nesting terns. Common terns declined from a high of 4,000 pairs in 1970 to only hundreds of pairs by 1985. Roseate terns on Monomoy NWR declined from a high of 900 pairs in 1966 to fewer than 100 pairs in 1981 (USFWS 1996b). During most years from the early 1980s through 2000, no roseate terns nested. Further, predators (Nisbet and Welton 1984, Nisbet and Forster 1980), storm-tides, and loss of habitat resulted in virtually zero productivity between 1980 and 1994 (Fitch 1985, USFWS unpublished reports 1985 to 1994).

The start of the avian diversity project in 1996 (refer to appendix J for more details), when thousands of nesting great black-backed and herring gulls were removed from potential tern nesting areas and gull-free areas were identified and maintained for terns, marked the beginning of nesting tern population increases that have been largely sustained for the last 15 years on Monomoy NWR. Nesting common terns increased from just a few hundred pairs in 1995 to more than 2,000 pairs in 1998 and more than 10,000 pairs by 2003. Maintaining gull-free areas for terns has also proven to be effective in restoring large numbers of nesting terns at other Massachusetts sites (Blodgett and Henze 1992) and in Maine (Kress 1983, USFWS 2005b).

Since the recent peak nesting years (2003 to 2006), numbers have fluctuated in response to habitat changes, predator pressures, and nesting habitat quality at other nearby sites. Monomoy NWR remains one of the most important common tern nesting sites in the State, and one of just a few sites that support roseate terns. However, the long-term continued success of this project depends on a flexible adaptive management approach that incorporates annual management actions (focused on habitat manipulations and management of predator and competitor species) and careful monitoring of habitat and birds' responses to the management actions, which in turn leads to informed adaptations of strategies for the following year. Detailed information on predators at Monomoy refuge is included in appendix J.

In more recent years, several species of specialist predators became problematic for nesting terns at Monomoy refuge. The most prevalent mammalian predator on the refuge during the last 12 years has been the eastern coyote. With the State's increasing coyote population, and the establishment of the land bridge to South Monomoy in 2006, coyote presence in the tern colony has increased substantially. In most years since 1998, coyotes also attempted to den on the refuge (USFWS annual field season activities reports from 1998 to present).

During the last 15 years, avian predators and competitors have also been prevalent in the tern colony, though species presence is not consistent between years. Overall, black-crowned night-herons, northern harrier, great horned owls, herring gulls, great black-backed gulls, and to a lesser extent, laughing gulls, have all preyed in the tern colony to some degree (USFWS annual field season activities reports from 1996 to present).

A focused predator and competitor management program targeting individual specialist predators and competing species can drastically improve habitat quality (by reducing competition for nesting space) and increase tern productivity (by reducing depredation). The predator and competitor species discussed above are still prevalent in some years at Monomoy refuge, as well as other tern nesting sites in the northeastern U.S. and Atlantic Canada (USFWS 2010a). Annual implementation of predator management programs are still integral to most actively managed tern nesting colonies to ensure continued reproductive success (USFWS 2005b, Kress and Hall 2004).

At Monomoy NWR, we have been utilizing a variety of non-lethal and lethal management techniques to reduce impacts of predator and competitor species during different times of the breeding season. Our predator and competitor management plan, which details the need for a management program, past management efforts, and management techniques, is located in appendix J.

Successful predator management is critical to success, but maximum benefits are realized when it is combined with a site-specific habitat management program. Roseate terns generally prefer dense vegetation or some level of overhead cover for nesting (USFWS 2000). This is somewhat contradictory to the more open habitat used by nesting common terns. Fortunately, these differences in habitat preference can usually be accommodated on the same island. Management that results in a mosaic of high-quality roseate and common tern nesting habitat typically includes a combination of multiple actions, including constructing nest boxes and chick shelters, promoting dense vegetation in some areas, suppressing vegetation in other areas (through herbicide, hand-pulling, or prescribed fire), and restricting public access to minimize disturbance (USFWS annual field season activities reports). Habitat management needs to be adaptive, and managers have found that techniques that work at one site may not work at others (USFWS 2005b, USFWS 2005c, Kress and Hall 2004).

In addition to trying to improve nesting habitat, we use social attraction to actively attract prospecting roseate terns to these areas. Terns are reluctant to colonize new nesting sites, even when the available habitat is suitable. Social attraction consists of placing wooden or plastic decoys of terns in the available habitat, combined with a sound system that plays vocalizations (Kress and Hall 2004). Sound systems that play recordings of terns, combined with tern decoys, have been successful at luring terns to nesting sites on other islands (Kress 1983, USFWS 2005a). Placement of sound systems is modified annually depending on habitat and where roseate terns nested in previous years. Artificial nesting structures are also placed in quality habitat to encourage nesting roseate terns. Each structure consists of six tern boxes (series 500, modeled after J. Spindelov, USGS Patuxent Wildlife Research Center, Laurel, MD) covered with

a 2.4×0.6 m×2 cm thick sheet of outdoor plywood, which is secured to the ground (USFWS 2012).

Monitoring population numbers can be an effective measure of success. The Roseate Tern Recovery Plan Update (USFWS 2010a) restates the primary recovery objective of 5,000 nesting pairs, with at least six large colonies (greater than 200 pairs) with high productivity. While this objective has only been partially met, the three large colonies (Ram and Bird Islands in Buzzards Bay, MA, Great Gull Island in NY) often have very high reproductive success (USFWS 2010a).

Members of the Gulf of Maine Seabird Working Group (GOMSWG) are also very focused on reproductive parameters (fledgling and recruitment rates) that may better indicate overall health of the populations. Researchers have set the productivity level of 1.0 fledged chick per nesting pair as an objective for both tern species. Population and productivity objectives are periodically evaluated in conjunction with GOMSWG and the Roseate Tern Recovery Team.

### Strategies

*Continue to:*

- Use temporary symbolic fencing (see glossary) to seasonally close tern nesting areas from May through August to minimize human disturbance; if no nesting activity occurs within the closed area, posts may be removed beginning July 1.
- Patrol and enforce closed areas during the nesting season.
- Establish and staff a temporary field camp from early May until mid-August to maintain human presence 24 hours per day to provide predator management and facilitate data collection.
- Erect temporary, hard-sided blinds to facilitate identifying possible limiting factors, including diet composition and impacts of kleptoparasitism, and to further facilitate nesting studies and predator management.
- Install temporary wooden chick shelters prior to nesting to increase chicks' ability to escape inclement weather and predators, thus increasing survival.
- Install temporary wooden nesting structures, decoys (minimum of 100, as per Kress and Hall 2004), and sound systems to attract nesting roseate terns during the start of the nesting season.
- Throughout the 125-acre gull management area (Areas A and B), minimize nesting of great black-backed and herring gulls through non-lethal harassment, and destroy all nests by scattering nesting materials and removing eggs.
- Minimize impacts of avian and mammalian predators to nesting terns through non-lethal and lethal management as described in appendix J.
- Manipulate vegetation in selected areas using mechanical methods, herbicide, and rotational prescribed burning to improve habitat for terns and discourage nesting by competitor species, including laughing gulls.
- Coordinate with avian disease specialists at the National Wildlife Health Center in Madison, WI, to document, detect, and minimize the spread of avian diseases.
- Review 5-year reviews and recovery plan updates for roseate terns within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.



Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### **Monitoring Elements**

- Conduct complete nest counts refugewide for both species during the Massachusetts Statewide tern census window (currently June 5 to 20) and collect spatial data via a 60×60 m grid system to determine success of management in maintaining suitable habitat.
- Quantify productivity to determine success of management by recording clutch sizes, hatch success, and fledgling success for all nesting roseate terns and approximately 3 to 5 percent of all nesting common terns in the main nesting area.
- Trap banded adults and band chicks (all roseate terns; subset of common terns, as time allows), to improve fledge success estimates, document nesting site fidelity, contribute to metapopulation studies, and determine whether Monomoy NWR serves as a sink versus a source population.
- Quantify diet, as time permits, by conducting feeding observations of common terns to determine if this is a limiting factor suppressing productivity.
- Document changes in habitat within the grid system, especially before and after habitat management actions, but otherwise at least annually.
- Census laughing, herring, and great black-backed gulls in Area A to track population changes and distribution of predator and competitor species; collect spatial data for laughing gull nests via a 60×60 m grid.
- Monitor nesting attempts of herring and great black-backed gulls in Area A.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings) and conduct nocturnal observations to improve understanding of predator impacts; quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Conduct a complete census of all gulls on North Monomoy Island and South Monomoy every 5 to 10 years using aerial survey method or ground counts.
- Monitor avian health by conducting surveillance to detect field mortality events, document observations of sick or dying birds, and identify, collect, and submit dead birds for analysis at the National Wildlife Health Center.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.
- Update the cover-type map refugewide every 5 to 10 years.

#### **Objective A1.2 (Beach Shoreline and Dune Edges— Piping Plover)**

Continue to protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for piping plovers on the refuge. Maintain a minimum productivity of at least 1.24 chicks fledged per pair annually and an average of 1.5 chicks fledged per pair over a 5-year period.

### Rationale

The Service has responsibility for protecting and assisting in the recovery of federally listed threatened and endangered species under the ESA. The Atlantic coast population of piping plover is both federally and State-listed as a threatened species. Providing nesting habitat, minimizing predation and human disturbance, and conducting monitoring all contribute to the recovery of this species (USFWS 1996a). The primary objective of the recovery program is to remove the Atlantic coast population from the endangered species list. Delisting criteria for the New England unit of the Atlantic coast population states that the region must reach and maintain 625 pairs for 5 years and achieve a 5-year average productivity of 1.5 fledged chicks per pair (USFWS 1996a). The New England unit has come close in recent years to reaching the criterion for pair numbers, but has not yet reached the productivity goals or other delisting criteria.

Historical population trends for the Atlantic coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic coast beaches (Haig and Oring 1987). By the beginning of the 20th century, uncontrolled hunting (primarily for the millinery trade) and egg collecting had greatly reduced the population, and in some areas along the Atlantic coast the piping plover was close to extirpation. Following passage of the Migratory Bird Treaty Act in 1918 and changes in the fashion industry, piping plover numbers recovered to some extent (Haig and Oring 1985).

Available data suggest that the most recent Atlantic coast population decline began in the late 1940s or early 1950s (Haig and Oring 1985). Starting in 1972, the National Audubon Society's "Blue List" of birds with deteriorating status included the piping plover. Johnsgard (1981) described the piping plover as declining throughout its range and in rather "serious trouble." The Canadian Committee on the Status of Endangered Wildlife in Canada designated the piping plover as "Threatened" in 1978 and elevated the species' status to "Endangered" in 1985 (Canadian Wildlife Service 1989).

Reports of local or Statewide declines between 1950 and 1985 are numerous and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). Blodget (1991 personal communication) reports that there was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of pairs of breeding piping plovers declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin 1984). Further, recent experience of biologists surveying piping plovers has shown that counts of these cryptic birds sometimes go up with increased survey effort. This suggests that some historic counts of piping plover numbers by one or a few observers, who often recorded occurrences of many avian species, may have underestimated the piping plover population. Thus, the magnitude of the species' decline may have been even more severe than available numbers imply.

Five pairs of piping plovers nested on Monomoy in 1985, fledging five young (MacIvor et al. 1985). In 1986, the piping plover was listed for protection under the ESA and pair numbers on the refuge started to increase as protection was provided. By the mid-1990s, the refuge was supporting about 20 pairs. In recent years, the refuge has supported approximately 30 to 40 pairs of piping plovers during the nesting season. On average, the refuge has maintained about 5 percent of the breeding population in the State of Massachusetts. An additional 10 to 12 percent (USFWS 2010c and USFWS 2009d) of the State's nesting plovers

occur on beaches that are also within the Town of Chatham. The largest single nesting site in the State is Nauset/South Beach, which is directly adjacent to the refuge and partially owned by the Town of Chatham.

Currently, Massachusetts supports the largest State population of breeding piping plovers along the Atlantic coast. Plovers return to Massachusetts in late March or early April and begin establishing nesting territories. Their nesting season spans from late March through the end of August, though nesting usually begins on the refuge between the last week of April and the first week of May. High-quality nesting habitat generally consists of wide, flat, sparsely vegetated barrier beaches. Quality nesting habitats may be located near or within areas with abundant moist sediments associated with blowouts, washover areas, spits, unstabilized and recently closed inlets, ephemeral pools, and sparsely vegetated dunes (USFWS 2009c). Plovers forage along the waterline, on the mudflats, and among the wrack line (USFWS 1996). Habitat loss from development has decimated the piping plover population along the Atlantic coast, which increases the importance of places like the refuge, a safe nesting area with high-quality habitat.

On Monomoy NWR, nesting habitat is currently not considered a limiting factor. A thorough assessment of refuge beaches conducted by Service and MDFW biologists in 1995 and 1997 found all prime piping plover habitat to be located on South Monomoy. Sections of the beach were ranked from “A+” such as areas that contained abundant suitable nesting habitat with feeding habitat available along an ocean-side beach and a pond, bay, estuary, or salt marsh, to “D,” which included habitat believed unlikely to be used by nesting plovers (USFWS 1996b). South Monomoy is a rare example of an actively accreting coastal landform (Giese et al. 2010) and, due to this, habitat has increased since the assessments conducted in 1995 and 1997. Recent shoreline monitoring surveys may also help us understand how much habitat we are gaining annually.

On many mainland sites, predation on eggs and chicks by coyote, fox, skunk, raccoon, and other predators is increasing (USFWS 2009a, USFWS 1996a). Mainland sites also deal with over-sand vehicle (OSV) users, and high volumes of beach visitors have the potential to impede foraging or accidentally crush the cryptic plover eggs or chicks. Management of beach recreation is imperfect, poses more conflicts with human beach activity at mainland sites, and requires costly and labor-intensive management (USFWS 2009, Hecht and Melvin 2009). Protecting critical habitat from development and restricting recreational use in plover nesting areas is essential to maintaining healthy piping plover populations (MA NHESP 1990). Much of the refuge upland is federally designated wilderness area that is mainly accessible by boat and where OSVs are not allowed. The refuge provides a safe place for plovers to nest, and is relatively unaffected by human disturbance issues that can be common at other mainland nesting sites. Thus, the refuge uses seasonal closures to protect areas containing prospecting pairs, but has not needed to close all areas that contain suitable habitat that are not in use. In this alternative, all high-quality habitat is monitored regularly to ensure proper protection from human disturbance. Areas that are known to have more public use are closed in April before the birds start nesting, and other closures are based on the breeding behavior observed on the refuge. See the glossary (e.g., symbolic fencing) for a definition of the types of signs used for closed areas.

Predation is the main issue of management concern for nesting piping plovers on the refuge. Predation has been identified as a major factor limiting piping plover reproductive success at numerous sites in the region (MacIvor 1990, Patterson et al. 1991, Cross 1991), and is included as an important strategy in the Piping Plover Recovery Plan (USFWS 1996a). As recognized in the recovery plan,

natural threats from predation have been exacerbated by many human activities in the coastal zone. In addition, the cumulative impacts on piping plovers from predation, habitat loss, human disturbance, and small population size decrease the plover's ability to withstand predation. Due to the magnitude of predation threats to plovers and limitations associated with all currently available solutions, the plan strongly recommended that onsite managers employ an integrated approach to predator management that considers a full range of management techniques (USFWS 1996a). At Monomoy NWR, both avian and mammalian predators have been documented preying on piping plover eggs, chicks, and adults. On the refuge, the most common predators are gulls and coyotes, which opportunistically take eggs and chicks.

Studies have shown that predator exclosures can help minimize predation or reduce nest abandonment (Rimmer and Deblinger 1990, Vaske et al. 1994, Mabee and Estelle 2000); exclosures are actively utilized on the refuge. Though exclosures are a useful tool, they may be inappropriate under certain conditions, including habitat that is too steep, highly vegetated, or susceptible to predators that may use the exclosures to target nesting birds (refer to Blodget and Melvin 1996 for more information about appropriateness of use). All exclosures placed on the refuge are monitored frequently to ensure that they are safely protecting the nests and birds within them and not putting the adults at risk. In addition to exclosures, active predator management has been employed on the refuge to remove unwanted predator species (see appendix J).

While many of the management actions associated with piping plovers also impact American oystercatchers and least terns, they were included in separate objectives in this alternative. We chose not to combine these species due to the piping plover's threatened status, and to maintain flexibility should future recovery plan efforts require new specific actions for this species.

### Strategies

#### *Continue to:*

- Use temporary symbolic fencing to seasonally close all suitable piping plover habitat that is located in areas vulnerable to human disturbance regardless of the presence of pairs by April 1; this may happen earlier if weather allows.
- Use temporary symbolic fencing to seasonally close additional areas that contain breeding piping plovers (May) as nesting or courtship behaviors are observed; maintain these areas as closed until at least July 1, if no nesting has occurred, or until all chicks have fledged (fencing would be removed as staff time allows once these criteria are met).
- Patrol and enforce closed areas during the nesting season.
- Use temporary predator exclosures on piping plover nests that are located in sparsely vegetated areas with nothing obstructing the view of the bird or inhibiting the bird's ability to detect predators.
- Minimize impacts of avian and mammalian predators to nesting plovers through non-lethal and lethal management as described in appendix J.
- Strengthen partnerships to manage lands adjacent to the refuge to ensure the success and survival of piping plovers in the surrounding area and create a larger area of continuous protection.
- Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults or collecting unhatched eggs for DNA analysis.

- Review 5-year reviews and recovery plan updates for piping plovers within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### **Monitoring Elements**

- Monitor piping plovers throughout the nesting season to include nest searches in traditional piping plover nesting areas beginning in mid-March; nest visits to monitor and record dates of laying, hatching, or failure, and cause of failure; and chick searches to determine survival or first observed flight (Blodget and Melvin 1996).
- Conduct the piping plover census during the Massachusetts Statewide census window (currently June 1 to 9) and collect spatial data of nest locations to document changes in habitat selection and site fidelity from year to year.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Resight banded adults to contribute to metapopulation studies and determine whether piping plovers nesting on Monomoy refuge wintered or migrated through the Gulf of Mexico after the Deepwater Horizon oil spill.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.
- Update the cover-type map refugewide every 5 to 10 years.

#### **Objective A1.3 (Beach Shoreline, Dune Edges, and High Salt Marsh—American Oystercatcher)**

Continue to protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for nesting pairs of American oystercatchers. Maintain a mean productivity of at least 0.40 chicks fledged per nesting pair consistent with current research.

#### **Rationale**

American oystercatchers are a species of high conservation concern that also breed on the refuge in high numbers. Though they are not currently protected under State or Federal endangered species legislation, they are protected under the Migratory Bird Treaty Act and are listed as a species of conservation concern in several management plans that guide refuge decision-making (see appendix A for full listing of conservation status). Historically, American oystercatchers were likely widespread on the Atlantic coast and may have nested as far north as Newfoundland and Labrador (Nol and Humphrey 1994). In the 1800s, market hunting and eggging reduced the population and extirpated the species from the Northeast. With passage of the Migratory Bird Treaty Act of 1918 (16 U.S.C. § 703-712), populations rebounded and oystercatchers began to move back into northern breeding areas (Nol and Humphrey 1994).

In 2001, the American oystercatcher was one of several species identified in the U.S. Shorebird Conservation Plan (Brown et al. 2001) as having small enough populations to warrant special attention. As a result, the High Priority Shorebird Group (HPSG), which met in November 2001, decided that a regional research strategy for the American oystercatcher was necessary to adequately address the following research priorities, breeding and wintering population estimates,

identification of limiting factors among all life stages, and demography. The group decided to focus efforts on American oystercatchers as a focal species for coastal shorebird conservation. The American Oystercatcher Working Group was formed and, since the initial meeting in 2001, the group has met every year at various locations within the birds' Atlantic coast range (American Oystercatcher Working Group 2011).



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*American oystercatcher*

Until recently, population estimates for American oystercatchers in the United States focused on the Atlantic coast and were compiled from multiple survey efforts, including state breeding surveys and coordinated boat surveys of roost sites. Both types of estimates may have undercounted birds. During the 2002 to 2003 nonbreeding season, the Manomet Center for Conservation Sciences conducted an aerial survey in cooperation with members of the American Oystercatcher Working Group, of which Monomoy refuge is a part. The survey covered the Atlantic and Gulf coasts, and encompassed the entire winter range of the eastern race of American oystercatcher in the United States. The survey resulted in a population estimate of  $10,971,298 \pm$  individuals, with 8,500 wintering on the Atlantic coast (Brown et al. 2005). While this aerial survey provided a reliable population estimate at a single point in time, tracking and projecting population trends is more complex and requires a better understanding of the population dynamics of the species. Current information on population trends comes primarily from state and local surveys, which often vary in methodology and coverage. Although survey data show that oystercatchers are continuing their range expansion in the Northeast (Nol et al. 2000), numbers are declining in core mid-Atlantic breeding areas (Mawhinney and Bennedict 1999, Davis et al. 2001).

American oystercatchers breed in most coastal states from Massachusetts to the Gulf coast of Texas. They nest on coastal islands and salt marshes, with the largest concentrations along the southeastern United States. Traditional breeding habitat includes accreting undeveloped barrier beaches, sandbars, shell rakes, and salt marsh islands. Nesting densities are generally highest near prime feeding territories, especially on sand flats near inlets (Schulte et al. 2010); this is where they are commonly found on Monomoy NWR. American oystercatchers tend to utilize similar habitat as piping plovers on Monomoy refuge, though they also use more vegetated areas of high salt marsh on North Monomoy Island that are not suitable for piping plovers. Other factors that influence the quality of habitat (by influencing reproductive success), include levels of human use, predator activity, and overwash potential (Thibault 2008, McGowan et al. 2005, Nol 1989, Novick 1996, Davis et al. 2001).

Since focused quantitative monitoring of American oystercatchers began on Monomoy refuge in 2002, the number of nesting pairs annually has roughly corresponded to changes in the Massachusetts' population. Both the State and refuge populations declined in 2004 to very low numbers, but have been rebounding in recent years. Most recently in 2010, both the State and refuge nesting numbers and productivity increased significantly from 2009. Overall, the refuge hosted 12 percent of the total statewide population in 2010, but has hosted up to 20 percent of the State population in previous years (USFWS 2010c; see chapter 2 for more details). A productivity of 0.40 chicks fledged per pair would maintain and slowly increase the population on the refuge (Murphy 2011 personal communication). Population growth and health for this species are shared objectives of the American Oystercatcher Working Group (Schulte et al. 2010), National Fish and Wildlife Foundation (NFWF 2008), and the Service (USFWS 2008a).

On Monomoy NWR, predation is one management concern impacting American oystercatcher productivity and population growth. On the refuge, the most common predators are herring and great black-backed gulls and eastern coyotes,

which opportunistically take eggs and chicks. This is consistent with most studies of nest success, which have shown that predation is a significant factor (Schulte et al. 2007).

Funding provided by the National Fish and Wildlife Foundation has allowed us to test two methods of non-lethal predator management on the refuge to protect American oystercatcher eggs and chicks from mammalian predators. In 2009, medium height 4-foot tall electrified fence and 6-foot tall non-electrified wire fencing were tested. In 2010, medium height fencing was used. The tall wire fencing was deemed inappropriate in 2009 and its use discontinued. Electric fencing has been successful in refuge areas that contain flat, sparsely vegetated areas that are free of the risk of overwash. If the fence is placed in areas where it may be overwashed by salt water, electrical shorts may occur and destroy the fence for future electrified use. Erecting the fence in thick vegetation is very difficult and the vegetation needs to be trimmed, causing potential habitat damage and increased staff labor, and drawing more attention to the fenced area. Currently, the energizers used at the refuge can only support fences of up to 12 panels, or a circumference of 1,800 feet. When the fencing is used in areas with varying elevations, predators can more easily breach the fence by jumping in from a higher area. This was observed on the refuge in both 2008 and 2009. For these reasons, enclosing the entire common and roseate tern colony is not practical. However, nesting least terns and piping plovers have benefited from areas protected by electric fence on the refuge.

In addition to non-lethal predator management, lethal predator management has afforded protection for nesting American oystercatchers on the refuge as well (see appendix J). Funding provided by the National Fish and Wildlife Foundation has enabled us to deploy several types of remote cameras to better document causes of nest failure, better understand nocturnal behavior of adult and juvenile birds, and gain insight into nocturnal predation, disturbance, and abandonment in annual reproductive success. This information will help us prioritize and focus predator removal efforts and identify areas where human disturbance may be limiting reproductive success.

Since oystercatchers are a coastal species that uses low-lying habitats for nesting and roosting, they are particularly vulnerable to pressure from storm overwash and, ultimately, the effects of sea level rise. Overwash is known to destroy nests when storms occur during the nesting season and can also destroy beach habitat at other sites (Schulte et al. 2007). Storm and tidal overwash is a major factor influencing the success of American oystercatchers on the refuge. In 2008, eight of 34 total nests and in 2009, three of 25 total nests lost, were lost to overwash or storm-related weather (USFWS 2008a, 2012a). Under this alternative, the refuge would continue preliminary experiments with nest platforms to elevate nests that are vulnerable to overwash during storm and high lunar tides. In 2011, experimental efforts were implemented on North Monomoy Island to raise one American oystercatcher nest that was close to the high tide line. The eggs were removed from the nest; a tire was placed where the nest had been and was filled and covered with sand. The eggs were then replaced on top of the sand-covered tire. The incubating adult returned to the nest and continued to incubate for several weeks until the nest was depredated by a coyote. This method was again attempted in 2012; further research into elevating nests and creating stable nest platforms to prevent overwash would be further investigated in this alternative.

### **Strategies**

*Continue to:*

- Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat that is located in areas vulnerable to human disturbance regardless of the presence of pairs early in the season (April); this may happen earlier if weather allows.

- Use temporary symbolic fencing to seasonally close additional areas that contain breeding American oystercatchers (May) as nesting or courtship behaviors are observed; maintain these areas as closed until August 1 if the areas remain unused, or until all chicks have fledged.
- Patrol and enforce closed areas during the nesting season.
- Participate in a landscape-level color-banding effort through the American Oystercatcher Working Group to improve productivity estimates on the refuge and contribute to a rangewide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales.
- Use temporary solar-powered electric fence in suitable nesting habitat to protect American oystercatchers from mammalian predators.
- Experiment with the use of temporary non-electrified fencing to reduce mammalian depredation.
- Explore the effectiveness of temporary nesting platforms for American oystercatchers to reduce nest loss due to overwash.
- Minimize impacts of avian and mammalian predators to nesting American oystercatchers through non-lethal and lethal management as described in appendix J.
- Strengthen partnerships with Mass Audubon's Coastal Waterbird Program and the Town of Chatham to manage lands adjacent to the refuge to ensure the success and survival of American oystercatchers in the surrounding area and create a larger area of continuous protection.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### **Monitoring Elements**

- Monitor American oystercatcher productivity throughout the nesting season by searching nesting areas 1 to 2 times per week beginning in early April to document nest locations, laying, hatching, nest failure or success, and overall productivity.
- Conduct the American oystercatcher census during the Massachusetts Statewide census window (currently May 22 to 31).
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Deploy temporary field cameras with digital video recorders near American oystercatcher nests to monitor disturbance, predator activities, and cause of nest loss.
- Resight and report banded adults during migration and staging periods to contribute to metapopulation studies coordinated through the American Oystercatcher Working Group and better understand Monomoy NWR's importance during migration and staging.



**Objective A1.4 (Beach Shoreline—Least Tern)**

Continue to protect nesting least terns from disturbance.

**Rationale**

Least terns are a State-listed species of concern that have been declining in Massachusetts in recent years. The species is listed as a high priority for conservation in BCR 30, among other designations (see appendix A). Though this species is not federally listed, it is a species of conservation concern and is currently protected when found nesting on the refuge. Like many beach-nesting species, least terns have suffered from habitat loss, increased predation, and increased human populations and disturbance in coastal areas.

Least terns were extirpated from much of the Northeast during the 1880s and 1890s (Nisbet 1973). Like many other seabirds, least tern populations rebounded after the passage of the Migratory Bird Treaty Act of 1918. After initial recovery, populations declined in many areas between 1950 and the early 1970s due to the displacement by humans, predation, and disruption by organochlorine pesticides (Kress and Hall 2004). Regionally, the number of least tern adults and colonies increased from 1972 to 1987; this was followed by 7 years of gradual decline. However, in 1995, dramatic increases in the number of least tern adults in New York and Connecticut resulted in the greatest number of least terns recorded in more than 25 years (Kress and Hall 2004). Least tern numbers in Massachusetts generally increased from 1985 to 2001, declined from 2001 to 2003, showed an increase in 2006 through 2008 (Mostello 2010), and have been decreasing since (information from 2010 and 2011 are based on preliminary data from the 2010 and 2011 Massachusetts Coastal Waterbird Meeting in Barnstable, MA). The least tern population in Massachusetts has been declining in recent years. From 2008 to 2009, there was a 5.5 percent decrease in the least tern population in the State. In 2009, 45 percent of the State's least tern population could be found in three large colony sites (Mostello 2010), which increases the vulnerability of the State population.

Least terns occupy similar habitat as nesting piping plovers, including sandy areas with little vegetation that are not prone to overwash or intense predation (Kress and Hall 2004). Though management for piping plovers often positively impacts least terns, the management priorities for the two species are different; therefore, these species have been listed separately in this chapter. Least terns are a lower management priority than piping plovers, which are federally listed as threatened.

The numbers of nesting least terns on the refuge has fluctuated between 200 pairs and no pairs over the last 10 years (see chapter 2 for more details). Though there is an abundance of least tern habitat on the refuge, especially on South Monomoy, numbers have likely fluctuated due to the prevalence of coyote on refuge beaches (USFWS annual Monomoy field season activities reports 1998 to present) throughout the nesting season, and the species' low threshold tolerance to disturbance and lack of nesting site fidelity (Kress and Hall 2004). Least terns are highly disposed to abandonment due to predator pressures. Although not quantitatively monitored, coyotes frequently prey on least tern eggs and chicks, and in some years, coyote tracks have frequently been seen through least tern nesting areas (USFWS 2012). Both gull species have also been documented preying on least tern eggs or chicks at Monomoy or other sites (Melvin et al. 1992, Ivan and Murphy 2005, Rimmer and Deblinger 1992, Wilke et al. 2007, USFWS 2009e, USFWS 2012). Abandonment or localized shifts in colony sites occur in response to flooding, changes in colony size, increased vegetative cover, human activities, or predation (Kotliar and Burger 1986, Atwood and Massey

1988). Even sites that have suitable nesting habitat often do not have consistent nesting populations year to year. Least terns are notoriously inconstant and may leave a site altogether if predator presence is too high (Thompson et al. 1997).

The refuge is not currently taking a proactive role to increase least tern nesting numbers, but predator management implemented for other higher priority species may benefit nesting least terns. We do not quantitatively monitor least tern productivity because in most years the nesting number is small and does not significantly contribute to the State's population. Due to our habitat availability and the lack of human disturbance at our site, least tern numbers may increase in the future. If nesting numbers on the refuge increased and represented a significant portion of the State's population, productivity would be monitored more closely.

### Strategies

*Continue to:*

- Patrol and enforce closed areas during the nesting season.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

### Monitoring Elements

- Monitor least tern nesting periodically through the nesting season by searching nesting areas once per week beginning in mid-May to qualitatively estimate reproductive success.
- Conduct a census of nesting least terns during the Massachusetts Statewide tern census window (currently June 5 to 20), and record general locations of nesting sites.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

### Objective A1.5 (Beach—Northeastern Beach Tiger Beetle)

Continue to protect from disturbance and degradation areas currently occupied by northeastern beach tiger beetle adults or larvae with sufficient protected habitat for expansion and genetic interchange (to be determined by future research). Maintain a peak count of at least 500 adults.

### Rationale

The Service has responsibility for protecting and assisting in the recovery of federally listed threatened and endangered species under the ESA. In 1990, the northeastern beach tiger beetle was listed as a threatened species. This tiger beetle is also listed as a State-endangered species in Massachusetts. The loss of protected and undisturbed beaches has been cited as one of the primary reasons for the decline of this species. The Northeastern Beach Tiger Beetle Recovery Plan establishes four geographic recovery areas (GRA) and status and goals for each area. Monomoy NWR is currently one of only two occupied sites in GRA 1 (coastal Massachusetts and islands) sustaining a population of northeastern beach tiger beetles; the other site is located at Squibnocket Beach on Martha's Vineyard. Both of these sites contain large populations (peak count greater than 500); however, Monomoy NWR is the only site that is considered permanently

protected (USFWS 2009b). The northeastern beach tiger beetle has been extirpated from most of its former range to the south between Massachusetts and Maryland (Kapitulik 2010).

The northeastern beach tiger beetle occurred historically in “great swarms” on beaches along the Atlantic coast from Cape Cod to central New Jersey and along Chesapeake Bay beaches in Maryland and Virginia. This particular tiger beetle has been identified as an indicator species for healthy beach communities, and its presence reflects positively on the ecological value of the habitats where it can be found. This species’ most preferable habitat is healthy, wild beach ecosystems that are highly dynamic, subject to natural erosion and accretion processes, and undisturbed by heavy human use (USFWS 1994).

The extirpation of the northeastern beach tiger beetle from most of its range has been attributed primarily to destruction and disturbance of natural beach habitat from shoreline developments, beach stabilization structures, and high recreational use, all of which are thought to affect the larval stage (Knisley et al. 1987). In addition, extensive surveys completed prior to listing indicated that this tiger beetle was rarely found on beaches with heavy public use or OSV access. Studies have also shown that mortality of early instars increases in direct proportion to the level of human use, including foot traffic (USFWS 1994).

Due to the presence of large, relatively undisturbed beaches, in 2000 the refuge was selected as a suitable recipient site to establish a new population. Reintroduction efforts began that year, with larvae translocated from Squibnocket Beach on Martha’s Vineyard to South Monomoy east of Hospital Pond (see map 2.4). Translocations of larvae occurred annually through 2003 and, although no new transplants have occurred since 2003, adult beetles have been documented every year since, with counts indicating that the refuge’s population is currently self-sustaining (see chapter 2 for more details). During a nor’easter in November 2006, the Nauset/South Beach property connected to South Monomoy Island near the refuge’s introduction site (map 2.4). Subsequent monitoring revealed that the tiger beetle population took advantage of the newly created habitat and has been expanding steadily northward on Nauset/South Beach and southward on South Monomoy from the introduction site. Map 2.4 details the most current information regarding the general location of adults seen on Nauset/South Beach and South Monomoy during the 2012 spawning season. Since there are two distinct cohorts occupying this site, the exact location of adult beetles varies from year to year. As the population is fluid and the beaches are dynamic, Nauset/South Beach may become increasingly important for protection of this species.

The Town of Chatham managed Nauset/South Beach when it connected to the refuge, and it prohibited public OSV use, which is essential to protect tiger beetle habitat from damage that might result in “take” as defined by the Endangered Species Act. Violations of town policy did occur. The town permits OSV use for emergency response and public safety purposes. Wilderness designation currently protects tiger beetle habitat from damage or “take” due to OSV use while providing for emergency access on the refuge property.

As the only permanently protected population in the Northeast, continuing and expanding these protections is integral to the long-term protection and recovery of this species. Management for northeastern beach tiger beetles also has a positive effect on other tiger beetle species that share habitat with this species, including the hairy-necked tiger beetle, which is listed as a species of special concern in Connecticut, and the hairy-necked subspecies, both abundant on the refuge.

### Strategies

*Continue to:*

- Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth. Cooperate with the Town of Chatham, State of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life; this includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by over-sand vehicles.
- Regularly inform and communicate with officials and the public about areas occupied by tiger beetles on the refuge, including Nauset/South Beach, to foster continued support for protection and monitoring of tiger beetles currently using these areas and to allow for continued expansion of spatial distribution.
- Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

### Monitoring Elements

- Conduct seven to eight adult beetle activity sampling occasions distributed evenly across the late June to late August period (Kapitulik and Smith 2010); during these visits, perform low intensity mark and resight efforts to estimate the population and calculate survival probability.
- Conduct larval activity site visits in the late September and early October peak period, to measure reproductive success and delineate larval habitat.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of spawning habitat.
- Update a cover-type map refugewide every 5 to 10 years.

### **Objective A1.6 (Maritime Shrubland—Black-Crowned Night-Herons and Snowy Egrets)**

Continue to minimize human disturbance to shrubland habitat generally consisting of northern bayberry and rugosa rose approximately 3 feet tall, which is used by nesting wading birds including black-crowned night-herons and snowy egrets.

### Rationale

Throughout the State of Massachusetts, colonies of nesting black-crowned night-herons have generally been declining and becoming more widely dispersed, although increases have been observed in some years. Black-crowned night-herons declined from an estimated 3,300 to 3,600 pairs in 1955 through the early 1970s. Although they increased to nearly 2,000 pairs in 1977 (Erwin 1978, Erwin and Korschgen 1979), only 973 pairs were counted during a coastwide survey in 1984 (Andrews 1990). Coastwide surveys were repeated from 1994 to 1995 and 2006 to 2008, and a 45 percent decline was documented between these two surveys, with only 781 pairs counted at 14 sites most recently (Melvin 2010a).

In contrast, snowy egrets first bred in Massachusetts in 1955 and the population steadily increased beginning in the late 1960s (Petersen and Meservey 2003).

During the 1977 coastwide survey, 459 pairs of snowy egrets were counted (Erwin and Korschgen 1979) and during the 1984 survey, 538 pairs were counted (Andrews 1990). However, the 2006 to 2008 survey revealed a 36 percent decline from the 1994 to 1995 survey to only 401 pairs at 10 sites (Melvin 2010a). Thus, current numbers are less than those observed in the 1970s. Of note is that these populations are "... relatively small, given the State's extensive coastline and abundant and diverse nesting and feeding habitats (Melvin 2010a)." Melvin (2010a) also recommends numerous actions in light of these declines, including more frequent monitoring (at least every 3 years), research to improve surveys, a thorough assessment of regional trends, and research to identify influential factors in nesting trends.

On Monomoy NWR, numbers of both species fluctuate annually (annual surveys have been conducted since 1998; see chapter 2 for details), but most recently this site hosted the second largest colony of black-crowned night-herons, which equalled 20 percent of the State's total. Monomoy NWR does not host as large a percentage of snowy egrets, but it is one of only six sites Statewide that hosts more than 30 nesting pairs (Melvin 2010a). We recognize the importance of maintaining nesting habitat and protecting these species on Monomoy NWR given the relative importance of this site, especially considering the likely future loss of additional sites due to sea level rise, shoreline erosion, and increasing pressure for development and human recreation. Many black-crowned night-herons and snowy egrets are nesting in nonnative rugosa rose, though some have begun nesting in northern bayberry in recent years. Because of the importance of Monomoy NWR to Statewide nesting populations, we have not been removing nonnative rugosa rose. Other wading bird species, including great egrets and glossy ibis, also occasionally nest in this habitat.

Disturbance to nesting black-crowned night-herons and snowy egrets can result in reduced productivity or alter the behavior of nestlings. Studies comparing colonies that received regular disturbance by researchers and colonies that were infrequently visited found that disturbance that occurred before laying began resulted in inhibition of laying, abandonment of nests and eggs, and increased nestling mortality later in the season (Tremblay and Ellison 1979). Parsons and Burger (1982) studied disturbance responses of nestlings that were and were not regularly handled since hatch, and found that chicks handled regularly habituated to disturbance and generally stayed in their nests, while non-handled chicks tried to flee. At sites where herons are not regularly handled and are nesting in close proximity to great black-backed and herring gulls (such as Monomoy NWR), single intense disturbances could result in significant chick loss to predatory gulls, as the chicks flee the cover of the nesting shrubs.

These studies provide guidance for minimizing disturbance from recreationists as well as researchers. Tremblay and Ellison (1979) suggested that heronries should not be visited until a week before hatching will begin. Fernandez-Juricic et al. (2007) suggested a buffer zone of 50 m around nesting colonies based on nestling responses to pedestrians and canoes. Davis and Parsons (1991) found no difference in survival rates of two groups of snowy egret nestlings that were subjected to different levels of handling disturbance by researchers. However, all nestlings in that study were disturbed "to some considerable degree" and the study did not address overall impacts of disturbance to nesting birds (compared to non-disturbed birds). At Monomoy NWR, we have seasonally closed nesting areas of herons and egrets that are most likely to be disturbed by recreationists (typically on North Monomoy Island). Standard buffer distances have not been implemented, but buffer distances are determined in the field so, in most cases, approaching pedestrians may cause birds to increase their time in alert posture, but do not cause adults to flush from the bush they are nesting in.

**Strategies***Continue to:*

- Allow nonnative rugosa rose to remain on the refuge in areas where wading birds nest.
- Use temporary symbolic fencing to seasonally close nesting areas in portions of the refuge with high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

**Monitoring Elements**

- Annually count active wading bird nests in primary nesting areas once between mid-April and mid-May.
- Conduct a complete census of all wading birds refugewide every 5 to 10 years using aerial survey method or ground counts, and in conjunction with Statewide efforts.
- Update a cover-type map refugewide every 5 to 10 years.

**Objective A1.7  
(Intertidal—Migrating and  
Staging Birds, Horseshoe  
Crabs, and Marine  
Mammals)**

Passively oversee up to 2,500 acres of intertidal habitat refugewide to benefit migrating and staging birds, particularly species of conservation concern, including black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, red knot, sanderling, semipalmated sandpiper, dunlin, short-billed dowitcher, roseate tern, and common tern. Continue to prohibit harvest of horseshoe crabs and minimize human disturbance to gray and harbor seals that also rely on these intertidal areas.

**Rationale***Staging Terns*

Intertidal areas on Cape Cod are extremely important for post-breeding staging common and roseate terns. Researchers have documented a dramatic decline in roseate tern populations since 2000, but not common terns, and this decline has occurred despite intensive management efforts at major colony sites and no apparent major change in either roseate tern adult survival or productivity (Spendelov et al. 2008). These facts suggest that there has been a decrease in post-fledging to first-breeding survival, as well as recruitment of young adults. This post-breeding dispersal period just prior to fall migration is an especially sensitive time for many species of terns, as parental care may continue well into fall migration and even after arrival at the wintering areas (Ashmole and Tovar 1968, Feare 2002, Nisbet 1976). At fledging, young terns usually have not achieved adult mass, and several studies have demonstrated that post-fledging parental care given prior to departure from breeding colony sites provides an increase in mass and post-fledging survival probability (Feare 2002, Stienen and Brenninkmeijer 2002, Schaubroth and Becker 2008). During the post-breeding dispersal period, young terns start to transition to independence, learning skills needed to fish independently, and increasing body condition and strength of flight muscles needed for the 7,000 km migration to South America. Much of the presumed recent reduction in post-fledging to first-breeding survival likely results from events that take place during

*Roseate tern*

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this period (Spendelov et al. 2002). After an initial period of more widespread dispersal, most, if not all, roseate terns in the northwest Atlantic congregate at locations around Cape Cod, including Monomoy NWR, and the offshore islands of Martha's Vineyard and Nantucket (Shealer and Kress 1994, Gochfeld et al. 1998). Refer to chapter 2 for numbers of staging terns using Monomoy NWR in recent years.

Conservation partners have been begun intensive studies to determine factors affecting survival during the period between post-fledging and fall migration, with an emphasis on the impacts of human disturbance. Tern responses to human disturbance can vary greatly, from short-term flight responses to permanent abandonment of a staging site; a study relating the type, duration, and intensity of human disturbance to tern response is needed to help managers best implement management that will minimize disturbance at the most important sites. During this period, roseate and common terns are concentrated in a small geographic area, and appropriate management actions can positively affect nearly the total roseate tern population and large numbers of common terns. However, this also means that continual disturbance at just one or two sites may have a significant impact on the population. Post-breeding staging terns are often found on gently sloping intertidal mudflats at lower tides and adjacent beach habitats at higher tides. These are the same habitats that are popular with beach enthusiasts during the summer, which increases the potential for interactions.

#### *Migrating and Staging Shorebirds*

Shorebirds rely on strategically located high-quality stopover sites when migrating long distances between breeding and nonbreeding grounds (Senner and Howe 1984, Myers et al. 1987, Helmers 1992). Shorebirds face strict time constraints when migrating north to breeding grounds because their passage rate is bound by seasonal availability of prey at stopover sites (Myers et al. 1987). During southward migration to nonbreeding grounds, shorebirds may undertake long oceanic flights that lack intermediate stopover areas (McNeill and Burton 1977, Dunn et al. 1988). High-quality stopover sites are those that provide abundant food and a disturbance-free environment, allowing shorebirds to maximize foraging time, replenish energy reserves, and continue migration in good body condition (Myers et al. 1987, Helmers 1992, Brown et al. 2001). Lower quality stopover sites may affect shorebirds' ability to reach breeding or nonbreeding grounds and reduce survivorship (Pfister et al. 1998, Baker et al. 2004). For example, declining prey availability at Delaware Bay, a critical stopover site for northward migrants, has been implicated in reduced breeding success and annual survival of red knots (Baker et al. 2004). Similarly, the annual return rate of semipalmated sandpipers at a southbound stopover site in Massachusetts was higher for birds with more body fat at time of departure (Pfister et al. 1998), suggesting body condition at departure is related to survival.

From maritime Canada to Virginia, the Western Hemisphere Shorebird Reserve Network has recognized six stopover sites that are especially important to migrating shorebirds: Monomoy NWR, Bay of Fundy in New Brunswick and Nova Scotia, the Great Marsh on the north shore of Massachusetts, Edwin B. Forsythe NWR in coastal New Jersey, Delaware Bay in New Jersey and Delaware, and Maryland-Virginia Barrier Islands in Maryland and Virginia (WHSRN 2006). The Bay of Fundy annually supports more than 30 species of southward migrating shorebirds, with peak counts of the nine most common species totaling 800,000 to 1,400,000 annually (Hemispheric Importance; Hicklin 1987). The Great Marsh supports about 30 shorebird species, with an estimated 67,000 shorebirds using the site annually, particularly during southward migration (Regional Importance; WHSRN 2006). Edwin B. Forsythe NWR supports 85,000 shorebirds annually during both migration periods combined (Harrington and Perry 1995). Maximum 1-day counts at Maryland-Virginia

Barrier Islands have exceeded 54,000 birds during northward migration, and at Delaware Bay have exceeded 216,000 shorebirds (Clark et al. 1993), making this site the most important for northward migrating shorebirds in the eastern United States (Hemispheric Importance; Harrington et al. 1989, Clark et al. 1993).

The designation of Monomoy NWR as a WHSRN Site of Regional Importance was based on a maximum 1-day count of approximately 21,000 shorebirds (WHSRN 2006). Based on a quantitative assessment of 500 stopover sites in the United States east of the Rocky Mountains, Monomoy NWR had the highest index value for southward migrating shorebirds, while Delaware Bay had the highest index value for northward migrating shorebirds (Harrington et al. 1989). Quantitative studies from 2005 to 2007 confirmed the continued importance of Monomoy NWR as one of the most important stopover sites for southward migrating shorebirds in the eastern United States. Although we did not attempt to estimate length-of-stay for shorebirds, shorebird use estimates from 2005 to 2007 suggest thousands of birds are using the refuge during northward migration (mean daily estimates of  $8,190 \pm 1,440$  in 2006 and  $2,250 \pm 13,320$  in 2007) and southward migration ( $6,030 \pm 43,290$  in 2006 and  $5,760 \pm 46,440$  in 2007; Koch and Paton 2009). Refer to chapter 2 for more details on abundance and distribution of shorebirds of conservation concern at Monomoy NWR.

Identifying and protecting shorebird stopover habitat is critical given recent population declines of many species of shorebirds (Howe et al. 1989, Morrison et al. 1994, Bart et al. 2007). The northern Atlantic region has been identified by the U.S. Shorebird Conservation Plan as “extremely important relative to the majority of other regions in the United States” for eight of the nine most abundant species on the refuge. Many shorebirds traveling north along the east coast of the United States stop at Delaware Bay and then migrate nonstop to sites in Canada, bypassing New England completely, although several species do stop at the refuge, albeit in lesser numbers than during fall migration. However, during southward migration, many shorebirds use more easterly migratory routes back to their nonbreeding areas, thus traveling through more northerly areas of the Atlantic coast (Morrison 1984, Myers et al. 1987). Monomoy NWR is a favored stopover site for southward migrating shorebirds because of its location in the landscape and its critical foraging habitats. The Cape Cod region of Massachusetts protrudes into the Atlantic Ocean, attracting southbound shorebirds that are following a more easterly path. Habitats at Monomoy NWR are dynamic, with tides and storms continually moving and depositing sediments. The combination of invertebrate-rich intertidal mudflats and bordering salt marsh and upper beach provide foraging and roosting habitats. Additionally, because most of the habitats used by shorebirds at Monomoy NWR are not easily reached without a boat, human disturbance is relatively low compared to other sites in Massachusetts (Koch and Paton 2009).

Of particular concern is the *rufa* subspecies of the red knot, a candidate species for federal protection under the Endangered Species Act. These birds undertake one of the longest migrations known, traveling from their furthest wintering ground at the tip of South America to their Arctic breeding grounds and back again each year, an estimated 16,000 miles round trip. Their migration also includes some of the longest nonstop flights in the bird world, an estimated 5,000 miles over a 6-day period (Niles et al. 2010). Protection of breeding, migration, and wintering habitat is critical to this species’ recovery (Niles et al. 2008). Southeastern Massachusetts, and Monomoy refuge in particular, are likely some of the most important sites for red knots during southward migration (adults and juveniles; Koch and Paton 2009, Harrington et al. 2010a, Harrington et al. 2010b). Research has shown that this region supports red knots bound for different



winter destinations. North American wintering birds exhibit different migration chronology, flight feather molt, and even foraging habits than South American-wintering birds (Harrington et al. 2010b). Red knots in this area have been documented primarily feeding on blue mussel spat and gem clams (Harrington et al. 2010b). During the last few years, geolocators have been placed on adult red knots at Monomoy refuge and Delaware Bay in an effort to learn more about important stopover sites and wintering destinations for adult birds. Preliminary results from geolocators retrieved from North American wintering red knots have confirmed the importance of Florida, but also raised the awareness of occupied sites in North and South Carolina, Haiti, Columbia, and Cuba (Burger et al. 2012). Juvenile wintering grounds remain unknown, but geocator work was initiated on the refuge in 2011.



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*Red knot with geocator*

Another species of particular concern at Monomoy refuge is American oystercatcher, with intertidal areas providing important foraging and resting areas for oystercatchers. In some years the refuge has been one of the more important staging sites for birds in New England prior to the onset of migration. Very little is currently known about oystercatcher staging site selection, but it is likely that disturbance is an important limiting factor. In some years, high counts of staging American oystercatchers on the refuge in September have exceeded 200 individuals, but usage varies widely between years (USFWS annual field season activities reports from 2002 to present).

#### *Horseshoe Crabs*

In addition to its importance to migrating and staging birds, the intertidal habitat at Monomoy NWR hosts one of the largest spawning sites for horseshoe crabs in Massachusetts (USFWS 2002). Horseshoe crabs are an important component of the northeast coastal ecosystem, and their eggs are an integral part of the coastal food web. Horseshoe crab eggs provide an important food source for birds, including gulls (Botton and Loveland 1993, Shuster Jr. 1982, Penn and Brockman 1994, Burger and Wagner 1995 as cited in Burger 1996) and migrating shorebirds.

The importance of horseshoe crab eggs to migrating shorebirds is well documented, especially in Delaware Bay (Castro et al. 1989, Castro and Myers 1993, Botton et al. 1994, Dutton 1998, Harrington and Shuster Jr. 1999, Tsipoura and Burger 1999). At least 20 species of shorebirds rely on horseshoe crab eggs to build up fat reserves during their migration to breeding grounds (Margraf and Maio 1998), and more than 10 species of shorebirds utilize horseshoe crab eggs in Delaware Bay (Sperry 1940, Recher and Recher 1969, Shuster Jr. 1982, Castro et al. 1989, Tsipoura and Burger 1999). While discussion of the horseshoe crab/shorebird relationship has principally focused on Delaware Bay, documentation of shorebirds feeding on horseshoe crab eggs on Cape Cod dates back to 1881, when red-breasted sandpiper (red knot) and turnstones are referenced with respect to foraging on horseshoe crab eggs (Hadgood 1881). There is very little published literature detailing the relationship between shorebirds and horseshoe crab eggs in New England, but a study conducted in Plymouth, Massachusetts, in 1976 confirmed that short-billed dowitchers were feeding on horseshoe crab eggs and that the number of agonistic encounters among these birds was higher when foraging in areas containing horseshoe crab eggs. In addition, the number of short-billed dowitchers feeding at these sites declined as horseshoe crab eggs became less abundant later in the season (Mallory and Schneider 1979).

In 2001 and 2002, Monomoy NWR biologists collected gut samples of southward (2001) and northward (2001 and 2002) migrating shorebirds to determine if horseshoe crab eggs were a prey item of shorebirds. Of the 21 shorebirds examined during northward migration, 16 had been feeding on horseshoe crab eggs, and of the 49 shorebirds examined during southward migration, 17 had been feeding on horseshoe crab eggs (Koch 2011 personal communication) (table 3.1). Although studies did not quantify the proportion of shorebirds' diets composed of horseshoe crab eggs, various species are clearly utilizing the eggs as a food source during both migration periods.

**Table 3.1. Gut Samples From Shorebirds at Monomoy NWR Examined During Migration.**

	Number Sampled	With Eggs
<b>Northward Migration</b>		
Black-bellied plover	2	0
Semipalmated sandpiper	1	1
Sanderling	3	3
Willet	1	0
Dunlin	14	12
<b>Southward Migration</b>		
Semipalmated sandpiper	1	0
Least sandpiper	3	0
Willet	1	0
Short-billed dowitcher	44	17

Shorebird surveys were combined with benthic community surveys in 2007 to investigate potential relationships in distributions during southward migration, and both red knots and semipalmated sandpiper densities were positively correlated with horseshoe crab egg density, though other factors may also have influenced these species' distribution (Koch 2010). Horseshoe crab eggs are a major food source for both red knots and semipalmated sandpipers in Delaware Bay during northward migration (Tsipoura and Burger 1999) and horseshoe crab egg density was the most important factor determining red knot beach use in Delaware Bay (Karpanty et al. 2006). Horseshoe crab spawning activity at Monomoy NWR generally peaks around the new and full moons in May (James-Pirri et al. 2005), which coincides with northward migration. However, sediment core samples during July and August showed that horseshoe crab eggs are still prevalent and widespread on the intertidal flats at Monomoy NWR during shorebirds' southward migration (Koch 2010).

In addition, horseshoe crab eggs and larvae are often eaten by minnows and juveniles of larger fish, (Harrington and Shuster Jr. 1999, Mugford 1975, USFWS 1988, Finley 2011 personal communication) including killifish species (Finley 2011 personal communication) such as striped killifish, eel species such as American eel (Warwell 1897, deSylva et al. 1962), weakfish, northern kingfish, Atlantic silverside, summer flounder, winter flounder (deSylva et al. 1962, Penn and Brockman 1994), striped bass (Martin 1974), and white perch (Shuster Jr. 1982). Observations of other fauna feeding on horseshoe crab eggs, hatchlings, and adults include sand shrimp (Price 1962), eight mollusk species (Perry 1940, as in Shuster Jr. 1982), fiddler crabs (Shuster Jr. 1958 as in Shuster Jr. 1982), blue crab, green crab, spider crab in Barnstable Harbor, Massachusetts (Shuster Jr. 1958 as in Shuster Jr. 1982), devil ray, (Teale 1945 as cited in Shuster Jr. 1982),

puffers (Shuster Jr. 1958 as cited in Shuster Jr. 1982), sharks, and loggerhead sea turtles (ASMFC 1998 and 1999). All of these species occur on or near Monomoy NWR.

In addition to their importance to wildlife, horseshoe crabs are harvested as bait for various fisheries, including American eel and whelk, or by biomedical facilities producing *Limulus Amebocyte Lysate* (LAL). LAL is a clotting agent (Novitsky 1984) used for the detection of endotoxins pathogenic to humans in all injectable drugs and implantable medical devices (Berkson and Shuster Jr. 1999). Horseshoe crabs are susceptible to overharvest because of their reproductive strategy and ecology. They are slow to reach sexual maturity (Shuster Jr. 1982) and do not spawn until 9 to 10 years of age. Beach geochemistry, local tidal rhythms, predation, and intraspecific competition for nesting space probably all affect nest site selection (Penn and Brockman 1994), but at Monomoy NWR many horseshoe crabs lay eggs in the gently sloping, wide intertidal areas. After a female lays 80,000 to 100,000 eggs during several high tides, she returns to deeper waters (Shuster Jr. and Botton 1985, as cited in Shuster Jr. 2000). Larvae hatch within 4 weeks after fertilization (Botton 1995), remain in the sand for several weeks, and then begin moving toward the beach surface (Rudloe 1979 as in Penn and Brockmann 1994). Within 2 weeks, they molt into juveniles (Sekiguchi et al. 1982 as in Penn and Brockmann 1994). During the first summer, juvenile horseshoe crabs generally live in shallow waters near the shore, but undergo multiple molts and disperse over the tidal flats, moving in an offshore direction (Shuster Jr. 1979). Intertidal flats remain extremely important to successful population recruitment. Adults return annually to spawn on beaches and may do so for at least 8 years (Shuster Jr. 2000). Horseshoe crabs may live as long as 15 to 20 years (USFWS 1998b).

Commercial fishing has significantly influenced the abundance and distribution of horseshoe crabs (Botton and Ropes 1987). Horseshoe crabs congregating on beaches during high tides to spawn are easily collected by harvesters in large quantities. Horseshoe crabs moving from deeper waters and subtidal areas to intertidal areas on Monomoy NWR are also vulnerable to this type of harvest. In the past, harvest for bait and biomedical use on Monomoy NWR has coincided with the spawning activity of horseshoe crabs and their movement into the shallow intertidal areas to reproduce. The gentle topography of the west side of North Monomoy Island and the north tip of South Monomoy allows horseshoe crabs in the subtidal areas to be easily harvested. Horseshoe crabs collected from the subtidal areas of the refuge during this time of year, especially close to the intertidal areas, are likely adults. In addition, because horseshoe crabs do not mature for nearly a decade, a heavily exploited population will recover slowly (Loveland et al. 1996).

The full impacts of the biomedical industry's use of horseshoe crabs are unknown. Because the number of horseshoe crabs harvested for this purpose is much less than those collected for the commercial bait fishery, and surviving horseshoe crabs are returned to the waters after bleeding, the impacts of this activity are likely less than those of bait harvesting. A comprehensive overview of bleeding studies is included in the compatibility determination, but a summary of some of these studies is included here. A 1999 study conducted in South Carolina (Wenner and Thompson 2000) found that mortality of bled crabs was 1.3 to 18.7 times greater than individuals that were not bled; based on information from their treatment group, this translates into an 8 percent mortality rate. Although information on mortality due to shipping and handling are scarce, Wenner and Thompson (2000) concluded that transport mortality to and from a biomedical facility was not significant and may be less than 2 percent. Another study conducted in Maryland from 1999 to 2001 compared mortality of bled and unbled horseshoe crabs; a 7.5 percent differential mortality was found between the two groups (overall mortality rate of bled and unbled crabs was 8 percent

and 0.5 percent, respectively) over the 3 years (Walls and Berkson 2003). Very recently, a study (Leschen and Correia 2010) found that mortality of bled female horseshoe crabs in Massachusetts (which included estimates of handling specific to a Massachusetts facility's protocol) ranged from 22.5 to 29.8 percent (higher for crabs held overnight), compared to 3 percent mortality for unbled crabs. No studies have been done on impacts to reproductive behavior following bleeding, and limited studies have been conducted on long-term survival following bleeding. Rudloe (1983) collected, tagged, bled, and released 10,000 mature horseshoe crabs; tag returns indicated a 10 percent mortality for horseshoe crabs bled during the first year after bleeding. Animals recovered during the second year following bleeding showed a cumulative 11 percent mortality (an additional 1 percent over the first year returns).

Determining the effects of harvesting is confounded by the fact that no studies to date have considered the long-term impacts and effects of bleeding on spawning behavior, fecundity, and long-term survival of horseshoe crabs. There are no scientific data that suggest horseshoe crabs return to their regular biological and reproductive cycle after they are released. Spawning behavior of horseshoe crabs following release could be critical to the long-term health of the population. Since horseshoe crabs are collected in intertidal areas during spawning activity or in subtidal areas on their way to spawning areas and females are selected over males because of their size, it is reasonable to assume that some horseshoe crabs are collected before they have spawned. In addition, while aquarium studies suggest that a crab regains its blood volume in 3 to 7 days and amoebocytes (a mobile cell that has an immune system function in invertebrates similar to white blood cells in mammals) regenerate in 3 to 4 months (Novitsky 1984), no studies have investigated how this regeneration affects the reproductive cycle of horseshoe crabs.

### *Seals*

Gray seals were found along the northwestern Atlantic coast until the 17th century, and were considered locally extinct until the 1980s (see Wood 2009 for detailed accounts of seal numbers). While their pupping grounds are historically further north on Sable Island in Nova Scotia and in the Gulf of St. Lawrence in Canada, there has been a year-round breeding population around Cape Cod and associated islands since the late 1990s. Monomoy refuge is one of only a few sites where gray seals consistently pup in Massachusetts, and it is likely the largest winter haulout site for gray seals on the U.S. Atlantic seaboard (see chapter 2 for more details on seal numbers; Waring 2013 personal communication). Muskeget Island west of Nantucket and the associated shoals host the largest breeding population of gray seals in Massachusetts and the United States. Though there is currently no estimate for the U.S. gray seal population, surveys conducted since their arrival in the 1980s indicate a steady increase in abundance in both Maine and Massachusetts. It is unclear if this is due to population expansion or immigration (Waring et al. 2009). Seals are protected by the Marine Mammal Protection Act and the Service has an affirmative responsibility to protect seals when they are on refuge lands and in refuge waters.

### **Strategies**

*Continue to:*

- Use temporary symbolic fencing to maintain seasonal closures in portions of intertidal mudflats (that are generally established for nesting species) to reduce disturbance to staging and migrating birds. Map 2.7 depicts closure areas implemented in 2012. Closed area and length of season may vary from year to year based on wildlife use and habitat changes.
- Work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances.



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*Seals on South Monomoy Island*

- Work with partners to document the importance of Monomoy refuge to migrating red knots and contribute to research that will inform the species' recovery.
- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Work with partners to study movement and embayment site fidelity of horseshoe crabs by tagging 500 crabs annually.
- Participate in State and regional efforts to document changes in populations of horseshoe crabs by conducting spawning surveys on Morris Island, North Monomoy Island, and South Monomoy.
- Work with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals, and help monitor injured or sick marine mammals.
- Maintain and enforce closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Review 5-year reviews and recovery plan updates for roseate terns or other listed species present in this habitat type within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

**Monitoring Elements**

- Conduct tern staging counts and resight and report color-banded roseate terns on the refuge and Nauset/South Beach to contribute to study of staging areas and disturbance.

- Opportunistically count and resight American oystercatchers on the northern half of the refuge in conjunction with partner efforts, and report color-banded birds through the American Oystercatcher Working Group to better understand Monomoy NWR's importance during migration and staging.
- Resight and report banded shorebirds to bandedbirds.org, with a focus on red knots, during migration periods to contribute to studies on migration pathways, strategies, habitat use, and survival, and to better understand Monomoy NWR's importance during migration.
- Rely on volunteers and refuge partners to conduct international shorebird surveys opportunistically during north and south migration on North Monomoy Island and South Monomoy and report new primary roost sites as they occur on the refuge.
- Conduct pupping counts and aerial surveys of haulout sites (partner-led) to track use by seals refugewide.
- Monitor and report entangled and stranded marine mammals.
- Obtain aerial photography through collaboration with the Town of Chatham to monitor changes in intertidal habitat at least every 2 years.

**Objective A1.8 (Salt Marsh)**

Continue to protect coastal salt marsh habitat through seasonal closures on North Monomoy Island to protect the quality and natural function of the marsh and provide important nesting habitat for saltmarsh sparrows and American oystercatchers.

**Rationale**

Salt marsh habitat develops when vascular plant communities colonize areas from about mean sea level extending to higher elevations where tides still frequently inundate the plants with salt water. Salt marshes provide important ecological functions and unique habitat for wildlife. "The diversity of habitats within salt marshes (e.g., grasslands, shrublands, creeks, ponds, and saline depressions) and their connection with estuarine and marine waters make them vital resources for many fish and wildlife species. Killifishes, juveniles of other species, and grass shrimp frequent the marshes at high tide where they feed and seek shelter from predatory fishes. Salt marshes are important for both resident and migratory bird species. Moreover, they are among nature's most productive natural habitats." (Tiner 2010).

Up to 80 percent of the marshes that once occurred in New England have already been lost to human development, and the remaining salt marshes in southern New England are rapidly being degraded by fragmentation and development (Bertness et al. 2002). Ninety percent of salt marshes in New England were parallel ditched for mosquito control and to facilitate salt marsh haying. In addition to years of pressures from dredging, filling, and diking, salt marshes are now threatened by submergence when development prevents upslope migration to keep pace with sea level rise (Smith 2008).

Salt marsh on North Monomoy Island provides important nesting habitat for American oystercatchers (see alternative A, objective A1.3 for refuge importance to American oystercatcher) and saltmarsh sparrows. Saltmarsh sparrows are a species of highest conservation priority in BCR 30. Partners in Flight lists the saltmarsh sparrow as a "species of continental importance for the U.S. and Canada," and includes it in the top category of watch list species in need of immediate conservation action due to multiple causes for concern across its entire range. The U.S. and Canada population estimate is 250,000 individuals, with a continental objective to increase the population by 100 percent (Rich et al. 2004).

More than 90 percent of the saltmarsh sparrow global breeding population is in the northeastern United States (Dettmers and Rosenberg 2000). Monomoy and Parker River refuges have the highest sparrow richness detected during counts performed by SHARP students within Massachusetts, and have some of the highest raw abundance counts of saltmarsh sparrows recorded in the State within the limits of the count locations (2013 personal communication, Maureen Correll, PhD student, University of Maine). North Monomoy Island is also one of the only places to reliably detect seaside sparrows, another salt-marsh obligate, within Massachusetts (2013 personal communication, Maureen Correll, PhD student, University of Maine). Generally, occurrence of saltmarsh sparrows within the Gulf of Maine is related to salt marsh patch size and connectivity. Large patches of good quality salt marsh habitat must be available across the landscape for sparrow populations to persist and grow.

One threat to saltmarsh sparrow productivity, especially in places like Monomoy Refuge where the patch size does not restrict habitat, is flooding. Flooding, particularly during new moon tides, is the primary cause of nest failure for the saltmarsh sparrows, which are 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).

In addition to flooding, studies at the Parker River NWR and on Long Island, New York have shown that saltmarsh sparrows accumulate potentially harmful levels of Mercury in their blood (Lane et al. 2011). These elevated blood mercury concentrations may pose a significant threat to the population viability of saltmarsh sparrows and potentially other species within tidal marsh communities. Mercury pollution represents an emerging stressor for coastal marsh ecosystems and requires urgent attention to better understand the processes and spatial extent of contamination that affect salt marsh dwelling species (2011 personal communication, Oksana Lane, BRI). Another stressor to saltmarsh sparrows is hybridization with the Nelson's sparrow. Recent research suggests there may be a southern expansion of the hybrid zone, which would have implications for the reduction of the range of "pure" populations of the saltmarsh sparrow. Hybridization, therefore, may be an additional threat to the persistence of this vulnerable species (2013 personal communication, Jen Walsh, PhD student, University of New Hampshire).

Foraging wading birds, roosting shorebirds, and young horseshoe crabs also benefit from this habitat type. Some other regionally important species that use refuge salt marshes include greater yellowlegs, semipalmated sandpiper, short-billed dowitcher, and northern harrier (State-listed threatened). Common mummichogs and other small fish live entirely within estuaries, tolerating low oxygen, high water temperatures, and high salinity. Mummichogs in turn are important prey for birds and other fish (WNERR 2002).

### Strategies

*Continue to:*

- Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates and minimize disturbance to nesting saltmarsh sparrows and American oystercatchers.
- Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability.

- Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it affects the population fitness of saltmarsh sparrows and Nelson's sparrows.
- Support partner efforts to investigate changes in tidal marsh bird populations on the Refuge and in eastern Massachusetts by comparing current surveys to historical data.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### Monitoring Elements

- Conduct annual census and monitor productivity of American oystercatchers as identified in alternative A, objective A1.3.
- Analyze saltmarsh sparrow survey data from previous years to determine population trends and inform future management and inventory needs.
- Update a cover-type map refugewide every 5 to 10 years.

#### Objective A1.9 (Nearshore Marine Open Water)

Oversee uses on 2,000 acres of nearshore marine open water, submerged aquatic vegetation beds, and subtidal bottoms to conserve natural and cultural heritage and assure sustainable productivity of marine resources to benefit federal trust resources, including migrating, staging, and wintering birds such as eiders, scoters, long-tailed duck, brant, bufflehead, loons, grebes, mergansers, northern gannet, terns, and gulls; marine mammals; horseshoe crabs; interjurisdictional fish; and sea turtles.

#### Rationale

Ongoing and future projects and activities that occur in nearshore marine waters within the Declaration of Taking and Marine Protected Area boundary have the potential to affect priority resources of the Service. Open waters and the underlying subtidal areas are considered refuge land for purposes of refuge/Service jurisdiction. To date, we have regulated only horseshoe crab harvest and clamming in the refuge boundary. Public uses such as fishing, tour boats, jet skis, and kite boards occurring within the Declaration of Taking are of primary concern. Protecting and, as appropriate, restoring submerged aquatic vegetation (SAV) beds, especially eelgrass beds, is vital for their value in sustaining waterfowl, providing habitat for fisheries, substrate for shellfish, and sediment and shoreline stabilization. Activities that alter subtidal bottoms such as towed fishing gear that contacts bottoms or SAV beds are also of concern. Conservation, restoration, and monitoring measures for SAV will continue to be required through the CCP plan period if the long-term trend of SAV decline is to become one of sustained recovery. Sustainability of federally managed fish stocks with essential fish habitat occurring within the refuge Declaration of Taking is also potentially impacted by activities occurring in nearshore marine waters, as are marine mammals (seals, dolphins, whales) and several species of sea turtles.

A continuous, uninterrupted supply of sand delivered by longshore currents is essential for the Monomoy landform to persist over time, especially in the face of rising sea levels. Protecting and improving regional water quality, such as how total maximum daily loads for nitrogen will be achieved in the waterways draining into the area surrounding Monomoy, are crucial issues for refuge management that extend beyond the Declaration of Taking and Marine Protected Area boundary. Therefore, the refuge will continue to actively engage with local, State, and Federal agencies to express any concerns regarding open water uses and recommend how impacts to Service trust resources can be minimized. However, where the Service demonstrates that there is a clear connection, or



nexus, between such activities and the Federal trust interest (federally listed endangered and threatened species, migratory birds, diadromous fish, or refuge resources), the Service may assert that Federal interests supersede conflicting State or local regulations. This nexus is exercised under the Supremacy Clause of the Constitution, Article VI, cl.2. These include, but are not limited to, wind farms, dredging, shoreline armoring, and beach renourishment.

Nearshore marine waters offer important habitat for a variety of species that together make up a complex ecosystem, including invertebrates, fish, sea turtles, marine mammals, and marine birds. Moreover, this coastal habitat is intertwined with adjacent intertidal, salt marsh, and dune grassland habitats. For example, although juvenile horseshoe crabs generally live in shallow waters near the shore during their first summer, they undergo multiple molts and disperse over the tidal flats moving in an offshore direction (Shuster Jr. 1979). The larger the animal, the further it is from shore (Shuster Jr. 2000), therefore, maintaining health of nearshore marine waters adjacent to horseshoe crab spawning areas is important for this species' life cycle. Similarly, nesting common and roseate terns utilizing dune grasslands for nesting rely on nearshore marine waters to find forage fish for themselves and young they are raising on Monomoy refuge. Nearshore marine waters also provide important habitat for some species that may rarely or never use intertidal, salt marsh, and dune habitats on the refuge, such as common eiders. Common eiders are a Service focal species, and the majority of eiders are known to migrate through, stage, or overwinter on nearshore waters of Cape Cod and Nantucket Sound (ACJV 2012). During the winter, eiders congregate in the bays, estuaries, and open ocean environments along the Massachusetts coast; the largest grouping is centered in Nantucket Sound (MA DFG 2006). They feed in waters 6 to 25 feet deep, and their most important food item during the winter (and throughout year) is the blue mussel (MA DFG 2006). Mortality of common eiders has been occurring since 1998 on Cape Cod and was recently identified to be caused by an orthomyxovirus, which has been termed Wellfleet Bay virus (ACJV 2012).

### Strategies

*Continue to:*

- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Reinstall permanent markers visually delineating the Declaration of Taking boundary in open waters based on Regional Surveyor's coordinates; provide commercial GPS software vendors with digital map layers for incorporation into their software products.
- Maintain closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Evaluate aquaculture requests, if any, in open water-submerged bottom areas (below mean low water) within the Declaration of Taking for compatibility and benefits to refuge resources on a case-by-case basis. All requests are subject to issuance of a special use permit.
- Participate in review and discussions with stakeholders regarding dredging channels and depositing dredge materials surrounding Monomoy NWR and impacts to priority wildlife and habitats.
- Support partner efforts to study wintering sea ducks using the waters surrounding the refuge and monitor impacts of diseases affecting these populations.
- Support partner efforts to study shellfish and fin fish stocks and marine mammals, including seals and their principal predator, the great white shark.

- Support partner efforts to assess distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.
- Support partner efforts (New England Aquarium and Mass Audubon) to rescue stranded sea turtles and to collect for scientific research dead sea turtles recovered from refuge waters.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

**Monitoring Elements**

- Monitor the impact of aquaculture activities initiated within refuge waters, if any.
- Monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post-dredging monitoring of substrates, SAV, or benthic communities.
- Conduct opportunistic surveillance year-round to detect field mortality events of marine wildlife, including sea turtles and sea ducks; document observations of sick or dying birds and turtles, and identify, collect, and submit these for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office and Mass Audubon Sea Turtle Stranding Office.
- Update bathymetry maps refugewide every 5 to 10 years.

**REFUGE GOAL 2:**

**Provide the public with wildlife-dependent recreational, interpretive, and environmental educational opportunities to enhance awareness and appreciation of refuge resources and to promote stewardship of the wildlife and habitats of Monomoy NWR.**

**Objective A2.1 (Access and Use)**

Allow public access to Morris Island, North Monomoy Island, South Monomoy, Minimoy Island, and the Declaration of Taking area to the extent that it will not adversely impact Federal trust resources or wilderness character, while maintaining closures that reduce disturbance to wildlife from visitors and protect suitable nesting habitat for species of concern. The exact location and timing of the closures is flexible to respond to the presence of wildlife. Visitors may participate in any compatible public use on the refuge in areas that are open to the public.

**Rationale**

The Service provides many public use opportunities to refuge visitors. Some activities, such as wildlife observation or fishing, are considered priority public uses because they are wildlife-dependent. These are to be facilitated by the Service when appropriate and compatible. Non-wildlife dependent public uses, such as swimming and sunbathing, can also be allowed as long as they are appropriate and compatible. Activities are managed both in time and space to ensure compatibility.

Visitors need a way to access the refuge headquarters, trail, and beach on Morris Island, or any of the areas on North Monomoy Island and South Monomoy Island when they are open to public use. Access to Morris Island generally occurs by car or bicycle. Access to North Monomoy Island and South Monomoy Island is by personal boat or ferry. We provide space at Morris Island for one seal tour-ferry company under a special use permit. That ferry provides its own mooring outside the Declaration of Taking boundary, but loads and unloads passengers on refuge property at the foot of the stairs under the SUP. The space provided also includes

limited parking for their operation. Vehicles and OSVs are not allowed anywhere on the refuge other than in the Morris Island and Stage Island parking lots. Access to South Monomoy Island is by personal boat or ferry.

Because of the limited space available at Morris Island, parking may not be sufficient during busy times of the year to accommodate all refuge visitors. When this happens, refuge visitors either leave and never visit the refuge, or park along the causeway and walk to the refuge headquarters, beach, and refuge trails. We have been working with the Town of Chatham to implement programs that would provide another means of access to Morris Island with the possibility of piloting a shuttle program to Morris Island.

We issue a very limited number of permits to allow parking in our lot on Stage Island. These permits have been issued on a yearly basis to specific individuals, but we have gradually reduced the number of special use permits issued. Once a permittee fails to request renewal of the permit, it is not re-issued, nor are family members allowed to use these permits. All permittees have been advised in writing that future use of the Stage Island parking area is likely to be discontinued. Under this alternative, we would eliminate all private parking and use on the Stage Island lot within a year.

### **Strategies**

*Continue to:*

- Provide parking at the refuge headquarters on Morris Island for beach and trail access.
- Provide 30 parking spaces free of charge at refuge headquarters on Morris Island. Issue special use permits to two boat operators who provide access to North Monomoy and South Monomoy, and allow boat access to North Monomoy and South Monomoy.
- Utilizing adaptive management, strive to keep Morris Island and large portions of South Monomoy Island open year-round, and re-open seasonally closed areas after chick fledging or staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatchers in order to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use of priority species.
- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season (map 2.8), an east-west trail corridor bisecting North Monomoy Island is open to the public, as is the Broad Creek area to the south; in addition, the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island.
- Restrict travel on the refuge to foot traffic to maintain the wilderness character of North Monomoy Island and South Monomoy, as well as to protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion, as necessary.
- Allow motorized and non-motorized boating in refuge waters, with landings prohibited in areas that are seasonally closed; map 2.7 shows recommended sites where the hazardous currents and shoals allow safe landing.

- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis) on the refuge land and in refuge waters.
- Maintain and enforce closure of the refuge to kiteboarding operation within the Declaration of Taking-Marine Protected Area boundary.
- Use the existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties.
- Phase out non-Service parking and dinghy storage at Stage Island Lot 7b.
- Grant up to two special use permits to ferry operations with drop-offs to North Monomoy Island and South Monomoy Island.
- Allow one ferry company to base its operations out of the Morris Island parking lot with exclusive use of refuge facilities and lands.
- Explore funding opportunities with partners to provide shuttle service to the refuge from offsite satellite parking area(s), and improve shoulder parking along the causeway.
- Assist in enforcing the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and International Fund for Animal Welfare.

#### **Monitoring Elements**

- Estimate the number of visitors at the refuge engaged in wildlife-dependent priority and other non-priority public use activities.
- Monitor available empty parking spaces and document traffic congestion at the Morris Island refuge administrative complex and nearby causeway throughout the year.
- Record the number of special use permits.
- Record the number of ferry trips and passengers by destination on the refuge.

#### **Objective A2.2 (Interpretation)**

Maintain the interpretation opportunities available on Morris Island and provide interpretive materials that inform visitors about the purpose and mission of the refuge, Refuge System, Monomoy Wilderness, unique natural resources of the refuge, and Monomoy NWR's importance to the recovery and management of migratory birds.

#### **Rationale**

Interpretation is one of the six priority public uses identified in the 1997 National Wildlife Refuge System Improvement Act, and is one of the most important ways the Service can raise our visibility, convey our mission, and identify the significant contribution the refuge makes to wildlife conservation. The guiding principles of the Refuge System's interpretive programs can be viewed at <http://www.fws.gov/policy/605fw7.html>. Interpretation is a communication activity designed to forge emotional and intellectual connections between an audience and the inherent values of natural resources. It also serves to make complex or arcane information more understandable and meaningful. Interpretation differs from environmental education in that it is more informal, geared toward the general public, and not necessarily curriculum-based.

Based on the USGS Visitor Survey – National Wildlife Refuge Survey results from 2010 to 2011, visitors to Monomoy NWR reported that, before participating in the survey, they were aware of the role of the U.S. Fish and Wildlife Service in managing national wildlife refuges (70 percent) and that the Refuge System has the mission of conserving, managing, and restoring fish, wildlife, plants, and their habitat (84 percent). Monomoy NWR is designated as a Western Hemispheric Shorebird Reserve Network site, an Important Bird Area, and a Marine Protected Area; these designations can be highlighted in our interpretive programs. Monomoy refuge is also part of the National Wilderness Preservation System. This designation is also considered a refuge purpose, and needs to be interpreted so people can learn about and appreciate the value of an enduring wilderness resource.

Our current interpretation program includes maintaining displays at the visitor contact station and interpretive kiosk and panels along the Morris Island Trail; conducting guided walks during the summer based on staff, volunteer, or intern availability; and sharing refuge brochures and other relevant information (e.g., seal haulout occurrences) with the commercial ferry services that operate at Monomoy NWR. The refuge also currently issues a special use permit for conducting interpretive, water-based tours operating from the refuge's parking lot. We believe these programs have raised awareness about shorebird, seal, and horseshoe crab conservation, although we are unable to quantify this adequately. We do not believe that we have informed the public sufficiently about the Wilderness Preservation System and the fact that most of Monomoy NWR is designated as wilderness. It is our aim to increase the level of awareness and appreciation of the importance of refuge efforts to manage habitats, protect and monitor breeding and migrating populations of seabirds and shorebirds, and communicate the meaning and purpose of wilderness. This is especially true for the local community, where we feel that heightened interpretation of our conservation efforts and the importance of the refuge could be increased.

### **Strategies**

*Continue to:*

- Welcome visitors to the visitor contact station on Morris Island and strive to have it open year-round, with reduced hours from October through April and open 7 days a week during summer months when the refuge hires interns.
- Inform the public about the refuge and Refuge System, its purpose and mission, and its resources using brochures, rack cards, interpretative panels on trails, and the refuge Web site.
- Update refuge literature and daily/seasonal information (e.g., flood warning, high tide info, etc.) in a timely manner as conditions and access change based on bird nesting and seal haulout occurrences.
- Provide refuge visitors with wilderness ethics and stewardship information and Monomoy Wilderness information through the visitor contact station, Web site, social media, printed materials, and community outreach activities.
- Maintain the interpretive panels along the Morris Island Trail.
- Install seven new or replacement interpretive panels along Morris Island Trail.
- Develop temporary, portable exhibits designed to describe Monomoy's biotic diversity, including wildlife, plants, fish, natural processes, wilderness character, and their management at Monomoy refuge.

- Provide an informational kiosk on Morris Island that contains signs and literature that orient visitors to the refuge and inform them of public use regulations.
- Issue permits for interpretive commercial water-based tours and interpretive commercial land-based tours.
- Conduct seasonal interpretive programs by refuge staff, interns, and volunteers, and provide roving interpreters on the Morris Island Trail.
- Issue press releases to inform the public about refuge activities and accomplishments.



USFWS

*Driftwood on the beach*

#### **Monitoring Elements**

- Record the number of participants at onsite and offsite refuge programs and events.
- Record the number of visitors to the refuge Web site.
- Record the number of visitors to the visitor contact station on a daily basis.
- Record the number of refuge brochures ordered on an annual basis.

#### **Objective A2.3 (Environmental Education)**

Over the next 15 years, continue to maintain the existing level of environmental education as requested and in coordination with refuge partners.

#### **Rationale**

Currently, the refuge does not actively pursue and develop formal environmental education programs on or off refuge. Rather, it hosts groups as requested and as staffing levels allow when possible. As one of the six priority public uses, environmental education receives enhanced consideration in refuge planning. The Refuge System's guiding principles for environmental education programs are detailed at <http://www.fws.gov/policy/605fw6.html>. Environmental education programs can promote understanding and appreciation of natural and cultural resources and their conservation on all lands and waters in the Refuge System. Generally, conducting environmental education involves more than facilitating field trips. It requires the refuge to develop a course of study designed to meet national and state curriculum-based academic standards. We believe that educating people about the significance of the refuge for birds and other wildlife would foster an appreciation of conservation and encourage them to make environmentally responsible decisions.

As environmental education is not an area of emphasis at Monomoy refuge, and due to limited staff, the refuge currently does not have a curriculum-based environmental education program. We occasionally accommodate requests to host school groups on the refuge and have gone to local schools when invited.

### Strategies

Continue to:

- Host school field trips as requested, as timing and resources allow.

### Monitoring Elements

- Record the number of students and teachers who participate in refuge environmental education programs and field trips.
- Record the number of students who engage in non-refuge-led environmental education on the refuge.
- Record the number of requests for supporting documentation and materials developed to support curriculum-based educational modules about the refuge and wildlife found on the refuge.

### Objective A2.4 (Wildlife Observation and Photography)

Over the life of the plan, continue to provide visitors with the opportunity to engage in wildlife observation and photography on the refuge by maintaining the refuge's existing boardwalk and overlook on the Morris Island Trail and continuing coordination with ferry vendors to provide access to North Monomoy Island and South Monomoy.

### Rationale

Wildlife observation and photography are two of the six priority public uses required by the 1997 Refuge Improvement Act to receive enhanced consideration on refuges. Guiding principles for these uses within the Refuge System for wildlife observation and photography can be viewed at <http://www.fws.gov/policy/605fw4.html> and <http://www.fws.gov/policy/605fw5.html>, respectively. Monomoy NWR and adjoining Nauset/South Beach provide spectacular opportunities to observe and photograph wildlife and enjoy the lands and waters of the refuge. Bird watching is a multi-million dollar industry; 48 million people in the United States alone engage in this activity (Carver and Caudill 2007). Providing opportunities for wildlife observation and photography annually contributes \$80,000 to \$90,000 to the local economy (Maillett 2012).

Providing opportunities for the public to engage in wildlife observation and photography provides a visceral connection to wildlife and habitats in a way that cannot be gained through reading or watching videos or television programs. The refuge's vistas and wildlife provide outstanding opportunities for wildlife observation and photography. Developing specific areas that visitors can conveniently access to view wildlife enhances wildlife observation and limits disturbance to wildlife and habitat. Morris Island provides opportunities to view and photograph wildlife in natural settings along the Morris Island Trail, which offers two viewing platforms; these overlooks along the trail provide views of North Monomoy Island and South Monomoy. An unmaintained footpath leads visitors from a boat landing to the Monomoy Point Light Station. The refuge has historically been a popular birding site, is part of the Western Hemispheric Shorebird Reserve Network, and has been recognized as a globally significant Important Bird Area by the National Audubon Society.

Special use permits are required whenever the photographic images will or can be marketed (e.g., sale of copyrighted images, including videography). Issuing special use permits protects refuge resources and ensures a quality photographic experience. All photographers are required to comply with stipulations for working in wilderness—no motorized equipment or equipment with wheels is allowed.

### Strategies

Continue to:

- Allow wildlife observation, which includes nature study year-round on refuge lands open to public use from ½ hour before sunrise to ½ after sunset; prohibit touching, feeding, or harassing wildlife.
- Maintain the two viewing platforms on Morris Island (map 1.2).
- Allow commercial filming and photography on the refuge only when there is a direct benefit to the refuge or the Service; all allowed commercial filming and photography would operate under a special use permit once determined compatible by the refuge manager.
- Allow photography in any area of the refuge open to the public.
- Host a youth or adult photography contest.

### Monitoring Elements

- Record the number of visitors engaged in wildlife observation and photography.
- Record the number of special use permits issued for commercial photography and guided wildlife observation tours.
- Record the number of photography contest submissions.

### Objective A2.5 (Fishing)

Continue to provide high-quality fishing opportunities to refuge visitors within areas otherwise open to public use.

### Rationale

Fishing is a healthy, traditional outdoor pastime that promotes public understanding and appreciation of natural resources and their management on all lands and waters in the Refuge System. The Refuge Improvement Act identifies fishing as a priority wildlife-dependent use, and further states that...“Compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System.” Guiding principles and other general information related to fishing within the Refuge System can be found at <http://www.fws.gov/policy/605fw3.html>. Sport fishing is an important activity on Monomoy and both boat and surf-fishing are popular. Fishing on the refuge consists primarily of saltwater fishing such as surfcasting off beaches, and fly fishing on tidal flats. Monomoy NWR provides quality surf fishing opportunities for anglers. Anglers fish primarily for striped bass, bluefish, bonito, false albacore, flounder, and fluke. Additionally, some freshwater fishing is possible in the ponds on South Monomoy, although access is difficult due to their location and the prevalence of poison ivy throughout the area.

Where fin fishing, lobster, crab, and whelk pot harvesting, and hand-harvest of scallops occur in the open waters lying above the submerged lands within the Declaration of Taking, we will work with the National Marine Fisheries Service and the Massachusetts Division of Marine Fisheries to implement their regulations for these fisheries. These activities do not cause disturbance to the submerged lands.

Many anglers' experience on the refuge is further enhanced because they hire a commercial fishing guide. We know these guides are working on the refuge, but we lack a complete understanding of guide numbers, when they operate, where they go, and how many clients they bring to the refuge.

Refuge fishing is in accordance with State regulations. Most fishing is dependent on access by boat. Morris Island offers 24-hour-a-day fishing opportunities.



### Strategies

Continue to:

- Allow fin fishing from all refuge lands otherwise open to public use, from ½ hour before sunrise to ½ hour after sunset, in accordance with Massachusetts and Federal regulations, including possessing a saltwater or freshwater fishing license recognized by the Commonwealth of Massachusetts.
- Allow fishing in the open waters, above submerged lands, under State and Federal regulations. Included fishing activities are: demersal long line fishing; mid-water trawl fishing, hook and line/rod and reel fishing; lobster, crab, and whelk pot fishing; and hand-harvest of scallops.
- Allow anglers to fish on Morris Island 24 hours per day in accordance with all Federal and State fishing regulations.
- Allow freshwater fishing in the ponds on South Monomoy during daylight hours.
- Allow commercial fishing guides to conduct fin fishing on the refuge in areas that are open to fishing in accordance with State seasons.

### Monitoring Elements

- Estimate the number of fin fishing visits to the refuge.
- Track the number of fishing license violations on the refuge.

### Objective A2.6 (Shellfishing)

Continue to allow Town of Chatham residents and refuge visitors to shellfish using nonmechanized hand raking tools only, and in accordance with Town of Chatham Shellfish Rules and Regulations.

### Rationale

In recent years, visitors have primarily harvested soft-shell clams and quahogs with hand tools. Softshell clam harvesting has been considered a traditional use and occurred prior to refuge establishment. Special regulations were issued in the 1970s and early 1980s allowing shellfishing on refuge lands to individuals who held a town shellfishing license. In 1994, shellfishing was determined to be a compatible use on the refuge, and the actual type of shellfishing described in the compatibility determination was the traditional hand digging of shellfish. Although softshell clams are never specifically identified in the compatibility determination, it is obvious that the intent of refuge managers at that time was to continue to allow the harvest of softshell clams only. Since then, other shellfish have been harvested in refuge waters, including quahogs, mussels, and scallops. Some marine worms, which are regulated by Town of Chatham shellfish regulations but are not shellfish, have been harvested on the refuge. Whelks, crabs, and lobsters are also harvested in refuge waters. Horseshoe crab harvesting did occur by special use permit but was completely banned from the refuge in 2002.

The Town of Chatham administers permits and enforces regulations throughout the town, including refuge lands (refer to [http://www.town.chatham.ma.us/public\\_documents/ChathamMa\\_shellfish/ShellReg2004Book.pdf](http://www.town.chatham.ma.us/public_documents/ChathamMa_shellfish/ShellReg2004Book.pdf) for more information). The refuge staff does not directly manage shellfish harvest activity using non-mechanized hand tools on refuge lands, but instead relies on indirect management through the Town of Chatham. Details regarding this use are found in the Shellfishing Compatibility Determination in appendix D.

The official process for opening refuges to hunting and fishing changed with the passage of the 1997 National Wildlife Refuge System Improvement Act. At this time, Monomoy NWR is only open by regulation to sport fishing, and it is not officially open for the harvest of any marine species other than fin fish.

The refuge posts and maintains closed areas for nesting birds generally from April through August or September. These closures prohibit all pedestrian access and may encroach into intertidal areas to ensure a disturbance-free buffer for nesting birds in the high salt marsh or beach dune grass (see biological objectives A1.1, A1.2, A1.3, A1.4, A1.6 and A1.8 for more details and rationales for protecting nesting species from human disturbance). In some areas, closures are also extended into late September to afford protection for staging and migrating terns and shorebirds, and may result in small bands of intertidal edge habitat being inaccessible for clam harvesting seasonally (see alternative A biological objective A1.7 for more details and rationale for protecting migrating and staging birds from human disturbance).

### Strategies

*Continue to:*

- Allow clamming using non-mechanized, hand methods on the majority of intertidal habitats year-round following State and Town regulations.
- Coordinate with the Town of Chatham Shellfish Warden as needed to discuss shellfish resource management, harvest levels, harvest regulations, and enforcement.

### Monitoring Elements

- Record the number of annual resident and nonresident shellfish harvest permits issued by the Town of Chatham Shellfish Warden.

## REFUGE GOAL 3:

**Communicate and collaborate with local communities, Federal and state agencies, and conservation organizations to promote natural resource conservation and to support the goals of the refuge and the mission of the U.S. Fish and Wildlife Service.**

### Objective A3.1 (Public Outreach)

Continue to conduct outreach to residents and visitors to the Cape Cod region about the refuge and refuge activities via the visitor contact station, social networking sites, and refuge Web site.

### Rationale

We strive to develop an effective outreach program targeted at local communities and residents who may be unaware that a national wildlife refuge is nearby. It is particularly important that local residents understand, appreciate, and support the Refuge System mission and the refuge's unique contribution to that mission. Our current program consists of a Facebook page, refuge Web site, regular news releases, participation in community events, and regular presentations to local civic organizations.

### Strategies

*Continue to:*

- Update and print brochures and rack cards and make them available to the Chamber of Commerce and tourist attractions.
- Use Internet resources to inform the public about the refuge, its mission, and management actions.
- Issue press releases to inform the public about refuge activities, respond to media inquiries, and publish our accomplishments online.
- Give presentations about refuge management actions and wildlife at venues such as the Cape Cod Natural History Conference.
- Occasionally participate in local festivals and parades.

- Work with Friends group and volunteers to increase refuge activities and funding opportunities.
- Speak about the refuge and its purpose to local service and civic organizations and regionwide conservation partners.
- Educate visitors and boaters to maintain a 150-foot minimum distance from seals in accordance with the Northeast Seal Watching Guidelines and Marine Mammal Protection Act.

#### **Monitoring Elements**

- Record the number of press contacts and press releases made annually.
- Record the number of attendees at offsite presentations and community events.
- Record the number of people visiting and receiving information through social media venues (e.g., Facebook “Likes”).
- Record the number of brochures and rack cards printed each year.

#### **Objective A3.2 (Community Support)**

Increase community support by fostering further growth of the Friends of Monomoy and increase volunteer hours by 150 hours a year for the next 10 years.

#### **Rationale**

Refuge Friends groups play a vital role in supporting the mission of the refuge and providing volunteers and community support. The Friends of Monomoy, a legal 501(c)(3) nonprofit entity, is an important part of the refuge, providing some financial support for interpretation and habitat management projects on the refuge. The Friends of Monomoy recently reorganized and reestablished itself, and is growing membership and revenue sources to help further the refuge purpose and Service mission.

In 2011, people contributed nearly 5,300 volunteer hours conducting wildlife management, habitat management, public use, or maintenance activities. This is a tremendous asset to a station that has only three permanent staff. Additional volunteer support will be necessary to continue providing quality access and opportunities for the public.

New community partnerships, such as with the American Lighthouse Foundation as a result of the restoration efforts on the historic Monomoy Point Light Station, can provide expanded community support for refuge programs and activities.

#### **Strategies**

*Continue to:*

- Recruit, train, and guide volunteer efforts on the refuge.
- Maintain a productive relationship with the Friends of Monomoy group that understands the refuge mission and actively supports refuge activities.
- Implement current Friends and volunteer policies according to Draft Friends Policy 633 FW 1-4 and National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 October 5.
- Maintain a volunteer database.
- Encourage the establishment of a local chapter of the American Lighthouse Foundation to support future maintenance and conduct interpretation at the historic Monomoy Point Light Station.

**Monitoring Elements**

- Record the number of volunteers and volunteer hours contributed annually.
- Track the number of members in the Friends group.

**REFUGE GOAL 4:**

**Ensure that the spirit and character of the Monomoy Wilderness are preserved.**

**Objective A4.1 (Wilderness Implementation and Designation)**

Manage the Monomoy Wilderness to preserve wilderness character and values, in a manner consistent with refuge establishment purposes (migratory birds and endangered species recovery) and the Refuge System mission.

**Rationale**

Wilderness is a congressionally designated land use. As defined by the Wilderness Act, wilderness is untrammeled (free from human control), undeveloped, and natural, and offers outstanding opportunities for solitude or primitive and unconfined recreation. Refuge wilderness must be managed to simultaneously secure an enduring resource of wilderness and accomplish refuge purposes in a way that preserves wilderness character. The Service is responsible for ensuring that the existing Monomoy Wilderness retains its primeval character and influence, without permanent improvements or permanent human habitation, and that its natural conditions are preserved. The Service is to manage the Monomoy Wilderness so visitors can experience an area affected primarily by the forces of nature where the imprint of humans in their immediate surroundings is substantially unnoticeable; find examples of ecological, geologic, scientific, educational, scenic, or historic features; and can seek and experience outstanding opportunities for solitude or primitive and unconfined recreation.

Under alternative A, we would continue our current management activities in the wilderness area, which are primarily outreach and enforcement. Management of the Nauset/South Beach area is not well described under alternative A because it is such a recent refuge addition. However, our intent would be to manage it consistent with other refuge wilderness lands.

Fire was an important part of this environment prior to the era of fire suppression around settled areas (MA NHESP 2006). Maritime shrubland is fire-dependent and is perpetuated by periodic disturbance. By implementing a 2- to 5-year burning regime, the refuge will help prevent woody encroachment in the open grassland (beach grass) habitat required by nesting terns.

Located outside designated wilderness on South Monomoy Island is the historic Monomoy Point Light Station consisting of a lighthouse, a keeper's house, and former oil shed. Stabilization and historic restoration of the light station buildings began in 2010 and was substantially completed in 2012. Such periodic in situ maintenance of the historic light station structures required mechanized transport or motorized equipment use and access to the worksite through the Monomoy Wilderness. We did and will continue to analyze all activities associated with light station upkeep, and determine through the use of a minimum requirements decision guide (MRDG) how best to safely and practically conduct those operations.

As mentioned under Conducting Resource Management and Public Use Activities Consistent with Wilderness Principles, we will complete minimum requirement analyses as needed during the plan period for refuge administrative and management activities conducted within wilderness essential to fulfilling the purposes of the refuge to ensure they are the minimum necessary.

### Strategies

*Continue to:*

- Manage the existing Monomoy Wilderness for naturalness, wildness, and outstanding opportunities for solitude or primitive and unconfined recreation by conducting refuge management operations and visitor uses in a manner that protects wilderness character.
- Continue managing the Inward Point and Powder Hole inventory areas to maintain or enhance their size, naturalness, and opportunities for solitude or primitive and unconfined recreation throughout the 15-year plan period, to the extent that it will not prevent fulfilling refuge establishment purposes or the Refuge System mission (610 FW).
- Use the appropriate response to unplanned wildfire ignitions that provides for public and firefighter safety while recognizing periodic fire as a natural process with long-term benefits to an enduring wilderness resource.
- Where fire exclusion or other man-caused alterations of natural coastal processes have led to unnatural wildland fuel and vegetation conditions, apply prescribed fire to restore a more natural fire regime or migratory bird or endangered/threatened species habitat conditions within the Monomoy Wilderness.
- Maintain wilderness boundary signs at three locations (two boat landings and on Nauset/South Beach).
- Implement management activities that involve temporary rather than permanent uses or site occupancy, create no new surface disturbance, do not involve placement of permanent structures or installations (e.g., temporary symbolic fencing), or use motorized equipment or mechanized transport unless it is the minimum tool possible.
- Provide refuge staff with wilderness stewardship training appropriate for their positions.
- Review all activities proposed within the Monomoy Wilderness and the Inward Point and Powder Hole inventory areas, and ensure they are consistent with wilderness management using the minimum requirements analysis process presented under Actions Common to All Alternatives.
- Review and implement actions recommended in the Wilderness Character Report (Untrammled; Undeveloped; Natural; Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation; and Other Features/Unique Attributes) within the Monomoy Wilderness.

### Monitoring Elements

- Maintain a listing of completed minimum requirement analyses for the refuge.
- Record the number of staff receiving wilderness orientation and number of training records for all refuge staff, volunteers, and interns.

### REFUGE GOAL 5:

#### **Objective A5.1 (Archaeological Resources and Historic Structures)**

#### **Protect cultural resources that exist on the refuge.**

Protect and preserve archaeological, Native American, and historical resources on Monomoy NWR from ground-disturbing activities or processes and artifact looting. Maintain the Monomoy Point Light Station, which is listed on the National Register of Historic Places, to meet the historic preservation standards of the Secretary of the Department of the Interior.

### Rationale

The Service has a legal responsibility, under sections 106 and 110 of the National Historic Preservation Act, to consider the effects its actions may have on cultural resources and to enforce all Federal cultural resource protection laws and regulations on refuge lands. Considering the topography of the area and its proximity to intertidal areas and estuaries, additional archaeological sites may be found in the future. Some archaeological sites probably were located in areas that have been inundated by rising seas (following the last ice age) or have vanished due to the dynamic nature of coastal barrier islands. The remains of historic shipwrecks may also be revealed in the intertidal zone. Protections extend not only to those cultural resources on refuge lands, but also to resources on land affected by refuge activities.

### Strategies

*Continue to:*

- Comply with section 106 of the National Historic Preservation Act prior to conducting any ground-disturbing activities on the refuge; compliance may entail any combination of state historic preservation officer/tribal historic preservation officer consultation, literature survey, or field survey.
- Identify, evaluate, and conduct archaeological evaluations, with subsurface testing as necessary, for any project where ground-altering activity is proposed.
- Enforce all Federal cultural resource protection laws and regulations including the necessary provisions of Archaeological Resources Preservation Act to protect cultural resources on the refuge.
- Conduct structural and basic maintenance on the Monomoy Point Light Station to comply with historic preservation standards.
- Develop and implement throughout the plan period a historic site management plan for the Monomoy Point Light Station structures and associated archaeological structures following National Historic Preservation Act sections 106 and 110 and 36 CFR Part 800 collaborative procedures that provide for systematic mitigation over time of the adverse effects from natural weathering, erosion, and decay processes.

### Monitoring Elements

- Maintain a log of all National Historic Preservation Act section 106 compliance actions and archaeological surveys performed prior to proposed ground-disturbing activities.

## REFUGE GOAL 6:

**Develop and maintain a diverse and inclusive workplace with sufficient resources, including infrastructure and equipment, to work productively toward fulfilling the refuge mission.**

### Objective A6.1 (Staffing)

Maintain current staffing levels at three full-time employees (refuge manager and two biologists), and continue to employ seasonal and term biological staff and interns (see appendix G for current staffing chart). Provide a diverse and inclusive workplace through annual training, support, and awareness.

### Rationale

Three permanent staff at Monomoy NWR include a refuge manager and at least one biologist. We supplement their efforts by hiring term and temporary (non-permanent) biologists, biological technicians, seasonal interns, students, and volunteers. If a vacancy occurs in our biological program, we have the ability to adjust our staffing requirements to hire a boat operator/maintenance worker instead of a biologist, or hire a biologist who can assume some maintenance responsibilities as well. A 2008 national staffing model for the National Wildlife

Refuge System indicated that Monomoy refuge, due to its location, size, number of visitors, and complexity of its biological program, should have a permanent staff of nine full-time employees. Funding levels have never been sufficient to sustain that staffing level.

In 2011, the Service released a diversity and inclusion implementation plan, which sets four strategic goals as follows:

- (1) Highlight diversity as a core value.
- (2) Establish partnerships, sources, and feeder systems.
- (3) Recruit and hire a diverse and highly skilled workforce.
- (4) Maintain a highly skilled diverse workforce through talent management.

We recognize that a workforce is more innovative, resourceful, and productive when it includes a diversity of skills, perspectives, ideas, and backgrounds. Diversity is a permanent commitment of the Service and resources, including time, money and people, will be committed to creating and maintaining a diverse and inclusive workplace. An inclusive workplace is one where all employees feel they are part of a team with open communication, all employees are treated with respect and fairness, and all employees can develop to their full potential.

### Strategies

*Continue to:*

- Recruit and employ seasonal and term biological, visitor services, wilderness staff, interns, and volunteers.
- Work with organizations such as the Student Conservation Association and the Federal Pathways program to hire talented young college students for seasonal intern positions.
- Provide a safe environment at work that promotes diversity and inclusion.
- Seek grants and funding partnerships to support additional staff.
- Request additional staffing as funding becomes available.
- Provide relevant staff training opportunities to increase work skills and increase understanding of diversity and inclusion.

### Objective A6.2 (Facilities and Maintenance)

Provide adequate, safe, and energy-efficient infrastructure and equipment to safely support refuge staff, interns, and volunteers, while sharing a headquarters site with co-located National Weather Service facilities.

### Rationale

The refuge headquarters and visitor contact station facilities share a small, waterfront parcel with an eroding coastal embankment on Morris Island with a National Weather Service (NWS) upper air sounding facility and personnel. The current site is largely built out, with little space for further expansion of building footprints or parking. Refuge infrastructure includes a building serving concurrently as an office headquarters and visitor contact station. A second building is a dormitory for seasonal staff and a maintenance shop. There is another public restroom building, two small storage sheds, the Monomoy Point Light Station, wildlife observation trails, platforms, stairs, and boat moorings. The lighthouse keeper's house at the Monomoy Light Station serves as a summer camp for staff and volunteers and equipment storage from April to September; the equipment includes three motor vehicles and three boats. Boats are necessary to safely perform biological work on the islands. Moorings need to be maintained

in places for refuge staff to be able to efficiently travel to North Monomoy Island and South Monomoy as channels continue to fill in. Two moorings are maintained at a small, waterfront lot with parking on the north side of Stage Island that is the only Service-owned waterfront suitable for loading/unloading boat transported cargo. The vehicle fleet consists of a truck, a small SUV, and a hybrid car.

The National Weather Service owns two buildings and a weather tower located next to refuge headquarters. We have a memorandum of understanding with the National Weather Service that governs the use of these buildings located on refuge property and tries to ensure that operations are conducted in a manner to minimize impact on both agencies' operations.

### Strategies

*Continue to:*

- Maintain the headquarters and visitor contact station, dormitory and maintenance buildings, and Monomoy Point Light Station to provide a safe working and living environment for refuge staff and volunteers.
- Work with the National Weather Service and maintain a memorandum of understanding with them for use of Service-owned land on Morris Island. Should the National Weather Service at any point decide to relocate their existing operation, the refuge would look into re-utilizing the current National Weather Service buildings and space/site use at the Morris Island site.
- Maintain a fleet of three highway vehicles and three outboard motor boats that provide safe and efficient transport to North Monomoy Island, South Monomoy, Minimoy Island, and offsite locations for resource management and administrative work; replace boats and motors as necessary to maintain a functional fleet.
- Develop potential partnership with the Town of Chatham or U.S. Coast Guard to establish new docks, covered boat storage, and maintenance with secure marine equipment storage and additional parking.

### Objective A6.3 (Energy Efficiency)

Move the refuge toward carbon neutrality consistent with the Service's 2010 Strategic Plan for Responding to Accelerating Climate Change, by using practices to avoid or minimize greenhouse gas emissions and offset remaining emissions, to meet the Service goal of carbon neutrality by 2020.

### Rationale

The refuge proposes several methods to support the Service's 2010 Strategic Plan for Responding to Accelerating Climate Change and achieve its objective. Guiding principles and other general information on implementing sustainable practices within the Refuge System can be found in Policy 565 FW 1. In an effort to create a smaller carbon footprint, we will evaluate the possibility of installing a wind turbine at the Morris Island visitor contact station, and a form of alternative energy (e.g., wind power, solar panel, etc.) on South Monomoy. Our goal is to increase the proportion of electricity consumption derived from renewable sources while reducing the proportion derived from fossil fuel combustion and the associated greenhouse gas emissions. These potential projects will be evaluated under a separate NEPA process.

Sources of renewable energy at refuge facilities would utilize the available natural resources to generate electrical power at those facilities, reducing power consumption from the utility grid. Installation of a renewable energy source (solar panels) on South Monomoy would restore electrical power for heat, sanitation, water distribution, hot water, and lights to the Monomoy Point Light Station site without connecting to the utility grid.



A solar-thermal domestic hot water system was added to the shop/dorm building in 2011, and additional thermal insulation was added to the headquarters attic. We are converting to more fuel-efficient technologies, such as alternative fuel-capable models as new or replacement vehicles and boat motors are purchased; this will reduce fossil fuel consumption and associated atmospheric carbon emissions.

The wind turbine generators and other energy conservation technologies proposed would provide public demonstrations of methods for reducing dependence on nonrenewable energy sources.

### **Strategies**

*Continue to:*

- Seek renewable energy project assistance through the Federal Energy Management Program to conduct a feasibility study to determine the technical performance of solar panels at the Monomoy Point Light Station.
- Evaluate the possibility of installing a wind turbine at the Morris Island contact station.
- Conduct bird and bat surveys at the site of the proposed wind turbine for Morris Island to determine what species are currently using the area.
- Train staff and volunteers about water and energy conservation, purchase materials made with post-consumer content or with built-in solar panels for charging cell phones and other electrical devices in the field, and recycle and reuse materials.
- Maintain recycling and compost bins at refuge facilities.
- Work with local and regional partners seeking funding for alternative transportation measures for refuge visitors that reduce fossil fuel consumption and associated carbon emissions, such as local passenger shuttles with satellite parking, improved highway signs, and improved facilities for pedestrians, bicyclists, and kayakers.
- Use hybrid and alternative fuel vehicles when available.

### **Monitoring Elements**

- Calculate the amount of electricity generated onsite through solar and wind production and as a ratio of electricity usage purchased from the commercial grid.
- Calculate the annual fossil fuel consumption (heat, vehicles, boats and small engine equipment) for refuge operations.
- Calculate the annual metered (potable) water use.
- Estimate total annual atmospheric carbon footprint for all refuge facilities and operations.
- Submit annual environment management system review and solid waste diversion reports that detail all our actions designed to conserve water, energy, and solid waste, including the tonnage of all waste that is recycled.

**Alternative B.  
Enhanced Management  
of Habitat and Public  
Uses (Service-  
preferred Alternative)**

In addition to actions common to all alternatives, alternative B represents an extension and progression of all areas of refuge management. Under alternative B, refuge staffing and funding levels increase, new wildlife population, habitat, and invasive/overabundant species management activities are initiated, and new compatible wildlife-dependent recreational opportunities are provided consistent with wilderness designation. Special emphasis is placed on obtaining baseline data of wildlife populations and habitat conditions, or filling in information gaps as needed, in order to develop detailed step-down plans under this CCP to provide professional and scientifically accurate resource management planning. Wildlife population and habitat monitoring surveys and inventories are continued on an on-going basis to provide the data needed to assess the effectiveness of management programs and practices, and to make mid-course adaptations to these practices to ensure they meet long-range refuge goals and objectives.

Special emphasis is also placed on providing enhanced but sustainable opportunities for all six priority wildlife-dependent recreation uses defined in the Refuge Improvement Act. Public use evaluations, along with wildlife and habitat monitoring programs, would assist us in both assessing the intensity of public use and adapting our management strategies and practices for those uses.

Neither area on South Monomoy excluded from wilderness designation in 1970 is recommended for addition to the Monomoy Wilderness, because the wilderness review determined that the impact of man's work remains noticeable. While structures were removed, the foundations still remain visible. This will be reconsidered in 15 years when restoration to a more native appearance may be more advanced. However, the lands and waters that were on the part of Nauset/South Beach that is now part of South Monomoy Island are automatically treated as wilderness, since the accretion occurred to land that was in wilderness status. The Service begins actively managing this land in this alternative.

Under this alternative, we propose several actions to enhance the wilderness character and values of the Monomoy Wilderness, including the Nauset/South Beach addition.

**Habitat and Population  
Management**

Under this alternative, the Service would take a more active role in habitat and species management both on and off the refuge through partnerships, including those facilitated by the North Atlantic LCC (see chapter 2). Our highest priority would be the protection of dynamic coastal beach and dune systems and the focal species that rely on them for critical nesting, resting, foraging, and staging habitat. Our actions would continue to include annually identifying and symbolically fencing important wildlife habitat to avoid and minimize adverse impacts from public use to sensitive beach and dune ecosystems for beach-nesting birds and other wildlife. In recent years, public access closures have generally occurred between April 1 and September 30 (see maps 2.7 and 2.8), however we would use an adaptive management process to annually adjust the size and length of closures based on habitat conditions and wildlife use. In addition, we would bring Nauset/South Beach under refuge management consistent with how we are managing those resources elsewhere on the refuge.

We would also evaluate the need for maintaining suitable nesting areas for shorebirds by setting back grassland succession, and monitoring and treating invasive species as staffing and funding permit. The refuge would consider increasing the acreage of grassland by removing some shrublands. The refuge would evaluate the potential to elevate areas, using dredge material, outside of the Monomoy Wilderness that are most at risk from inundation due to sea level rise. In particular, we are interested in exploring the use of dredge material on Minimoy, on the flats adjacent and west of Minimoy, and along the beach on Morris Island. All of these areas lie outside of the Monomoy wilderness area and we would need to conduct a separate NEPA analysis before making a decision. Refuge staff would work with partners to protect alternative, offsite areas in order to maintain habitat otherwise lost to sea level rise.

Species management would follow Federal piping plover recovery guidelines and State plover and tern guidelines, which would benefit other species such as nesting American oystercatchers. We would provide protection for staging terns in the late summer/early fall by minimizing pedestrian disturbance. Predator management measures would be employed as necessary to support declining populations of piping plovers, and least, common, and roseate terns potentially nesting on the refuge.

### **Inventories and Monitoring**

Inventory and monitoring efforts would be similar to, but expand from, those proposed under alternative A. The Service would conduct monitoring and inventory efforts to provide key information on the trust resources as long as we have the necessary resources to accomplish them. Primarily, the focus would be on piping plover and nesting or staging common and roseate terns. Monitoring of seals on the refuge would be included as well. We would target any alterations or additions to these ongoing surveys to help us better understand the implications of our management actions. We would continue to work closely with our conservation partners to conduct these inventories and surveys.

### **Visitor Services**

Under this alternative, visitor opportunities would be expanded and enhanced on and off the refuge. We would increase opportunities for priority wildlife-dependent public uses, especially environmental education and interpretation. Interpretive opportunities would be increased through the use of additional kiosks and new exhibits outside the Monomoy Wilderness, such as at the visitor contact station. Environmental education would be expanded through new, curriculum-based programs that are linked with State educational programs. Wildlife photography opportunities along the Morris Island Trail would increase by installing a photography blind or viewing platform with access trail.

Fishing opportunities would continue to occur within open waters under State and Federal regulations. Other fishing opportunities would be allowed consistent with appendix D. Under alternative B, the refuge would officially open for waterfowl hunting through a *Federal Register* announcement.

We would work more closely with a concessionaire or professional guide services to better inform refuge visitors about the Monomoy Wilderness and unique values of the refuge. Under this alternative, we would pursue the use of virtual technology, such as critter-cams and podcasts, to offer opportunities to learn about the refuge remotely. In addition, we would explore the feasibility of and, if warranted, institute a wilderness access pass for all visitors to North Monomoy Island and South Monomoy, including the intertidal flats and beaches.

The refuge would be open for hand harvesting of scallops and subterranean clams, as well as fin fishing and lobster, crab, and whelk pot fishing. Horseshoe crab harvesting would continue to be prohibited. The refuge would remain closed to personal watercraft operation and kiteboarding. We would enhance local community outreach and partnerships, continue to work with and support our Friends group, and improve our relationships with our neighbors in the Cape Cod and Islands region to strengthen support for Service resource management and management priorities in the local communities we serve.

### **Wilderness Management**

The majority of Monomoy NWR was designated as wilderness in 1970. At that time, the wilderness designation encompassed 2,600 acres. With the exception of excluded areas, the written description of the Monomoy Wilderness boundary includes all lands comprising North and South Monomoy Islands lying above mean low water within the original 1944 Declaration of Taking that established Monomoy NWR. Examination of the U.S. Coast and Geodetic Survey map which was used in 1938 as the basis for approving the establishment of the refuge reveals that the area above mean low water at that time was over 7,000

acres. The refuge eroded substantially along its eastern shore and by 2000, the Service Regional Office surveyors completed an updated survey of the refuge that identified the refuge wilderness acreage to be 3,244 acres, the Inward Point exclusion as 432 acres, and the Powder Hole exclusion as 163 acres. The sizes and configuration of the wilderness area and exclusions have changed due to accretion and erosion. With the addition of the lands and waters below the new inlet on Nauset/South Beach, the Monomoy Wilderness is now about 4,000 acres. This number will change as the islands change over time. The Monomoy Wilderness is currently the only nationally designated wilderness on the densely populated New England coastline.

The Inward Point inventory area includes the site of the former Monomoy Branting Club and seasonal camps. The Inward Point area is now nearly but not yet completely free of visual evidence of permanent or man-made structures. While all the camps that were located in this area have been removed, utility poles, building foundations, and cisterns are still visible. The Powder Hole includes the sites for the former Whitewash Village fishing community, where little evidence remains today, and the former Monomoy Point Lifesaving Service and Coast Guard Stations. In addition, the Powder Hole area also includes the “cherry stem” access trail corridor and approximately 4-acre site of the existing Monomoy Point Light Station buildings, a National Register of Historic Places designated site.

Although these two areas were excluded from the Wilderness designation in 1970 because of the number of cabins and buildings located in these areas, Congress intended the Secretary of the Interior to manage the entire area consistent with the concept of wilderness (House of Representatives, Report No. 91-1441) in order that they will eventually achieve wilderness character and be added to the Monomoy Wilderness. Neither area has yet achieved wilderness character due to remaining evidence of past human occupation, and therefore neither is recommended for further study as a wilderness study area (WSA) during the plan period. Significant progress toward achieving wilderness character was made in both areas since 1970. We expect that through time or restoration actions by the Service that nearly all evidence of human occupation will be lost, except for the lighthouse, keepers house and oil shed, and any disturbance necessitated by the need for access for periodic maintenance. Continuing to apply wilderness stewardship principles in both areas through the 15-year planning period will bring them still closer to achieving wilderness character, when they may once again be reviewed by the Service for suitability as additions to the National Wilderness Preservation System.

### **Cultural Resources**

In addition to project-specific cultural resource surveys and law enforcement under alternative A, under this alternative a refugewide cultural resource overview would be completed.

### **Refuge Administration**

Over time, it is anticipated that refuge staffing levels will increase under this alternative. The refuge staff would increase to 10 permanent, full-time positions by adding the following 7 positions: two park rangers (law enforcement), one maintenance worker/boat operator, one visitor services manager, one visitor services specialist, one biological technician, and one administrative assistant. Although the refuge headquarters would remain the primary contact station for visitors, we would establish an alternate, more convenient, and perhaps less congested, location where the public could obtain refuge information or pick up a shuttle to take visitors to the refuge headquarters.

The section that follows describes in detail the goals, objectives, and strategies that we would implement in alternative B.

**REFUGE GOAL 1:**

**Perpetuate the biological integrity and diversity of coastal habitats to sustain native wildlife and plant communities, including species of conservation concern.**

**Objective B1.1 (Dune Grasslands—Roseate and Common Terns)**

Protect from disturbance and degradation 75 acres of nesting habitat for common terns and enhance and maintain 10 acres of prime nesting habitat for roseate terns within this area. Maintain a minimum productivity of 1.0 chick per nesting pair over a 5-year period for both species of terns.

**Rationale**

The need for active management for common and roseate terns (including habitat and predator management) is detailed in chapter 2 and the rationale of objective A1.1 under alternative A. In alternative B, however, we propose managing more than twice as much habitat for common terns (75 acres versus 30 acres) and five times the habitat for roseate terns (10 acres versus 2 acres) in a manner consistent with preserving wilderness character. More resources would be put toward improving a larger area of habitat for both species, as well as attracting prospecting birds to newly created habitats. Because the Northeast population of roseate terns only nests in association with large, productive common tern colonies, habitat and predator management still needs to focus on both species (USFWS 1998a, USFWS 2005c, and USFWS 2010a).

Since the reestablishment of a productive common tern colony on Monomoy refuge in the late 1990s, this site has been one of the most important sites in the State, and in some years has provided nesting habitat for more than 50 percent of the State's total population. The increase of nesting common terns in the first few years following the start of the reestablishment project was concomitant with a decline in the number of nesting common terns at Plymouth Beach (USFWS 2000, Blodget 1999). Birds nesting at Plymouth Beach had been subjected to predator pressures prior to abandoning that site and moving to Monomoy NWR, suggesting that, at the time, Monomoy NWR was more appealing to prospecting terns. Common terns were successfully nesting at Monomoy NWR, and as predator pressures remained unresolved at Plymouth Beach, many terns continued to return to Monomoy NWR to nest in future years, attracting more common terns each year. For several years Monomoy NWR had also hosted an increasing number of roseate terns (USFWS 2000). However, the increasing terns were generally nesting in a similar sized area in successive years, although the shape of the nesting colony changed somewhat. Impacts of increased nesting density were not specifically studied, but anecdotal observations suggested increased neighbor aggression and disturbance among common terns. In

addition, increased aggression was seen between common and roseate terns, and this may have contributed to the decline in roseate tern numbers and their eventual relocation to Minimoy Island (although predation by great horned owl likely also contributed to this shift) (USFWS 2007a). Storm overwash and erosion over the last several years has severely reduced available nesting space on Minimoy Island, and roseate terns have mostly abandoned this site now as well (USFWS 2012).

During the last 10 years, we experimented with various types of habitat management on a small scale (see chapter 2 for details), but only recently applied management at a scale that exceeds the current nesting area (a prescribed burn of 30+ acres).

*Tern chick and adult*



USFWS

Careful monitoring of different techniques now provides the foundation for moving forward with habitat management on a much larger scale. Providing more habitat may allow for even more nesting common terns, but more importantly, would allow common terns to increase nearest neighbor distances, while still maintaining the benefit of being a colony member. We also expect prospecting roseate terns to find nesting space more readily within a common tern colony that is not at a saturated density. Roseate terns generally nest 7 to 10 days later than common terns at Monomoy refuge, so prospecting roseate terns are often trying to establish a territory amid hundreds or thousands of already established common tern territories. Roseate terns are also generally a bit more skittish and less aggressive than common terns, which presents an additional challenge to prospecting roseate terns that are repeatedly being chased by common terns (Koch 2013 personal communication, Spindel 2013 personal communication, Burger and Gochfeld 1991a, Burger et al. 1995a, Cooper et al. 1970, Nisbet 1981). A larger habitat base would also allow terns to move around between microhabitats within the larger area, as we apply a rotational-based habitat management scheme. We plan to continue working mostly on the north end of South Monomoy, where terns have nested during the last 15 years; however, we will also consider establishing suitable nesting habitat on other areas of the refuge if there is evidence of more suitable sites (consideration would be given to habitat, potential human disturbance, ease of access for monitoring, and presence of predators).

The U.S. Army Corps of Engineers is often involved in dredging projects to enhance harbors and shipping channels, including in the Chatham area, and in this alternative we would consider the appropriateness of using this material to benefit wildlife. Deposition of the dredge material sometimes creates enhanced barrier beach or nesting islands that are used by terns and black skimmers (Mallach and Leberg 1999). More than 1,400 least terns (the largest colony ever reported in Massachusetts at that time) used a newly created nesting site in Hyannis Cape Cod when dredge material was deposited at Kalmus Beach in 1999 (Blodget 1999, Peterson 1999). More than 800 pairs and nearly 600 pairs nested there again in 2000 and 2001, respectively (Blodget 2000, Blodget and Mostello 2001), before numbers substantially declined beginning in 2002 (Mostello 2003a). Dredge material likely varies from project to project, and not all material will create quality nesting habitat. Kress and Hall (2004) discuss these and other important considerations when evaluating the appropriateness of using dredge material to create suitable nesting habitat. Refer to Kress and Hall 2004 for more details.

- (1) Size and shape of island to be created—dredge material may be placed on existing nesting areas that are or are not islands, but when creating new islands, the ideal size is less than 10 acres. Terns prefer to nest in areas with an elevation of 3 m (10 ft) or less.
- (2) Method of deposition—methods that allow control of over the direction and flow of deposition are ideal to create the desired slope and shape and avoid sensitive areas.
- (3) Particle size—coarse, clean sand is preferable, and fine sand, silt, clay, and mud are not suitable.
- (4) Location—remote islands that are far (at least a mile) from the mainland are preferable because they are less likely to have predators and human disturbance.
- (5) Timing—depositing dredge material outside of time windows that are important for fisheries and nesting birds.

- (6) Cooperation—collaboration with partners, especially the U.S. Army Corps of Engineers, is critical to ensuring that high-quality dredge material is placed in areas that will benefit nesting birds.

### Strategies

#### *Continue to:*

- Use temporary symbolic fencing (see glossary) to seasonally close tern nesting areas from May through August to minimize human disturbance; if no nesting activity occurs within the closed area, posts may be removed beginning July 1.
- Patrol and enforce closed areas during the nesting season.
- Establish and staff a temporary field camp from early May until mid-August to maintain human presence 24 hours per day for the purpose of providing predator management and facilitating data collection.
- Erect temporary, hard-sided blinds to facilitate the identification of possible limiting factors, including diet composition and impacts of kleptoparasitism, and to further facilitate nesting studies and predator management.
- Install temporary wooden chick shelters prior to nesting to increase chicks' ability to escape inclement weather and predators, thereby increasing survival.
- Install temporary wooden nesting structures, decoys (minimum of 100, as per Kress and Hall 2004), and sound systems to attract nesting roseate terns during the start of the nesting season.
- Throughout the 125-acre gull management area (Areas A and B), minimize nesting of great black-backed and herring gulls through non-lethal harassment, and destroy all nests by scattering nesting materials and removing eggs.
- Minimize impacts of avian and mammalian predators to nesting terns through non-lethal and lethal management as described in appendix J.
- In selected areas, manipulate vegetation using mechanical methods, herbicide, and rotational prescribed burning to improve habitat for terns and discourage nesting by competitor species, including laughing gulls.
- Coordinate with avian disease specialists at the National Wildlife Health Center in Madison, WI, to document, detect, and minimize the spread of avian diseases.
- Review 5-year reviews and recovery plan updates for roseate terns within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### *Within 1 year of CCP implementation:*

- Evaluate potential for establishing new tern habitat and attracting birds to areas of the refuge not currently used, including further installation of sound systems and decoys.
- Strengthen partnerships to manage lands adjacent to the refuge to create a larger area of continuous protection for terns.

*Within 5 years of CCP implementation:*

- Control nonnative invasive plant species throughout dune grasslands using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide, with a control emphasis in tern nesting areas.
- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise.

**Monitoring Elements**

- Conduct refugewide complete nest counts for both species during the Massachusetts Statewide tern census window (currently June 5 to 20) and collect spatial data via a 60×60 m grid system to determine success of management in maintaining suitable habitat.
- Quantify productivity to determine success of management by recording clutch sizes, hatch success, and fledging success for all nesting roseate terns and approximately 3 to 5 percent of all nesting common terns in the main nesting area.
- Trap banded adults, and band chicks (all roseate terns; subset of common terns, as time allows), to improve fledge success estimates, document nesting site fidelity, contribute to metapopulation studies, and determine whether Monomoy NWR serves as a sink versus a source population.
- Quantify diet by conducting feeding observations of common terns to determine if this is a limiting factor suppressing productivity.
- Document changes in habitat within the grid system, especially before and after habitat management actions, but otherwise at least annually.
- Census laughing, herring, and great black-backed gulls in Area A to track population changes and distribution of predator and competitor species; collect spatial data via a 60×60 m grid for laughing gull nests.
- Monitor nesting attempts of herring and great black-backed gulls in Area A.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings) and conduct nocturnal observations to confirm predator presence, and take, thereby improving understanding of species-specific predator impacts; quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Conduct a complete census of all gulls on North Monomoy Island and South Monomoy every 5 years using aerial survey method or ground counts.
- Monitor avian health by conducting surveillance to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat. (This may help us prioritize areas where dredge material deposition could be beneficial.)
- Update a cover-type map refugewide every 5 to 10 years.



**Objective B1.2 (Beach Shoreline and Dune Edges—Piping Plover)**

Protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for piping plovers on the refuge, with a goal of increasing the nesting population over a 5-year period. Maintain a minimum productivity of at least 1.24 chicks fledged per pair annually and a mean productivity of at least 1.5 chicks fledged per pair over a 5-year period.

**Rationale**

Productivity is the most meaningful measure of our management success. The productivity goals for this objective correspond to recovery criteria in the Piping Plover Recovery Plan (USFWS 1996a) and are consistent throughout this document. It is currently unknown whether juvenile piping plovers return to those areas where they hatched to breed, so while increasing productivity on the refuge would likely help the population as a whole, it is unknown whether this would increase the nesting population on the refuge.

We currently protect approximately 5 percent (35 to 40 pairs) of the State's nesting population of piping plovers. Habitat assessments conducted in 1995 indicated the refuge could have supported approximately 94 pairs (approximately 50 percent of the State's population at that time). Even today, much seemingly high-quality plover nesting habitat remains unused every year. Common limiting factors for piping plovers rangewide are loss of habitat due to human development and intensive recreation (Hecht and Melvin 2009). These are not limiting factors for the refuge population. Habitat has been increasing in recent years due to an annual influx of sand from Nauset/South Beach and the outer Cape Cod. Additionally, human use in nesting areas is minimized and restricted to a few easily accessed areas on the refuge. Research could shed more light on why more available habitat on the refuge is not utilized by piping plovers. We also recognize that the importance of Monomoy refuge relative to the percentage of the State population we support could increase if sea level rise adversely affects habitat on artificially stabilized sites.

In this alternative, we would increase management to protect nesting piping plovers in a manner consistent with preserving wilderness character by closing all available high-quality habitat to the public by mid-April. All high-quality habitat (mainly, the upper beach and lower dune areas; refer to alternative A for a description of high-quality habitat) would be closed, with access corridors provided for the public to cross the island or access the interior of the island at various locations determined each season. These access points would be mapped on the annual closed area map and would be posted in public locations (map 2.7). The method of closures would be improved from those referred to in alternative A, objective A1.1, to be more appropriate for preserving wilderness character. Closed areas would be created using fiber rod posts (1/2-inch diameter) and string. Signs currently used on the refuge for closing areas would be interspersed with the new posts, approximately one sign every 100 meters, to explain the reason for the posted areas. Using this method, closed areas would be visually less obtrusive and more in line with wilderness management, but would still adequately identify closures to visitors. Closed areas would be maintained until all plover chicks within them have fledged or no nesting activity has been initiated by July 1. In addition to predator management already being used in alternative A, we would experiment in this alternative with the use of temporary electric and non-electric predator fencing to protect piping plovers. Refer to the rationale for alternative A, objective A1.3, for a full explanation of when the use of electric fencing is deemed appropriate on the refuge.

Piping plovers are subject to impacts of sea level rise and loss of high-quality nesting habitat. According to the IPCC Fourth Assessment Report: Climate Change 2007: "coasts are projected to be exposed to increasing risks, including

coastal erosion, due to climate change and sea level rise. The effect will be exacerbated by increasing human-induced pressures on coastal areas.” Although we cannot predict with certainty how storm frequency and intensity would directly impact the refuge, we know that these factors will continue to increase relative to 20<sup>th</sup> century trends (CCSP 2008b, Giese et al. 2010). Sea level rise alone would increase coastal flooding during storm surges and amplify rates of habitat change on coastal beaches. Increased numbers and intensity of storms during the breeding season could directly affect piping plover breeding success by increasing long-term rates of nest inundation, nest abandonment, or chick mortality due to harsh weather (USFWS 2009d). This would also likely impact other beach nesting species, such as American oystercatcher and least tern. Therefore, in this alternative refuge staff would consider projects involving deposition of dredge material in non-wilderness (primarily subtidal) areas within the Declaration of Taking to create additional nesting habitat above the storm surge tide line (refer to alternative B, objective B1.1, for an explanation of the benefits of using dredge material). Shoreline monitoring would allow us to pinpoint areas of deposition and erosion and possible appropriate locations for depositing dredge material.

While many of the management actions associated with piping plovers also impact American oystercatchers and least terns, they were included in separate objectives in this alternative. We chose not to combine these species due to the piping plover’s threatened status and to maintain flexibility should future recovery plan efforts require new specific actions for this species.

### Strategies

*Continue to:*

- Patrol and enforce closed areas during the nesting season.
- Use temporary predator exclosures on piping plover nests that are located in sparsely vegetated areas with nothing obstructing the view of the bird or inhibiting the bird’s ability to detect predators.
- Minimize impacts of avian and mammalian predators to nesting plovers through non-lethal and lethal management as described in appendix J.
- Strengthen partnerships to manage lands adjacent to the refuge to ensure the success and survival of piping plovers in the surrounding area and create a larger area of continuous protection.
- Review 5-year reviews and recovery plan updates for piping plovers within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 1 year of CCP implementation:*

- Use temporary symbolic fencing to seasonally close all suitable piping plover habitat regardless of the presence of pairs early in the season (March or April) and to seasonally close additional areas that contain breeding piping plovers (May through July) as nesting or courtship behaviors are observed; maintain these areas as closed until July 1 if no nesting has occurred, or until chicks have fledged within the closed areas (fencing would be removed as staff time allows once these criteria are met).

- Participate in partner-based, high priority, landscape-level piping plover research, which may include resighting banded adults, collecting unhatched eggs for DNA analysis, or evaluating habitat availability as a limiting factor.
- Use temporary solar-powered electric fence in suitable nesting habitat to protect piping plover nests from mammalian predators.
- Experiment with using temporary non-electrified fencing to reduce mammalian depredation.

*Within 5 years of CCP implementation:*

- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise.

**Monitoring Elements**

- Monitor piping plovers throughout the nesting season, including nest searches in traditional piping plover nesting areas beginning in mid-March; nest visits to monitor and record dates of laying, hatching, or failure, and cause of failure; and chick searches to determine survival or first observed flight (Blodgett and Melvin 1996).
- Conduct the piping plover census during the Massachusetts Statewide census window (currently June 1 to 9) and collect spatial data of nest locations to document changes in habitat selection and site fidelity from year to year.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Resight banded adults to contribute to metapopulation studies and determine whether piping plovers nesting on Monomoy refuge wintered or migrated through the Gulf of Mexico after the Deepwater Horizon oil spill.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of nesting habitat.
- Update a cover-type map refugewide every 5 to 10 years.

**Objective B1.3 (Beach Shoreline, Dune Edges, and High Salt Marsh—American Oystercatcher)**

Protect from disturbance and degradation all high-quality nesting habitat and nearby foraging habitat for approximately 30 to 40 nesting pairs of American oystercatchers per season. Maintain a mean productivity of at least 0.60 chicks fledged per nesting pair, as consistent with current research.

**Rationale**

In this alternative, we would increase efforts to improve reproductive success of American oystercatchers. An annual productivity level of 0.60 chicks per pair is the target necessary for a 30 percent increase over 10 years (Murphy 2011 personal communication). Productivity elsewhere in the State is often far below this. Because the refuge hosts a large nesting population, by increasing productivity at this site, we could greatly impact the State and regional population over the long term.

Hatch success in American oystercatchers is very low at many sites, including the refuge, due to overwash and predator pressures (see appendix J). In this

alternative, several management techniques would be investigated to minimize nest loss to overwash and predation, and ultimately increase productivity. Innovative research on nesting oystercatchers in South Carolina and Georgia has shown promise in a new technique involving artificial incubation of eggs. In this alternative, refuge staff would investigate the feasibility and appropriateness of artificially incubating eggs from nests on Monomoy refuge to increase hatch success. Eggs would be removed from nests and replaced with artificial eggs so adults will continue incubating and attending the nest. The real eggs would then be incubated in an incubator and replaced in the nest bowl just before hatching.

Actions involving deposition of dredge material considered in this alternative for terns would also likely benefit American oystercatchers (refer to alternative B, objective B1.1, for an explanation of the benefits of using dredge material).

### **Strategies**

*Continue to:*

- Patrol and enforce closed areas during the nesting season.
- Use temporary solar-powered electric fence in suitable nesting habitat to protect American oystercatchers from mammalian predators.
- Experiment with using temporary non-electrified fencing to reduce mammalian depredation.
- Explore the effectiveness of temporary nesting platforms for American oystercatchers to reduce nest loss due to overwash.
- Minimize impacts of avian and mammalian predators to nesting oystercatchers through non-lethal management and lethal management as described in appendix J.
- Strengthen partnerships with Mass Audubon's Coastal Waterbird Program and the Town of Chatham to manage lands adjacent to the refuge to ensure the success and survival of American oystercatchers in the surrounding area and create a larger area of continuous protection.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 1 year of CCP implementation:*

- Use temporary symbolic fencing to seasonally close all suitable American oystercatcher habitat regardless of the presence of pairs early in the season (March or April); maintain these areas as closed until August 1 (if the areas remain unused), or until all chicks have fledged.
- Increase refuge participation in landscape-level color-banding efforts through the American Oystercatcher Working Group to improve productivity estimates on the refuge, and contribute to a range-wide understanding of survival, movement, and dispersal, which are critical to understanding and predicting population trends at multiple spatial scales.

*Within 5 years of CCP implementation:*

- Evaluate appropriateness of artificially incubating eggs to increase hatching success of American oystercatchers and minimize loss to predators.

### Monitoring Elements

- Monitor American oystercatcher productivity throughout the nesting season by searching nesting areas at least 2 times per week beginning in early April to document nest locations, laying, hatching, nest failure or success, and overall productivity.
- Conduct the American oystercatcher census during the Massachusetts Statewide census window (currently May 22 to 31).
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.
- Deploy temporary field cameras with digital video recorders near American oystercatcher nests to monitor disturbance, predator activities, and cause of nest loss. In this alternative, there may be an increased level of monitoring (with appropriate funding) compared to alternative A.
- Resight and report banded adults during migration and staging periods to contribute to metapopulation studies coordinated through the American Oystercatcher Working Group and better understand Monomoy NWR's importance during migration and staging.

### Objective B1.4 (Beach Shoreline and Dune Edges—Least Tern)

Protect nesting least terns and habitat to provide opportunities for an increased number of nesting pairs on the refuge. Maintain an average productivity of 1.0 tern chicks per nesting pair when the refuge supports 10 percent of the State's population.

### Rationale

In addition to the measures taken to protect least terns in alternative A, alternative B actively seeks to increase the number of nesting pairs on the refuge. This may be accomplished in several ways, including increasing predator management efforts, using chick shelters to increase chick survival, and use of electric or nonelectric fencing (refer to alternative A, objective A1.3, for an explanation of when electric fencing is appropriate). In this alternative, if the refuge population reached or exceeded 10 percent of the State population, further measures would be taken to manage avian predators such as large gulls (using shooting as the primary method) and productivity would be quantitatively assessed. Through working with other sites, methods for collecting productivity information would be selected to continue to minimize human presence within the nesting areas.

Although lethal predator management would not be implemented to protect least terns if their population remained below 10 percent of the State population, nesting least terns would benefit from predator management being implemented for the protection of other species on the refuge. Fencing has been proven to increase hatch success in colonies that are susceptible to mammalian predation (Rimmer and Deblinger 1992). Chick shelters have been successful in protecting chicks from avian predators including northern harrier (Jenks-Jay 1982), which are abundant on the refuge.

### Strategies

*Continue to:*

- Patrol and enforce closed areas during the nesting season.

- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 1 year of CCP implementation:*

- Use temporary symbolic fencing to close all suitable least tern nesting habitat in May, and additional areas as nesting behaviors are observed; maintain these areas as closed until August (when chicks have fledged), or until they are no longer being used by breeding birds.
- Use lethal predator management to protect nesting least terns if the population reaches or exceeds 10 percent of the State population.

*Within 5 years of CCP implementation:*

- Use temporary solar-powered electric fence in suitable nesting habitat to protect least terns from mammalian predators.
- Use temporary chick shelters to provide chicks with shade and protection from avian and mammalian predators; chick shelter design would be modified from other successful designs to address the most common predators on Monomoy refuge.

**Monitoring Elements**

- Monitor least tern nesting periodically through the nesting season by searching nesting areas once per week beginning in mid-May to qualitatively estimate reproductive success; if the population reaches 10 percent or more of the Statewide population, quantitatively assess productivity using methods that have been standardized at other sites.
- Conduct a census of nesting least terns during the Massachusetts Statewide tern census window (currently June 5 to 20) and record general locations of nesting sites.
- Record all predator presence data in and around nesting areas (tracks, scat, loss of productivity, sightings); quantify prey taken by predators through dissection of collected scats and digestive systems of lethally removed predators.

**Objective B1.5  
(Beach—Northeastern  
Beach Tiger Beetle)**

Continue to protect areas currently occupied by northeastern beach tiger beetle adults or larvae from disturbance and degradation with sufficient protected habitat for expansion and genetic interchange (to be determined by future research). Continue to maintain a peak count of at least 500 adults. Enhance recovery opportunities and meet recovery objectives by serving as a donor site/source population for other sites in the Northeast.

**Rationale**

The most recent 5-year review of the Northeastern Beach Tiger Beetle Recovery Plan (USFWS 2009b) recommends that the status of this species be upgraded from threatened to endangered, and identifies a list of current research gaps. One gap identified is the lack of knowledge concerning genetic differentiation between the Massachusetts and Chesapeake Bay populations. By enabling work on this subject, the refuge would assist researchers in understanding the metapopulation structure of this species over time. Vogler et al. (1993) examined genetic variation in the two populations of the northeastern beach tiger beetle and found that the Massachusetts and Chesapeake Bay sites had low genetic variability, but little work has been done since regarding the genetic makeup of these two populations. Necessary additional research includes a further analysis

of the habitat currently being utilized on Monomoy NWR. The analysis done in Chesapeake Bay included looking at parameters such as sand grain size, sand bulk density, and slope, which have to be collected from the field, as well as parameters such as beach aspect, fetch, and bathymetry fronting the sites, which can be obtained from GIS (Drummond 2011 personal communication).

In addition to the protection afforded to tiger beetles under alternative A and addressing research needs identified in the most recent 5-year review, management for this species under alternative B would include working with partners to locate new introduction sites. One of the best ways to ensure the future survival of isolated, rare species is to protect and maintain as many populations across as broad an area as possible. In the event of a catastrophic loss of an entire population at one location, other non-contiguous sites with viable populations are likely to persist. Surviving populations can subsequently be used as donor sites. New sites would not be viable unless they were able to provide permanent protection for the beetle population. In this alternative we would work with the New England Ecological Services Field Office to serve as a donor population for newly identified sites by providing adult beetles. Though the Monomoy population is considered stable, precautions would be taken to continue protection for the population while acting as a donor site for new locations.

### Strategies

#### *Continue to:*

- Maintain vehicle closures on refuge lands to protect habitat and allow for continued population growth; cooperate with the Town of Chatham, State of Massachusetts, U.S. Coast Guard, and other partners involved in emergency and public safety operations to protect tiger beetles and habitat when vehicle access is deemed essential to protect human life. This includes increased monitoring when vehicles are present to minimize habitat degradation and mortality by OSVs.
- Regularly inform and communicate with the public about areas occupied by tiger beetles on the refuge, including the part of Nauset/South Beach that is now part of South Monomoy Island, to foster continued support for protection and monitoring of tiger beetles currently using these areas and allow for continued expansion of spatial distribution.
- Review 5-year reviews and recovery plan updates for northeastern beach tiger beetles within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

#### *Within 5 years of CCP implementation:*

- Facilitate and expand research opportunities on the refuge to fill data gaps that will promote tiger beetle recovery including, but not limited to, genetic work to determine differences between beetle populations in Massachusetts and Chesapeake Bay.
- Work with the New England Ecological Services Field Office staff to determine other potential areas for translocation on the refuge or other viable sites in New England or New Jersey for population augmentation or introduction.
- Work with the New England Ecological Services Field Office to utilize Monomoy refuge as a donor population for newly identified sites, while ensuring that the Monomoy population is not adversely impacted.

### Monitoring Elements

- Conduct seven to eight adult beetle activity sampling occasions distributed evenly across the late June to late August period (Kapitulik and Smith 2010); during these visits, perform low intensity mark and resight efforts to estimate the population and calculate survival probability.
- Conduct larval activity site visits in late September and early October peak period to indicate reproductive success and delineate larval habitat.
- Work with partners to evaluate the characteristics of the habitat currently being used by beetle larvae and adults on the refuge, using similar parameters that are evaluated for the Chesapeake Bay sites; repeat these surveys every 3 years.
- Monitor success of larval transport if other introduction efforts are undertaken.
- Monitor shoreline change at least annually using standardized protocols used throughout the Northeast to document changes in sediment erosion and deposition and loss or gain of spawning habitat.
- Update a cover-type map refugewide every 5 to 10 years.

### Objective B1.6 (Maritime Shrubland—Neotropical Migrant Songbirds, Black-Crowned Night-Herons, and Snowy Egrets)

Protect existing native maritime shrubland and evaluate use by migrating land birds of conservation concern. If large patches of maritime shrubland are regionally important, maintain native species composition (including bayberry, beach plum, etc.) with less than 5 percent invasive plants. Continue to minimize human disturbance to shrubland habitat generally consisting of northern bayberry and the nonnative rugosa rose approximately 3 feet tall, which is used by nesting wading birds, including black-crowned night-herons and snowy egrets.

### Rationale

Alternative B affords similar importance of protection of nesting habitat for black-crowned night-herons and snowy egrets as alternative A. In alternative B, we would additionally evaluate the importance of native maritime shrubland habitat on the refuge to neotropical migrating birds.

Statewide, maritime shrubland is a declining habitat type (Swain and Kearsley 2001) that is critically important for nesting and migrating land birds. Shrubland-associated nesting birds consistently rank near the top of lists of species showing population declines (Steinkamp 2008). Coastal states have the primary responsibility for most of the native shrubland habitat in the region (Dettmers 2003, Litvaitis 2003), with shrub-dominated communities enduring the longest at high elevations and in areas exposed to marine salt spray (Latham 2003). The loss and degradation of naturally maintained shrublands has been extensive throughout the region, but coastal Massachusetts still supports persistent maritime shrublands. Maritime shrublands support large concentrations of migrating songbirds (Smith et al. 2007, Suomala et al. 2010), particularly juveniles during their first fall (Morris et al. 1996). Many land birds shift from a largely insectivorous diet during the breeding season to a diet high in fruits during migration. This diet shift is particularly well documented in thrushes, vireos, warblers, mockingbirds, and their relatives (Parrish 2000). Parrish (2000) captured red-eyed vireos, a highly frugivorous migrant, more than 10 times more frequently in coastal maritime scrub than in old orchard habitat on Block Island, off the coast of Rhode Island. Observations of migratory land birds feeding on fruits show that these birds can spend less time and encounter more prey while foraging on fruit, an important implication for a bird's energy budget (Parrish 2000).



Though there is some question as to how much of the pre-European settlement landscape was early successional habitat, there does seem to be agreement that coastal southern New England was much more prone and likely to be susceptible to disturbance, by both natural and human processes (Cronon 1983, Covell 2006, Motzkin and Foster 2002). The paleoecological record for coastal islands including Nantucket, Martha's Vineyard, Block Island, and Long Island indicate that grasslands were uncommon in these areas in the absence of natural disturbances capable of creating and maintaining them (Motzkin and Foster 2002). Restoration and maintenance of naturally occurring shrublands is therefore recommended as a priority for coastal states.

The importance of maritime shrubland to migrating songbirds has been evaluated at other New England sites (Smith et al. 2007, Suomala et al. 2010, Morris et al. 1996); more than 150 species of songbirds use shrub habitats on Parker River NWR in Newburyport, Massachusetts. Monomoy refuge's maritime shrubland may be important to migrating land birds, but we have just begun to evaluate this. In 2011, we mist-netted migrating songbirds on 18 days from August 31 to October 11; 70 different species of songbirds were caught in this limited trapping effort, including 283 yellow-rumped warblers. The 10 most abundant species were yellow-rumped warbler, tree swallow, savannah sparrow, American robin, song sparrow, common yellowthroat, blackpoll warbler, red-eyed vireo, golden-crowned kinglet, and cedar waxwing. Alternative B includes more extensive mist netting and banding to further evaluate species' presence and abundance during migration.

Maritime habitats often contain invasive species of shrubs, including honeysuckles, buckthorn, Asiatic bittersweet, and others, that bear fruit and provide cover but also out-compete native vegetation. Removing these invasive shrubs could reduce the habitat suitability for some species in the short term. An assessment is needed prior to removal to determine the short- and long- term effects of removal and options for restoring native shrubs. Smith et al. (2007) studied nutritional requirements of songbirds and nutritional composition of commonly consumed fruits and found that songbirds need a variety of fruit-bearing shrubs to meet optimal fat, protein, and carbohydrate requirements. Vegetation structure, microhabitat conditions, and landscape context are the most important habitat features for these birds, rather than specific plant species (Dettmers 2003).

As in alternative A, we would tolerate nonnative rugosa rose in areas of the refuge that host nesting black-crowned night-herons and snowy egrets. The importance of the refuge to these wading bird species is detailed in the rationale section of alternative A, objective A1.6. Currently, standard buffer distances have not been implemented at Monomoy refuge, but buffers are instead determined in the field and signs are placed at a distance so approaching pedestrians do not flush birds from nesting bushes. In this alternative, we would more carefully evaluate appropriate buffer distances. This is especially important at this site due to the large number of gulls that will prey on eggs and chicks nesting in close proximity to herons and egrets.

### Strategies

*Continue to:*

- Allow nonnative rugosa rose to remain on refuge areas where wading birds nest.
- Use temporary symbolic fencing to seasonally close primary nesting areas in portions of the refuge with high seasonal public visitation to provide disturbance-free nesting opportunities for wading birds.

- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 5 years of CCP implementation:*

- Implement standard buffer distances for seasonal closures based on findings at other sites, and modify to be more restrictive at Monomoy refuge if buffers are not sufficient.
- Evaluate regional importance of maritime shrubland on Monomoy refuge to migrating land birds and, if appropriate, periodically evaluate habitat conditions (including species composition, nonnative plant presence, and community structure).
- Utilize biological, mechanical, chemical, and fire management to reduce nonnative species in maritime shrublands deemed important for migrating land birds.

**Monitoring Elements**

- Annually count active wading bird nests in primary nesting areas once between mid-April and mid-May, approximately one week prior to peak hatch to minimize disturbance impacts and depredation by gulls.
- Conduct a complete census of all wading birds refugewide every 5 to 10 years using aerial survey method or ground counts, and in conjunction with Statewide efforts.
- Oversee mist netting efforts conducted by Monomoy Banding Station staff/volunteers at the south end of South Monomoy from August through November to quantify abundance of neotropical migrants and evaluate importance of Monomoy refuge to shrubland-dependent birds.
- Map locations and record abundance of invasive/nonnative species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Update a cover-type map refugewide every 5 to 10 years.

**Objective B1.7  
(Intertidal—Migrating  
and Staging Birds and  
Horseshoe Crabs)**

Adaptively manage the refuge's approximately 2,500 acres of intertidal habitat to protect staging and migrating birds, particularly species of conservation concern, including black-bellied plover, piping plover, American oystercatcher, ruddy turnstone, red knot, sanderling, semipalmated sandpiper, dunlin, shortbilled dowitcher, roseate tern, and common tern, so at least 90 percent of habitat being used annually by species of conservation concern is not subjected to frequent disturbances. Also manage this intertidal habitat to benefit juvenile and spawning horseshoe crabs and allow no harvest of horseshoe crabs within the refuge boundary.

**Rationale**

*Migrating and Staging Birds*

In this alternative, we consider implementing seasonal closures to more actively reduce disturbances to staging and migrating birds. The importance of minimizing disturbance has already been discussed in alternative A, but we provide further discussion of disturbances to migrating shorebirds and research conducted specifically at Monomoy refuge.

Conservation of stopover sites that provide abundant food and a relatively disturbance-free environment is critical to the long-term future of many shorebird populations, especially those that concentrate at just a few stopover sites (Myers 1983, Senner and Howe 1984, Myers et al. 1987). Human disturbance

at stopover sites can be loosely categorized as direct impacts that may displace shorebirds or alter their behavior, or indirect impacts that have an effect on prey populations (such as shellfishing or horseshoe crab harvesting) (Brown et al. 2001). Both direct and indirect impacts may degrade the quality of stopover sites. Vulnerability to changes in habitat availability or suitability is likely amplified for migrating shorebirds because large concentrations of shorebirds rely on just a few sites (Myers 1983, Senner and Howe 1984, Myers et al. 1987). Coastal stopover sites in particular are increasingly subjected to development and human disturbance, and loss of high-quality stopover habitat is likely one factor contributing to declines in local abundance and overall populations of shorebirds in North America (Myers et al. 1987, Pfister et al. 1992, Brown et al. 2001).

Understanding shorebirds' reactions to pedestrians on Monomoy NWR is necessary to develop management strategies that minimize human disturbance of shorebirds during migration. In 2006 and 2007, we quantified flight-initiation distances for 11 different species of shorebirds through controlled field trials. Researchers approached shorebirds foraging on the intertidal mudflat and recorded distances at which shorebirds flew away from the approaching researchers; distances differed by species. Smaller *Calidris* sandpipers generally allowed pedestrians to approach within 20 m before flushing, while larger shorebirds (black-bellied plover and American oystercatcher) had flight initiation distances over 50 m. Based on flight-initiation distances, we developed species-specific conservative buffer distances for 11 species that ranged from 61m for least sandpiper to 186 m for black-bellied plover (Koch and Paton 2013 in preparation).

We also investigated the potential impacts of shellfish harvesters, raking for softshell clams on mudflats where shorebirds actively foraged. Microhabitats with recent shellfishing activity had a positive influence on the density of two species (ruddy turnstone and American oystercatcher), while the presence of shellfishers did not appear to affect the density of other species of shorebird we monitored. We regularly detected black-bellied plovers and ruddy turnstones actively foraging in microhabitats where shellfishers had recently exposed sediment.

Refuge staff would continue to implement seasonal closures to public use to protect wildlife. Generally, those closures have occurred between April 1 and September 30. Map 2.7 depicts approximate closure areas implemented in 2012, excluding South Beach. However, closure areas and closure dates may vary from year to year based on wildlife use and changes in habitat. Given the levels of pedestrian traffic at Monomoy NWR in recent years, we think a small expansion of the current seasonal closures described in alternative A, is sufficient to reduce most disturbance to migratory shorebirds using this stopover site. However, if the amount of pedestrian traffic were to increase substantially, we may need to adjust closures further during peak migration periods.

Although approximately 2,500 acres of intertidal habitat is generally available on Monomoy refuge, not all acreage provides the environmental characteristics that staging and migrating birds rely on, and the location of suitable habitat often changes several times within a season and even during a day. Foraging shorebirds are often patchily distributed, depending on the location of the tide line and prey populations. These locations change between and within years, especially following storms that redistribute sediment on the flats.

Based on our flushing trials, implementing a buffer of 61 to 97 m at important foraging sites with frequent disturbance should benefit least and semipalmated sandpipers, semipalmated plovers, sanderlings, dunlins, and short-billed dowitchers. Larger buffer distances (113 to 186 m) should be implemented to

protect willets, red knots, ruddy turnstones, American oystercatchers, and black-bellied plovers.

#### *Horseshoe Crabs*

Actions we identified under Alternative A to protect adult horseshoe crabs would also be implemented under alternative B. In addition, we would monitor juvenile horseshoe crab activities to assess whether additional protection measures are warranted. After a female lays eggs, larvae hatch within 4 weeks after fertilization (Botton 1995), remain in the sand for several weeks, and then begin moving toward the beach surface (Rudloe 1979 as in Penn and Brockmann 1994). Within 2 weeks, they molt into juveniles (Sekiguchi et al. 1982 as in Penn and Brockmann 1994). During the first summer, juvenile horseshoe crabs generally live in shallow waters near the shore (Shuster Jr. 1979), and we often see these juveniles in the intertidal-salt marsh interface (Koch 2012 personal communication). Thus, intertidal flats remain extremely important to successful population recruitment.

#### **Strategies**

##### *Continue to:*

- Work with partners to determine the relative importance of tern staging sites on Cape Cod, identify problematic disturbances, and develop solutions to minimize disturbances.
- Work with partners to document the importance of Monomoy refuge to migrating red knots and contribute to research that would inform species' recovery.
- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Work with partners to study movement and embayment site fidelity of horseshoe crabs by tagging 500 crabs annually.
- Participate in State and regional efforts to document changes in populations of horseshoe crabs by conducting spawning surveys on Morris Island, North Monomoy Island, and South Monomoy.
- Maintain and enforce closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Review 5-year reviews and recovery plan updates for roseate terns within 6 months of completion to make appropriate changes in management to accommodate updated recovery criteria, research needs, etc.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

##### *Within 1 year of CCP implementation:*

- Continue to use temporary symbolic fencing to implement seasonal closures to public use to protect wildlife. There may be a small expansion to these closed areas which may occur along the western salt marsh edge of North Monomoy Island, around the barrier beach and salt marsh edge of Minimoy Island, and around the north end of South Monomoy. Habitat will be assessed on Nauset/South Beach.
- Use the Atlantic Flyway Shorebird Conservation Business Strategy as a guiding document for establishing priority research and conservation efforts.

Within 5 years of CCP implementation:

- Initiate an outreach campaign to provide information to all visitors about the importance of minimizing disturbance to migrating and staging birds; the outreach message would focus on a recommended viewing distance of at least 50 m to allow birds to remain undisturbed in their resting and foraging areas, which are critical to successful migration.
- Annually identify areas refugewide that consistently support foraging or staging shorebirds or terns and close areas that are subject to high levels of disturbance to all human use; a rapid-assessment method of identifying areas would be developed and implemented. This assessment will now include Nauset/South Beach and will inform potential closures.

#### Monitoring Elements

- Conduct tern staging counts and resight and report color-banded roseate terns on the refuge and Nauset/South Beach to contribute to study of staging areas and disturbance.
- Conduct post-breeding counts of American oystercatchers on the northern half of the refuge in conjunction with partner efforts, and report color-banded birds through the American Oystercatcher Working Group to better understand Monomoy NWR's importance during migration and staging.
- Resight and report banded shorebirds to *bandedbirds.org*, with a focus on red knots, during migration periods to contribute to studies on migration pathways, strategies, habitat use, and survival and to better understand Monomoy NWR's importance during migration.
- Rely on volunteers and refuge partners to annually conduct international shorebird surveys opportunistically during north and south migration refugewide to contribute to landscape data sets and identify new primary roosting and foraging sites as they occur on the refuge.
- Every 5 to 10 years, quantify migrating shorebird chronology and spatial distribution for 2 consecutive years according to Koch and Paton (2009) to monitor longer-term changes in shorebird use.
- Periodically monitor human disturbance levels in an effort to ensure that at least 90 percent of habitat being used by species of conservation concern is not subjected to frequent disturbance.
- Quantify flushing of feeding and resting shorebirds from human disturbance.
- Obtain aerial photography through collaboration with the Town of Chatham to monitor changes in intertidal habitat every year.

#### Objective B1.8 (Beach Berm, Intertidal, and Nearshore Marine Waters—Marine Mammals)

Protect and support healthy seal populations on the refuge and ensure compliance with Marine Mammal Protection Act seal guidelines.

#### Rationale

The rationale for alternative A, objective A1.7, as well as chapter 2, includes a summary of Monomoy refuge's importance to gray and harbor seals. Marine mammals are protected by the Marine Mammal Protection Act. Concerns about an increasing seal population, their impact on fishing, and the increase in the great white shark population are resulting in some deliberate acts of harassment. We protect these animals when they are on refuge lands and in refuge waters.

### Strategies

Continue to:

- Work with the Cape Cod Stranding Network to assist with rescues of stranded and entangled marine mammals, and help monitor injured or sick marine mammals.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

Within 1 year of CCP implementation:

- Encourage, support, and actively participate in partner efforts to study marine mammals, including gray and harbor seals.
- Evaluate use of symbolic fencing for seal haulout sites and pupping sites that are subject to frequent human disturbance.

### Monitoring Elements

- Conduct pupping counts and partner-led aerial surveys of haulout sites to track use by seals refugewide.
- Monitor and report entangled and stranded marine mammals.

### Objective B1.9 (Salt Marsh)

Over the next 15 years, manage at least 150 acres of coastal salt marsh (including a mix of high and low salt marsh and pool and panne habitat with no more than 10 percent invasive species) to ensure that the quality and natural function of the marsh is sustained, and provides nesting habitat for saltmarsh sparrow and American oystercatchers, foraging areas for wading birds, roosting areas for shorebirds, and nursery habitat for horseshoe crabs.

### Rationale

Alternative B expands management to include control of nonnative invasive species to improve the salt marsh integrity index (SMI) values. Salt marshes are unique and highly productive ecosystems with high intrinsic value to wildlife, and many refuges, including Monomoy, have been established in coastal areas and have the ability to protect large tracts of salt marsh and wetland-dependent species. Prioritizing refuge salt marshes for application of management actions and choosing among multiple management options requires scientifically based methods for assessing marsh condition. We would investigate salt marsh health through installation of salt marsh elevation tables and participation in regionwide studies of salt marsh integrity.

On Cape Cod, evidence shows salt marsh has been declining over the last 60 years. “Analysis of aerial photographs dating back to 1947 reveals that extensive marsh area loss and alterations of tidal creek structure have occurred where vegetation along the edges of tidal creeks and mosquito ditches in the low marsh has declined or disappeared. The extent of high marsh vegetation in virtually all systems has diminished greatly, particularly since the 1980s, with the seaward edge of this zone rapidly retreating in a landward direction. In several systems, this has resulted in high marsh being replaced by barren mudflat.” (Smith 2008).

Salt marshes throughout Cape Cod have additionally been impacted by the loss of marsh vegetation—termed sudden wetland dieback. The loss of *Spartina alterniflora* in the low marsh has been substantial on Cape Cod, and has been attributed to herbivory by the nonnative purple marsh crab. “Surveys revealed that *Sesarma* herbivory has denuded nearly half the creek banks in Cape Cod marshes, and differences in crab-grazing intensity among marshes explained greater than 80 percent of variation in the extents of the die-offs. Moreover, the rate of die-off expansion and area of marsh affected have more than doubled since 2000.” (Holdredge et al. 2008). In the high marsh, loss of *Spartina patens*

has also been documented, but although purple marsh crabs have been observed feeding on this plant, loss of *Spartina patens* may be more closely linked with hydrologic changes (Smith 2008). Purple marsh crabs may be increasing in number due to overharvesting of blue crabs, a predator of purple crabs ([http://www.nsf.gov/news/special\\_reports/science\\_nation/purplemarshcrabs.jsp](http://www.nsf.gov/news/special_reports/science_nation/purplemarshcrabs.jsp); accessed November 2013). We do not know if purple marsh crabs are present in salt marshes on Monomoy refuge.

As with most habitats, detailed studies of salt marshes are sometimes required to determine if they are structured and functioning to provide the most benefit for species of concern. Salt marsh is also a type of habitat that responds to sea level rise. If the rate of sea level rise is approximately the same as the rate of deposition of marsh soils, this habitat would persist. High rates of sea level rise would cause inundation and loss of this habitat. It is currently unknown what the soil deposition rates in refuge marshes are relative to sea level rise.

### Strategies

*Continue to:*

- Use temporary symbolic fencing to seasonally close most salt marsh habitat on North Monomoy Island from April to September to minimize trampling of vegetation and invertebrates, and minimize disturbance to nesting saltmarsh sparrows and American oystercatchers.
- Support partner efforts to investigate impacts of mercury on saltmarsh sparrows and natural processes that affect mercury speciation and bioavailability.
- Support partner efforts to investigate the hybridization of saltmarsh sparrows and how it impacts the population fitness of saltmarsh sparrows and Nelson's sparrows.
- Support partner efforts to investigate changes in tidal marsh bird populations on the refuge and in eastern Massachusetts by comparing current survey data to historical data.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 1 year of CCP implementation:*

- Expand the areas of temporary symbolic fencing to include protection for salt marshes on Morris Island and South Monomoy Island.
- Participate in regional efforts to monitor the health and integrity of salt marsh habitat on the refuge. Focus management on reducing non-climate stressors to salt marshes.
- Install sediment elevation tables (SETs) in refuge salt marshes to evaluate the effects of various factors on salt marshes' ability to keep pace with sea level rise.
- Complete rapid assessments of vegetative composition on the North Monomoy Island salt marsh to evaluate suitability for sparrow nesting and allow for proactive development of habitat adaption efforts if needed.
- Determine presence and abundance of purple marsh crabs in all salt marshes on the refuge; if present, initiate studies to determine if herbivory is having an impact on salt marsh vegetation and health.

### Monitoring Elements

- Conduct annual census and monitor productivity of American oystercatchers as identified in alternative B, objective B1.3.
- Analyze saltmarsh sparrow survey data from previous years to determine population trends and inform future management and inventory needs.
- Collect salt marsh elevation information from SETs and evaluate the need for remediation.
- In future years, monitor growth and expansion of the marsh through coastal shoreline monitoring protocols currently being developed; in the meantime, monitor growth and expansion through onscreen digitizing of aerial photos combined with ground-truthing.
- Map locations and record abundance of invasive/nonnative species; monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Update a cover-type map refuge-wide every 5 to 10 years.

### Objective B1.10 (Freshwater Ponds and Marshes)

Maintain ecological integrity in freshwater habitats on the refuge by managing freshwater ponds and marshes to have no more than 10 percent invasive species, and ensure that the quality and natural function of the habitats are maintained for migratory birds and other resources of concern.

#### Rationale

Monomoy refuge includes approximately 150 acres of freshwater ponds and associated emergent and shrub wetlands, mostly located at the south end of South Monomoy. Although these habitats are not the most important habitat to priority resources of management concern, we recognize the importance of maintaining healthy freshwater wetlands in coastal environments, particularly for migratory birds. Monomoy refuge has one of the most diverse suite of breeding waterfowl species in Massachusetts, though total numbers of breeding waterfowl pairs are low (Petersen and Meservey 2003). Brood surveys done sporadically over the years have confirmed the presence of all Massachusetts-nesting waterfowl species (USFWS unpublished data) on South Monomoy, and these species also rely on freshwater habitats for migration. The freshwater ponds and marshes also provide important migratory stopover and wintering habitat for redheads, bufflehead, common goldeneye, hooded merganser, lesser scaup, greater scaup, ring-necked duck, and canvasbacks. Many of these waterfowl species are regional priorities (see appendix A). Secretive nesting marsh birds such as sora (Koch 2013 personal communication) also nest in the freshwater marshes, and pied-billed grebe and American coot use these habitats for migration (Nikula 2011 personal communication).

The freshwater wetlands and associated habitats at the south end of South Monomoy are also likely providing an abundant food supply for migrating bats. Bats have been reported migrating through Cape Cod since at least the late 1800s (Miller 1897), and the importance of coastal sites in general to migrating bats has been recently receiving more attention. Baseline surveys at Parker River NWR in Newburyport revealed several species of bats migrating through coastal habitat (Anderson and Yates 2011). At Monomoy NWR, we have collected 2 years of bat migration information using acoustic monitors, but haven't analyzed the data yet.

Many of the freshwater ponds on South Monomoy are fringed with nonnative common reed (*Phragmites*), a perennial, aggressive wetland grass that outcompetes native plants and displaces native animals. Genetic studies have



confirmed that there is a native variety of common reed along the eastern seaboard of the United States, but none of the stands tested from Monomoy refuge in 2003 were the native variety. Common reed is problematic because it outcompetes and blocks out native vegetation and provides little or no food or shelter for wildlife, compared with native vegetation. Common reed grows readily in disturbed wetland areas and is usually an indicator of a wetland ecosystem that is out of balance. Once established, common reed is difficult to control or eradicate ([http://www.fws.gov/GOMCP/pdfs/phragmitesQA\\_factsheet.pdf](http://www.fws.gov/GOMCP/pdfs/phragmitesQA_factsheet.pdf); accessed March 2012). On Monomoy refuge, common reed has been present since at least 1969 (Lortie et al. 1991). We have not monitored changes in locations and sizes of infestations, but present day infestations are probably similar to those (or slightly increased) of the late 1990s.

### Strategies

*Within 1 year of CCP implementation:*

- Analyze 2 years of acoustic bat monitoring data to quantify the importance of Monomoy refuge to migrating bats and determine if future monitoring is warranted.
- Control nonnative invasive plant species, especially common reed, throughout freshwater habitats using manual tools, herbicides, or prescribed fires to ensure less than 10 percent coverage refugewide.
- Submit samples of common reed from stands that have not been previously tested to determine if they are native.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

### Monitoring Elements

- Map locations and record abundance of invasive/nonnative species. Monitor changes in species composition, and evaluate effectiveness of control techniques implemented.
- Update a cover-type refugewide map every 5 to 10 years.

## Objective B1.11 (Nearshore Marine Open Water)

Protect, manage, and restore 2,000 acres of nearshore marine open water, submerged aquatic vegetation beds, and subtidal bottoms to conserve natural and cultural heritage and assure sustainable productivity of marine resources to benefit federal trust resources, including migrating, staging, and wintering birds such as eiders, scoters, long-tailed duck, brant, bufflehead, loons, grebes, mergansers, northern gannet, terns, and gulls; marine mammals; horseshoe crabs; interjurisdictional fish; and sea turtles.

### Rationale

The rationale sections for alternative A, objective A1.9, and chapter 2 include a summary of the importance of Monomoy refuge's nearshore marine, subtidal bottom, and submerged aquatic vegetation habitats to migrating, staging, and wintering waterfowl and other migratory birds, marine mammals, sea turtles, and interjurisdictional fish.

### Strategies

*Continue to:*

- Maintain and enforce closure of the refuge to horseshoe crab harvesting.
- Reinstall permanent markers visually delineating the Declaration of Taking boundary in open waters based on the Regional Surveyor's coordinates; commercial GPS software vendors would be provided with digital map layers for incorporation into their software products.

- Maintain closure of the refuge to mussel harvesting to preserve food sources for red knots and American oystercatchers.
- Evaluate aquaculture requests in open water-submerged bottom areas (below mean low water) within the Declaration of Taking boundary for compatibility and benefits to refuge resources on a case-by-case basis.
- Participate in review and discussions with stakeholders regarding dredging of channels and the possible deposition of dredge materials surrounding Monomoy NWR, particularly impacts to priority wildlife and habitats.
- Support partner efforts to study wintering sea ducks using the waters surrounding the refuge, and monitor impacts of diseases affecting these populations.
- Support partner efforts to study shellfish and fin fish stocks and marine mammals, including seals and their principal predator, the great white shark.
- Support partner efforts to assess the distribution and genetic diversity of eelgrass across the region and test it against an experimental factorial design of potential stress parameters.
- Support partner efforts of the New England Aquarium and Mass Audubon to rescue stranded sea turtles and to collect for scientific research dead sea turtles recovered from refuge waters.
- Facilitate and participate in research relevant to this habitat type and priority species when research has conservation implications and would inform future management.

*Within 1 year of CCP implementation:*

- Prohibit bottom substrate-disturbing fishing activities such as mussel harvesting, scallop dragging, or any hydraulic dredging for shellfish within the Declaration of Taking refuge boundary in order to protect eelgrass beds and maintain productive benthic communities for wildlife.
- Determine appropriateness of using beach renourishment or other habitat alteration techniques in non-wilderness areas to protect habitats from the effects of erosion and sea level rise.
- Support partner efforts to study potential impacts of offshore wind or tidal energy development to resources of concern.
- Encourage, support, and actively participate in efforts to study shellfish and fin fish stocks and marine mammals, including seals and their principal predator, the great white shark.

*Within 5 years of CCP implementation:*

- Work with partners to evaluate and map the current and historic extent of submerged aquatic vegetation (SAV), specifically eelgrass, within the Declaration of Taking to determine whether these species are stable, decreasing, or increasing, and to determine if active management of the resource is necessary.
- Collect baseline data of flora and fauna in the subtidal areas of the refuge to help determine priority species and develop a management plan to ensure conservation of these species.

- Evaluate need for “no anchoring zones” to minimize disturbance to eelgrass beds and implement as warranted.
- Evaluate the possibility of using dredge spoils to enhance beach and flats habitat on the refuge (e.g., Minimoy, flats west of Minimoy, and Morris Island Beach) outside of the wilderness area. If feasible, pursue NEPA analysis.

#### **Monitoring Elements**

- Monitor the impact of aquaculture activities initiated within refuge waters.
- Monitor the impacts of dredging projects on subtidal areas within the refuge boundary; this may involve pre-and post- dredging monitoring of substrates, SAVs, or benthic communities.
- Monitor the benefit to focal species of habitat created on the refuge using dredge material.
- Monitor avian health specific to common eider and other sea ducks by conducting surveillance during fall and winter to detect field mortality events, documenting observations of sick or dying birds, and identifying, collecting, and submitting dead birds for analysis at the National Wildlife Health Center in collaboration with the Region 5 Migratory Birds Office.
- Update bathymetry data refugewide every 5 to 10 years.

#### **REFUGE GOAL 2:**

**Provide the public with wildlife-dependent recreational, interpretive, and environmental educational opportunities to enhance awareness and appreciation of refuge resources and to promote stewardship of the wildlife and habitats of Monomoy NWR.**

#### **Objective B2.1 (Access and Use)**

With primary consideration given to wildlife protection, character of the Monomoy Wilderness, and public safety, continue to allow public access to Morris Island, North Monomoy Island, South Monomoy Island (including Nauset/South Beach), and Minimoy Island while implementing a concessionaire system that accommodates an anticipated visitor increase of 25 percent. Maintain seasonal closures that reduce disturbance to wildlife from visitors and protect suitable nesting habitat for species of concern. The exact location and timing of the closures is flexible to respond to the presence of wildlife. Visitors may participate in any compatible public use on the refuge in areas that are open to the public.

#### **Rationale**

Our primary responsibility is to protect wildlife, preserve wilderness character, and promote wildlife conservation. To this end, some sensitive areas require us to restrict public access to minimize disturbance to wildlife, especially during the nesting season. The Service provides many public use opportunities to refuge visitors. Some activities, such as wildlife observation or fishing, are considered priority public uses because they are wildlife-dependent. These are to be facilitated by the Service when appropriate and compatible. Non-wildlife dependent public uses, such as sunbathing, can also be allowed as long as they are appropriate and compatible. Activities are managed both in time and space to ensure compatibility.

The majority of the land on Morris Island is privately owned, and access to the refuge headquarters and visitor contact station is provided via rights-of-way over private roadways. Some neighboring land owners have disputed the Service’s right to allow general public and visitor access over the rights-of-way, voicing concern over levels of visitation and traffic. There has been some encroachment upon the Service’s rights-of-way.

The U.S. Department of Transportation Volpe National Transportation Systems Center study, “Alternative Transportation Study: Monomoy National Wildlife Refuge” (May 2010), evaluated 21 (of 39 identified) transportation interventions addressing a variety of transportation safety and access issues at Monomoy NWR. These interventions improve multi-modal access, reduce traffic and parking congestion, improve traveler safety, enhance the visitor experience to Monomoy NWR and within Chatham, and develop and enhance partnerships with governmental and non-governmental agencies. Alternative B strategies initiate several interventions recommended by the Volpe Center that offer potential long-term relief from conditions currently limiting visitor access, specifically, finding a route through Chatham to reach Monomoy NWR.

Visitors to Monomoy NWR must navigate an often confusing maze of narrow, winding, congested roads with limited or no signs through downtown Chatham to reach the Monomoy NWR headquarters and visitor contact station. Upon reaching these destinations, visitors are often confronted with a full parking lot and are compelled to park along the east side of the Morris Island Road causeway and walk back to the refuge complex. The causeway is narrow, and cars parked on the side impede traffic flow and can be a safety issue for pedestrians. Some visitors simply give up in frustration and go elsewhere. The absence of both directional and informational signs can make Monomoy NWR difficult to locate. No signs off the highway or in Chatham direct or inform potential visitors about Monomoy NWR until just before the refuge entrance. A further complication is that the Morris Island parcel where the headquarters and visitor contact station is located lies beyond a gate identifying the roads of the Quitneset neighborhood as private. The lack of adequate signs deters and discourages visitors and confuses visitors who may accidentally drive through private neighborhoods while trying to find the refuge facilities.

Refuge visitors need to access the refuge by vehicles to fish, observe, photograph, and learn about wildlife, as well as enjoy the beach. Most of this access is by personal means or ferry service. The Service has a responsibility to manage pedestrian, vehicular, and watercraft use to minimize disturbance to wildlife, as described in goal 1 and chapter 1. At the same time, we strive to provide quality opportunities for visitors to learn about and enjoy refuge resources and experience the Monomoy Wilderness. The Service also has a responsibility to promote and provide compatible and appropriate wildlife-dependent visitor use.

Under this alternative, we would close the refuge to dog walking within a year of the publication of this plan. We have not previously found dog walking to be a compatible use on the refuge, but a decision was made in the refuge’s 1988 Master Plan to allow dogs on the refuge from October 1 through March 31. This decision was apparently not successfully implemented, as dogs are currently present on leash year-round, even though the use itself has not been found to be compatible. We propose closing the refuge to dogs because many visitors unleash their dog on the beach; dogs may disturb other visitors; dog feces on the beach create unsanitary conditions; and dogs disturb wildlife. Dogs can disrupt breeding displays (Baydack 1986), disrupt foraging activity in shorebirds (Hoopes 1993), and disturb roosting activity in ducks (Keller 1991). Other studies have shown that even when dogs are restrained on leash, they have the ability to displace native migratory bird species from natural habitats (Banks and Bryan 2007). A study of shorebird disturbance from humans and dogs found that gulls recovered faster from disturbance than did smaller shorebird species (Burger et al. 2007). This rapid recovery time could give a competitive advantage to gulls over other shorebirds that are the focus of refuge management goals. Dog walking is not a priority public use, nor an appropriate use of the refuge.

### Strategies

#### *Continue to:*

- Open all of North Monomoy Island to the public from October to March. During the April to September nesting season (map 2.8) an east-west trail corridor bisecting North Monomoy Island is open to the public, as is the Broad Creek area to the south; in addition, the entire perimeter of North Monomoy Island below the mean high tide line is open for public circumnavigation around North Monomoy Island.
- Restrict travel on the refuge to foot traffic to maintain the wilderness character of North and South Monomoy Islands, as well as to protect sensitive nesting areas and wildlife habitat; this may include limiting access to dune areas to prevent erosion, as necessary.
- Allow motorized and non-motorized boating in refuge waters with landings prohibited in areas that are seasonally closed; map 2.7 shows recommended sites where the hazardous currents and shoals allow safe landing.
- Maintain and enforce closure of the refuge to operation and landings of motorized personal watercraft (e.g., wave runners, jet skis) on the refuge land and in refuge waters.
- Maintain and enforce closure of the refuge to kiteboarding operation within the Declaration of Taking-Marine Protected Area boundary.
- Use the existing rights-of-way on Tisquantum Road, Wikis Way, and Stage Island Road to access refuge properties.
- Phase out non-Service parking and dinghy storage at Stage Island Lot 7b.
- Assist in enforcement of the Marine Mammal Protection Act through regular communication and coordination with staff from partner agencies and organizations, including the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, and International Fund for Animal Welfare.

#### *Within 1 year of CCP implementation:*

- Utilize adaptive management, striving to keep Morris Island and large portions of South Monomoy (including Nauset/South Beach) open year round, and reopen seasonally closed areas after chicks fledge or after staging seasons for migratory birds such as roseate and common terns, piping plovers, red knots, and American oystercatchers to provide additional wildlife viewing and photography opportunities; temporarily close portions of the refuge only when necessary to protect wildlife and their habitat based on seasonal use by priority species.
- Improve visibility of the right-of-way trail access to the western portion of Morris Island refuge property off Tisquantum Road; improve signs so visitors can easily view the access point and understand that they have the right to use the path to access the refuge.
- Do not allow pets, including dogs on leash, on the entire refuge, including Morris Island and the part of Nauset/South Beach that is attached to South Monomoy Island.
- Work to acquire an additional lot adjacent to the Stage Island lot for refuge use only.
- Include parking requirements in all special use permits issued to commercial guides, photographers, and others.